



EfficiencyOne

# 2024 DSM PROGRAMS EVALUATION REPORTS

Final DSM Reports

March 27, 2025

In Collaboration with:





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EfficiencyOne

# 2024 DSM PROGRAMS EVALUATION

Final Report

## OVERALL EXECUTIVE SUMMARY

March 26, 2025

In collaboration with:



## ABBREVIATIONS

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|                  |                                              |
|------------------|----------------------------------------------|
| <b>AMH</b>       | Affordable Multifamily Housing               |
| <b>ARs</b>       | Adjustment Ratios                            |
| <b>ARet</b>      | Appliance Retirement                         |
| <b>ASFH</b>      | Affordable Single-family Homes               |
| <b>BER</b>       | Business Energy Rebates                      |
| <b>BNI</b>       | Business, non-profit and institutional       |
| <b>CASHP</b>     | Central air-source heat pump                 |
| <b>CGH Grant</b> | Canada Greener Homes Grant                   |
| <b>DAs</b>       | Delivery Agents                              |
| <b>DHW</b>       | Domestic hot water                           |
| <b>DIY</b>       | Do-it-yourself                               |
| <b>DR</b>        | Demand Response                              |
| <b>DSM</b>       | Demand-side management                       |
| <b>E1</b>        | EfficiencyOne                                |
| <b>EAs</b>       | energy auditors                              |
| <b>ENS</b>       | Efficiency Nova Scotia                       |
| <b>EPI</b>       | Efficient Product Installation               |
| <b>EUL</b>       | Effective useful life                        |
| <b>GHG</b>       | Greenhouse gas                               |
| <b>HEA</b>       | Home Energy Assessment                       |
| <b>HRM</b>       | Halifax Regional Municipality                |
| <b>LED</b>       | Light-emitting diode                         |
| <b>M&amp;V</b>   | Measurement and verification                 |
| <b>MA</b>        | Measure Assessment                           |
| <b>MSHP</b>      | Mini-split heat pump                         |
| <b>MURB</b>      | Multi-Unit Residential Buildings             |
| <b>NECB</b>      | National Energy Code of Canada for Buildings |
| <b>NS Power</b>  | Nova Scotia Power                            |
| <b>NSUARB</b>    | Nova Scotia Utility and Review Board         |
| <b>NTGR</b>      | Net-to-gross ratio                           |
| <b>OLPA</b>      | Oil to Heat Pump Program                     |
| <b>SBES</b>      | Small Business Energy Solutions              |
| <b>SEM</b>       | Strategic Energy Management                  |



## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Available Demand Response Capacity</b> | The capacity which is available to NSP to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure the available DR capacity. Available DR capacity is evaluated on a per-participant basis, based on the average demand reduction observed for each event that the participant was scheduled to participate in. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                 |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or load reduction in response to events called by the electric utility (Nova Scotia Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.                                                                                                                                                                                                                                                |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                           |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Equipment life</b>                     | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

|                                         |                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global-warming potential is estimated over a timescale of 100 years.                                                                |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                         |
| <b>First-year savings</b>               | The first full year of energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                         |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program regardless of why they participated.                                                                                                                                    |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                      |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems in a building (such as heating and cooling) due to the installation of an energy-efficient measure.                                                                                                                                                               |
| <b>In-service rate</b>                  | The proportion of incentivized products that are installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as LED lamps.                                                   |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.             |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                              |
| <b>Line loss factor</b>                 | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                      |
| <b>Margin of error</b>                  | The amount of random sampling error.                                                                                                                                                                                                                                                                                 |
| <b>Market effects</b>                   | The impact of a program on the market (in terms of increased product availability, practices, and prices) that extends beyond changing program participant behaviours. This includes spillover among non-participants.                                                                                               |

|                                 |                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Net savings</b>              | Energy or peak demand savings that can be reliably attributed to a program. This includes effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                           |
| <b>Net-to-gross ratio</b>       | The ratio of net energy savings to gross energy savings.                                                                                                                                                                                                                                                                                     |
| <b>Non-sampling error</b>       | Errors arising during all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                 |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when Nova Scotia Power's 10-minute reserve is low.                |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                            |
| <b>Random sampling error</b>    | An error in measurement because measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                        |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                           |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                   |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                           |
| <b>Spillover</b>                | Savings attributable to participants who implement the energy efficiency measure(s) introduced by a program after participating in it once, without participating in the program a second time.                                                                                                                                              |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, except the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one-tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                      |



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## INTRODUCTION



EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight of its DSM activities is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electricity DSM activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs, three business, non-profit, and institutional (BNI) programs, and one demand response (DR) program that are marketed to Nova Scotians through the ENS franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2024 DSM program portfolio.

To carry out these services, Econoler collaborated with Equilibrium Engineering (a brand under the LMMW Group Ltd.), Bouthillette Parizeau, Richard Patterson of CDM Energy Solutions, Narrative Research, and Akonovia. Econoler served as team leader and was involved in every aspect of the evaluation. Specifically, Econoler was in charge of coordinating and supervising all activities, conducting final reviews of all data-collection instruments, performing process and market evaluations and impact evaluation calculations, as well as preparing and reviewing evaluation reports. Bouthillette Parizeau, Richard Patterson, and Akonovia conducted project reviews.<sup>1</sup> Equilibrium Engineering conducted project reviews, on-site visits, and follow-up interviews.<sup>2</sup> Narrative Research conducted interviews and surveys with participants and partners<sup>3</sup> as well as analyzed and reported on the data collected from those activities. Throughout this report, this team is referred to as the Evaluator.

The evaluation confirmed that the E1 DSM program portfolio achieved a total of 172.760 GWh in net electrical energy savings at the generator, 30.688 MW in net peak demand savings at the generator, and 8.091 MW in available demand response capacity in 2024. These net savings represent 81,577 tonnes of CO<sub>2</sub> eq in terms of annually avoided GHG emissions. Total net lifetime electrical energy savings at the generator amounted to 2,430.564 GWh.

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<sup>1</sup> For the 2024 evaluation, Bouthillette Parizeau and Akonovia conducted project reviews of Custom New Construction projects, while Richard Patterson conducted project reviews of Custom Retrofit and Building Optimization projects.

<sup>2</sup> For the 2024 evaluation, Equilibrium Engineering conducted project reviews complemented by follow-up interviews for AMH projects as well as on-site visits for EPI and SEM projects.

<sup>3</sup> For the 2024 evaluation, Narrative Research conducted surveys with Instant Savings, ASFH, EPI, Green Heat, HEA, and BER participants, as well as with SBES non-participants. They also conducted interviews with AMH participants, non-participants and dropped-out participants, energy auditors, ASFH contractors, BER distributors, Custom participants, non-participant builders, and non-participant or new to program modellers.



# 1 Evaluation Scopes and Objectives

The 2024 Portfolio Evaluation Plan was based on the Evaluation Schedule outlined in the Overall Strategic Evaluation Plan<sup>4</sup> that provides the framework and approach to guide evaluation planning and implementation for the 2023-2025 demand-side management (DSM) activities. The Evaluator is responsible for designing annual evaluation plans that meet the evaluation goals and principles for conducting third-party reviews of E1 program results and reporting evaluated results in evaluation reports.

The following factors are used to guide the prioritization of evaluation activities in the development of annual evaluation plans:

- › The level of program savings compared to portfolio savings: More resources should be allocated to programs that account for a relatively large portion of total portfolio savings.
- › Uncertainty regarding expected savings: Those initiatives with lower uncertainty regarding results should be given a lower evaluation priority. Similarly, evaluation efforts should prioritize those program characteristics or assumptions associated with a higher level of uncertainty.
- › Changes to program design or delivery: Changes to a program that could affect parameters, such as baseline scenarios, indicate that a comprehensive evaluation is likely warranted.
- › Timely feedback in the program life cycle: Information valuable to planning a new initiative (e.g. a pilot) or improving an ongoing program should be prioritized. Process evaluations should be scheduled to obtain early feedback to help ensure that a program is on track to meeting its goals.
- › Regulatory requirements: The information needed to respond to regulatory orders or requirements should be more highly prioritized than the information not needed for that purpose.
- › Evaluation scheduling: The evaluation schedule should be carefully thought out to optimize the robustness and usefulness of evaluation results (e.g. the need to evaluate a program after changes are made to program offerings, the length of the interval between two consecutive evaluations of a program).

There are three broad evaluation categories: Impact evaluations, process evaluations, and market evaluations. Based on the three evaluation categories, Table 1 below presents a summary of the 2024 Portfolio Evaluation Plan. The table also indicates the scopes of the impact evaluations (comprehensive or condensed), which are further detailed in the following subsection.

It should be noted that some program components are further divided into services that are discussed throughout this report. Such is the case for the Custom component that includes the Retrofit, New Construction, Pay-for-Performance, and Building Optimization services as well as for the Business Energy Rebates program component comprised of two services, namely Application Rebates and Instant Rebates.

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<sup>4</sup> Econoler, Overall Strategic Evaluation Plan, December 2024.

**Table 1: 2024 Portfolio Evaluation Plan**

| Program Components                            | PY2024                     |                |        |
|-----------------------------------------------|----------------------------|----------------|--------|
|                                               | Impact                     | Process        | Market |
| <b>Residential DSM Program Components</b>     |                            |                |        |
| Appliance Retirement                          | Condensed                  |                |        |
| Instant Savings                               | Comprehensive              |                |        |
| Affordable Multifamily Housing                | Comprehensive              | X              |        |
| Affordable Single-family Homes                | Condensed                  | X              |        |
| Efficient Product Installation                | Comprehensive              |                | X      |
| Home Energy Assessment                        | Comprehensive <sup>5</sup> |                |        |
| Green Heat                                    | Comprehensive <sup>6</sup> |                |        |
| Mi'kmaw Home Energy Efficiency Project        | Condensed                  |                |        |
| Residential Behaviour                         | Comprehensive              |                |        |
| New Home Construction                         | N/A                        |                |        |
| <b>BNI DSM Program Components</b>             |                            |                |        |
| Business Energy Rebates – Application Rebates | Condensed                  |                |        |
| Business Energy Rebates – Instant Rebates     | Comprehensive              | X              | X      |
| Custom                                        | Comprehensive              | X <sup>7</sup> |        |
| Strategic Energy Management                   | Comprehensive              |                |        |
| Small Business Energy Solutions               | Condensed                  |                |        |
| <b>Demand Response Program</b>                |                            |                |        |
| Residential Demand Response                   | Comprehensive              |                |        |
| BNI Demand Response                           | Comprehensive              |                |        |

The following subsections describe the objectives of the impact, process, and market evaluations.

## 1.1 Impact Evaluation Objectives and Scope

The impact evaluation activities were aimed at determining:

- › Gross electrical energy and peak demand savings at the meter and at the generator
- › Available demand response (DR) capacity for demand response programs
- › Net-to-gross ratios (NTGRs), including free-ridership and spillover levels where appropriate
- › Net electrical energy and peak demand savings at the meter and at the generator
- › Effective useful life (EUL) values of program measures
- › Gross and net lifetime electrical energy savings at the generator
- › Avoided greenhouse gas (GHG) emissions linked to evaluated gross and net electrical savings

<sup>5</sup> Does not include update to NTGRs.

<sup>6</sup> Does not include update to NTGRs.

<sup>7</sup> For Custom New Construction.





Impact evaluations were conducted for all program components. As explained below, there were two types of impact evaluations:

- › **Comprehensive impact evaluation** – A comprehensive impact evaluation consists of reviewing the following four key elements: (1) The baseline definition; (2) the savings calculation methodology; (3) the values of the parameters used to calculate savings; and (4) NTGRs. The specific activities to be carried out for such reviews may include surveys, project reviews, site visits, billing analyses, literature reviews, etc.
- › **Condensed impact evaluation** – A condensed impact evaluation consists of using all of the previous year's impact evaluation parameters, such as unitary savings values, adjustment ratios, installation rates, and NTGRs, to provide evaluated results.

At least one comprehensive impact evaluation is conducted every three years for all program components with the exception of program components that represent a small proportion of portfolio savings or whose savings calculation methodologies rely on parameters that are evaluated through another program component comprehensive evaluation. To determine which type of impact evaluation (comprehensive or condensed) should be planned for each program component, when they should be conducted, and why, the Evaluator applied the priorities outlined above. For impact evaluations, factors driving uncertainty include:

- › Program maturity and the stability of impact evaluation parameters (e.g. adjustment ratios and free-ridership levels) over time. Mature and stable programs warrant fewer comprehensive impact evaluations.
- › Complexity of savings calculations. Complex or custom savings calculation methodologies that are more likely to result in errors indicate that a comprehensive evaluation is likely warranted.

## Demand-side Management Measure Assessment Document

The impact evaluation scope for 2024 also included an update of the Demand-side Management Measure Assessment (DSM MA) document. This update covered all prescriptive measures and their parameters for the 2024-2025 evaluation period and the semi-prescriptive measures in Business Energy Rebates (BER) – Instant Rebates. There was also a complete review of the top 10 measures in BER Application Rebates and Small Business Energy Solutions (SBES) – the other measures in those program components will simply be transferred from the CIRx Screening Tool<sup>8</sup> to the DSM MA without modifying the algorithms.

The Evaluator conducted a literature review of technical reference manuals, metering studies, and program evaluations to determine if there were more appropriate methodologies or parameters to be applied to the following elements covered in the DSM MA:

- › Unitary energy savings, including baseline assumptions
- › Peak demand-to-energy ratios
- › Interactive effect factors
- › EUL values

The Evaluator reviewed peak demand-to-energy ratios since most of these were obtained based on the modelling conducted for E1's 2016-2018 DSM Plan and new data sources (notably the National Renewable Energy Laboratory ResStock and CommStock models) were available. The Evaluator targeted some end uses for which the 2016-2018 peak demand-to-energy ratios were not sufficiently granular (e.g. if a measure had become important within a program and the current ratios were not adapted to that measure) or if a load shape might have changed since the last model (e.g. the space heating load shape might not have been as representative now that heat pumps were so much more prevalent than they had been 10 years ago).

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<sup>8</sup> The CIRx Screening Tool is a tool provided by E1 and that presents the savings calculation methodologies, assumptions, and calculation parameters for measures implemented under E1 programs.



The Evaluator also reviewed the interactive effects factors to ensure the methodology was aligned with the most recent information available. The methodology is presented in Appendix IV of the 2024-2025 DSM MA.

In addition, the following parameters, which are planned to be updated annually in the DSM MA, were updated in 2024:

- › LED lighting
  - › Lifetime energy savings
  - › Analysis of wattage for popular models
  - › EUL for measures with a dual baseline
- › Freezer and refrigerator retirements and replacements
  - › Proportion of units per manufacture-year class
  - › Average unit size

## Net-to-gross Ratio Review

The evaluation scope included a NTGR review that served to update the NTGR questionnaires and algorithms for the DSM portfolio so that they were consistent across programs and in line with the latest best practices. The review was focused on the self-report approach applied in past evaluations, which is also the most commonly used approach. The review included:

- › A summary of the latest best practices in NTGR algorithm development, based on a literature review.
- › A review and documentation of the Evaluator's overall approach and detailed rules for NTGR questionnaires and algorithms and how these are aligned with best practices. The set of rules covered topics such as the weighting of intermediate results, treatment of inconsistent results, correct formulation of survey questions, etc.
- › An update to NTGR algorithms used for E1's portfolio of DSM programs to ensure they continue to be aligned with best practices, account for all necessary factors and, where appropriate, use a consistent approach. Please note that this review does not provide an approach to non-participant spillover or market effects.

The deliverable was used to guide the NTGR data collection and analysis for the programs for which a NTGR update was planned for 2024 (i.e. Efficient Product Installation, Business Energy Rebates – Instant Rebates, and Custom; Instant Savings was excluded because data collection occurred early in the year, and the data-collection tool had to be developed before the guide was issued) and will be applied to other programs for the remainder of the current DSM Plan period (i.e. 2023-2025) and, in principle, as long as a self-reporting NTGR approach is used.

## 1.2 Process and Market Evaluation Objectives and Scopes

Two market evaluations were completed in 2024. Market evaluation activities were aimed at achieving the following objectives:

- › Identify new opportunities for residential electrician-installed measures for Efficient Product Installation
- › Analyze the market evolution of BNI lighting for Business Energy Rebates – Instant Rebates

Results from the market evaluations of Efficient Product Installation and Business Energy Rebates – Instant Rebates are presented further below in Section 5.



A total of four process evaluations were completed for Affordable Multifamily Housing, Affordable Single-family Homes, Business Energy Rebates – Instant Rebates, and Custom New Construction respectively.

Process evaluation activities were aimed at achieving the following objectives:

- › Collect information on participant and partner perspectives
- › Analyze barriers to Affordable Multifamily Housing participation, including the design of the operating agreement (affordability covenant)
- › Explore opportunities to expand Custom New Construction presence outside of the multi-unit residential building market
- › Update the Custom New Construction program logic model

Process evaluation results are presented in the relevant evaluation reports.



## 2 Evaluation Methodology

This section presents the methodologies used and the activities carried out to evaluate E1 DSM program components and services through impact, process, and market evaluations.

### 2.1 Impact Evaluation

The impact evaluations were conducted through a range of activities such as tracking sheet audits, data-collection tool development, project reviews assisted by participant follow-up interviews, energy model reviews, on-site visits, as well as other data-collection activities and analyses. The following subsections describe the steps that were followed to conduct the impact evaluations.

#### 2.1.1 Tracking Sheet Audits

The final tracking sheets submitted to the Evaluator by E1 contained both data for all completed projects for 2024 and the tracked results required to calculate final savings. The final tracking sheets were audited to assess the consistency and completeness of program data, including discrepancies that needed to be clarified to enable savings calculations. Following this analysis, the Evaluator determined corrected tracked values and then compiled evaluated savings.

The Evaluator audited the project tracking sheet of each program component. Therefore, the tracked savings results presented in the evaluation reports refer to the corrected tracked savings obtained by the Evaluator as a result of the tracking sheet audits.

#### 2.1.2 Data-collection Tool Development and Sampling Strategy

Data-collection tool development and sampling were carried out for Instant Savings, Affordable Multifamily Housing (AMH), Affordable Single-family Homes (ASFH),<sup>9</sup> Efficient Product Installation (EPI), Green Heat, Home Energy Assessment (HEA), Business Energy Rebates (BER), Custom, Small Business Energy Solutions (SBES), and Strategic Energy Management (SEM).

The Evaluator developed the relevant data-collection instruments, namely survey questionnaires, interview guides and project review protocols. Data-collection instruments were informed by the results of documentation reviews, program staff interviews, and preliminary tracking sheets.

Using an integrated approach, the data-collection tools also included questions to inform select process and market evaluation activities.

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<sup>9</sup> While the survey was aimed solely at process data collection, it was included in this section for completeness.

## 2.1.3 Data Collection

### Surveys and Interviews

This subsection describes the data-collection activities conducted for the impact evaluations. It should be noted that surveys and interviews were often integrated to collect impact, process, and market information as discussed in Subsection 2.2 below.

- › **Participant and non-participant surveys** were used to collect data on free-ridership and spillover, insights to establish billing analysis results (Home Energy Assessment and Green Heat) and to reassess unconverted D assessment savings parameters (Home Energy Assessment). Most surveys were conducted by telephone with the exception of online surveys conducted for Instant Savings, Green Heat, and Home Energy Assessment. Between September and December 2024 inclusively, the Evaluator conducted surveys with 1,239 participants and non-participants. Table 2 below lists the surveys completed for each program component and the number of respondents to each survey. Note that Table 1 includes all surveys completed as part of the 2024 evaluation for completeness.

**Table 2: 2024 Participant and Non-participant Surveys**

| Program Component                             | Number of Respondents |
|-----------------------------------------------|-----------------------|
| <b>Residential</b>                            |                       |
| Instant Savings                               | 200                   |
| Affordable Single-family Homes                | 60                    |
| Efficient Product Installation                | 100                   |
| Green Heat – Past Participants                | 240                   |
| Home Energy Assessment - Expired Participants | 76                    |
| Home Energy Assessment - Past Participants    | 483                   |
| <b>BNI</b>                                    |                       |
| Business Energy Rebates – Instant Rebates     | 50                    |
| Small Business Energy Solutions               | 30                    |
| <b>Total</b>                                  | <b>1,239</b>          |

- › **In-depth interviews** with program staff, participants, and partners were conducted as part of impact evaluation activities to collect data on free-ridership and spillover. Between September 2024 and January 2025 inclusively, the Evaluator conducted 105 interviews with various market actors and stakeholders. The number of completed interviews for each program component is presented in Table 3 below. Note that Table 3 includes all in-depth interviews completed as part of the 2024 evaluation for completeness. In-depth interviews aimed solely at market and process data collection only are indicated in green.

**Table 3: 2024 Interviews Completed**

| Program Component                      | Program Manager/1<br>E1 Staff/Business<br>Development Manager | Service Providers/<br>Distributors/<br>Contractors | Participants    | Non-<br>participants | Dropped-out or<br>Overdue<br>Participants |
|----------------------------------------|---------------------------------------------------------------|----------------------------------------------------|-----------------|----------------------|-------------------------------------------|
| <b>Residential</b>                     |                                                               |                                                    |                 |                      |                                           |
| Appliance Retirement                   | 1                                                             | -                                                  | -               | -                    | -                                         |
| Instant Savings                        | 2                                                             | -                                                  | -               | -                    | -                                         |
| Affordable Multifamily Housing         | 2                                                             | 4                                                  | 11 <sup>2</sup> | 10                   | 8 <sup>3</sup>                            |
| Affordable Single-family Homes         | 2                                                             | 9 <sup>4</sup>                                     | -               | -                    | -                                         |
| Efficient Product Installation         | 2                                                             | -                                                  | -               | -                    | -                                         |
| Green Heat                             | 2                                                             | -                                                  | -               | -                    | -                                         |
| Home Energy Assessment                 | 2                                                             | -                                                  | -               | -                    | -                                         |
| Mi'kmaw Home Energy Efficiency Project | 2                                                             | -                                                  | -               | -                    | -                                         |
| Residential Behaviour                  | 2                                                             | -                                                  | -               | -                    | -                                         |
| <b>BNI</b>                             |                                                               |                                                    |                 |                      |                                           |
| Business Energy Rebates                | 2                                                             | 10                                                 | -               | -                    | -                                         |
| Custom                                 | 6 <sup>5</sup>                                                | -                                                  | 18 <sup>6</sup> | 5                    | -                                         |
| Strategic Energy Management            | 2                                                             | -                                                  | 3               | -                    | -                                         |
| <b>Demand Response</b>                 |                                                               |                                                    |                 |                      |                                           |
| Residential Demand Response            | 2                                                             |                                                    |                 |                      |                                           |
| BNI Demand Response                    |                                                               | -                                                  | -               | -                    | -                                         |
| <b>Total</b>                           | <b>29</b>                                                     | <b>23</b>                                          | <b>32</b>       | <b>10</b>            | <b>8</b>                                  |

<sup>1</sup> Two rounds were performed with the program manager (round 1 in May 2024 and round 2 in September 2024) except for Appliance Retirement (ARet).

<sup>2</sup> AMH: Includes one impact interview as part of project reviews and 10 as part of the process evaluation.

<sup>3</sup> AMH: Includes two partial interviews with two prescriptive path dropped-out participants.

<sup>4</sup> ASFH: Five interviews were conducted with contractors and four interviews were conducted with delivery agents.

<sup>5</sup> Custom: Four program manager interviews were conducted (two for New Construction and two for Retrofit) as well as an interview with the Business Development Manager and another with the Program Manager (for New Construction as part of the process evaluation).

<sup>6</sup> Custom: Eight interviews were conducted with builder participants for New Construction and 14 interviews were conducted with participants for Retrofit.

## Site Visits and Project Reviews with Follow-up Site Visits or Interviews

The Evaluator performed a total of 146 project reviews during the summer and fall of 2024, 70 of which were complemented through site visits and 14 were complemented through phone interviews.

For Efficient Product Installation, site visits were conducted to validate the installation rates of implemented measures.

For Affordable Multifamily Housing, Custom, Strategic Energy Management, and BNI Demand Response, the Evaluator carried out full technical reviews of project documentation and followed up through telephone interviews or site visits with participants to finalize the project reviews when required. The telephone interviews were also used to collect information on free-ridership and spillover as well as participant perspectives on the program component where relevant. For one new Strategic Energy Management participant, a site visit was also conducted.

Table 4 indicates the number of site visits and project reviews conducted for each program component. The complete results of the on-site visits are provided in the relevant program component evaluation reports.

**Table 4: 2024 Site Visits and Project Reviews with Follow-up Site Visits or Interviews**

| Program Component                                                                                                                                                                                                                                                                                                                                                                          | Project Reviews Followed by Site Visits | Project Reviews Followed by Phone Interviews | Project Reviews Without Site Visits or Phone Interviews | Site Visits Only | Total Project Reviews or Site Visits |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------------|---------------------------------------------------------|------------------|--------------------------------------|
| <b>Residential</b>                                                                                                                                                                                                                                                                                                                                                                         |                                         |                                              |                                                         |                  |                                      |
| Affordable Multifamily Housing                                                                                                                                                                                                                                                                                                                                                             | -                                       | 1                                            | 14                                                      | -                | 15                                   |
| Efficient Product Installation                                                                                                                                                                                                                                                                                                                                                             | -                                       | -                                            | -                                                       | 60               | 60                                   |
| <b>BNI</b>                                                                                                                                                                                                                                                                                                                                                                                 |                                         |                                              |                                                         |                  |                                      |
| Custom*                                                                                                                                                                                                                                                                                                                                                                                    | 9                                       | 10                                           | 15                                                      | -                | 34                                   |
| Strategic Energy Management                                                                                                                                                                                                                                                                                                                                                                | 1                                       | 3                                            | 3                                                       | -                | 7                                    |
| <b>Demand Response</b>                                                                                                                                                                                                                                                                                                                                                                     |                                         |                                              |                                                         |                  |                                      |
| BNI Demand Response                                                                                                                                                                                                                                                                                                                                                                        | -                                       | -                                            | 30                                                      | -                | 30                                   |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                               | <b>10</b>                               | <b>14</b>                                    | <b>62</b>                                               | <b>60</b>        | <b>146</b>                           |
| * Custom: 34 project reviews were conducted (20 for Retrofit, 12 for New Construction and two for Building Optimization). Of the 20 Retrofit project reviews, 19 project reviews for regular Retrofit projects were included in the adjustment ratio calculation. One large-scale compressed air leak audit project was reviewed and was not included in the adjustment ratio calculation. |                                         |                                              |                                                         |                  |                                      |

## Energy Model Reviews

The Evaluator performed energy model reviews for the 12 Custom New Construction projects to verify the accuracy of energy models. After the initial file reviews, the Evaluator concluded that the available documentation was sufficient and site visits or follow-up phone interviews were not required. The energy model reviews involved comparing energy models against as-built drawings and project documentation. The Evaluator also compared baseline energy models against the appropriate baseline definition for each project. The resulting adjusted models were then used to establish evaluated savings.



## Unitary Savings Review

As part of the update to the 2024-2025 DSM MA that was reviewed in its entirety in 2024, for program components with unitary savings values - namely Appliance Retirement, Instant Savings, Home Energy Assessment, Green Heat, Efficient Product Installation, the Mi'kmaw Home Energy Efficiency Project, Business Energy Rebates – Instant Rebates, and the Small Business Energy Solutions Commercial Direct Installation pilot - the Evaluator validated the parameters and equations used to obtain the values and updated them where necessary through the development of the 2024-2025 DSM MA. Parameters or calculation methodologies for new measures added to the DSM MA in 2024 were also reviewed and the 2024-2025 DSM MA was updated accordingly. The measures added to the 2024-2025 DSM MA included advanced learning thermostats for central heating systems, humidity sensors for bathroom exhaust fans, and solar photovoltaic systems in the residential sector as well as horticultural lighting in the commercial sector. Unitary savings values were reviewed using one or more of the following approaches: Literature reviews of technical reference manuals; metering studies; billing analyses; energy models; evaluation reports; engineering calculations; adjustments based on data collected through participant surveys or site visits; and secondary research about household/facility characteristics such as types of heating and cooling systems.

### Billing Analyses

In 2024, three billing analyses were performed for Green Heat, Home Energy Assessment, and Residential Behaviour. The Green Heat billing analysis was conducted to obtain measured electrical energy savings generated through the installation of MSHPs and wood or pellet stoves or fireplace inserts. The results were used to update the unitary savings values for these measures.<sup>10</sup> The Home Energy Assessment billing analysis was conducted to establish adjustment ratios to be directly applied to the savings estimates obtained from HOT2000.<sup>11</sup> The past participant surveys were used to identify participants that had modified their homes while participating in Home Energy Assessment and Green Heat (for example, by adding heating to rooms that were not previously heated or by increasing the floor area of their home), and those participants were removed from the billing analysis since a pre and post-participation analysis of their energy consumption would not accurately represent the electrical energy savings associated to the measures installed. Finally, the Residential Behaviour billing analysis was performed to calculate net electrical energy savings, including a comparison of the treatment and control group electricity consumption levels using a difference-in-difference approach.

#### 2.1.4 Effective Useful Life Review

As part of the DSM MA update in 2024, the Evaluator reviewed the EUL values for existing and new measures to ensure they were valid and revised them where appropriate. The EUL update was based on a literature review of the most recent technical reference manuals from other jurisdictions. The resulting EUL values were included in the 2024-2025 DSM MA.

In addition, for some measures, the Evaluator considered not only the measure life, but also the evolution of the baseline over the lifetime of the measure. Lifetime electrical energy savings were calculated based on the existing baseline until the end of the period when the equipment would have been replaced and then based on the new standard baseline for the remaining EUL of the measure. The adjusted EUL of a given project was then calculated as the lifetime electrical energy savings divided by first-year electrical energy savings.

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<sup>10</sup> Results from the Green Heat billing analysis were also applied to Affordable Single-family Homes non-modelled heat pumps, and the updated full-load-hours was applied to Affordable Multifamily Housing heat pumps projects.

<sup>11</sup> Results from the Home Energy Assessment billing analysis were also applied to Affordable Single-family Homes and Mi'kmaw Home Energy Efficiency Project modelled savings.





## 2.1.5 Gross Savings Analysis

Gross savings refer to changes in energy consumption resulting from actions taken by participants regardless of their reasons for participating in a program. Upon completion of the impact evaluation activities described above, the Evaluator analyzed the data collected to calculate evaluated gross savings and compare results with the data tracked by E1. Establishing gross savings consists of compiling all measures savings implemented through a program component along with the evaluated parameters.

## 2.1.6 Net Savings Analysis

### Net-to-gross Assessment and Net Savings Calculations

Free-ridership levels were established for select program components by conducting self-report surveys or in-depth interviews. Those surveys and interviews included a set of questions used to establish program component attributions for the free-ridership calculations. The self-report approach consisted of asking questions to participants to assess factors such as planning, quantity, efficiency, period, and cost as well as the influence of a given program component. For the midstream BER – Instant Rebates program component, both market actor (distributor) and end-user (participant) perspectives were used to assess free-ridership. Based on survey or interview results, a free-ridership level was established for each respondent. Subsequently, a weighted average based on each respondent's savings was used to estimate overall program component free-ridership levels. The free-ridership calculation methodology also takes into account the impact of cross-influence of previous participation in other E1 program components.

As part of the 2024 evaluation, free-ridership levels were updated for Instant Savings, Efficient Product Installation, Business Energy Rebates – Instant Rebates, as well as Custom Retrofit and New Construction. The NTGR review, as discussed in Subsection 1.1 above, guided the data collection and analysis of all program components except for Instant Savings since that data collection occurred too early in the year.

The free-ridership levels from past evaluations were used for Appliance Retirement, Home Energy Assessment, Green Heat, Business Energy Rebates – Application Rebates, Custom Pay-for-Performance, Building Optimization, as well as Small Business Energy Solutions.

The impact evaluations included an assessment of spillover levels for program components wherein spillover was a factor. For all program components with the exception of Instant Savings and Home Energy Assessment, the spillover levels corresponded to participant spillover. Participant spillover assessments were conducted through telephone surveys or during follow-up interviews or site visits during project reviews. In all cases, participants were asked if they had implemented additional energy efficiency measures without receiving additional funding or assistance from E1. If so, participants were then asked a set of questions designed to identify the additional energy efficiency measures implemented and their associated savings. Subsequently, another question was asked to quantify the level of influence a given program component had on their decision to implement the additional measures. Thereafter, the value established on the level of influence was used to determine the portion of the additional savings attributable to the given program component. Finally, the level of participant spillover was established by dividing the total additional savings attributable to the program component by the total savings achieved by said component for all survey respondents.

As part of the 2024 evaluation, the spillover levels were updated for Efficient Product Installation and Custom. The spillover levels from past evaluations were used for Appliance Retirement, Instant Savings, Home Energy Assessment, and Business Energy Rebates – Application Rebates. In addition, the 2024 unconverted D assessment spillover was updated for Home Energy Assessment.



For Small Business Energy Solutions, the Evaluator conducted a survey with non-participants from a sample of commercial customers to assess non-participant spillover.

The Evaluator did not establish free-ridership and spillover levels for measures and program components offered to low-income participants as they were considered to have nil free-ridership and spillover levels.

## **Avoided GHG Emission Calculations**

The Evaluator estimated the avoided annual GHG emissions resulting from the evaluated electrical energy savings generated through all program components. Avoided GHG emissions were estimated by using a Nova Scotia-specific factor<sup>12</sup> for GHG emissions generated by electricity production. This factor was updated with the most recent NS Power data on total system emissions and electricity generation.

## **2.2 Process and Market Evaluations**

Process and market evaluations were conducted using a range of activities such as program component documentation as well as secondary data reviews, jurisdictional scans, logic model reviews, as well as participant surveys and in-depth interviews with program staff, stakeholders, and participants. The following subsections describe the key tasks the Evaluator carried out for the market evaluations of Efficient Product Installation and Business Energy Rebates – Instant Rebates and the process evaluations of Affordable Multifamily Housing, Affordable Single-family Homes, Business Energy Rebates – Instant Rebates, and Custom New Construction.

### **Documentation Review**

The Evaluator reviewed all relevant evaluation and program component-specific documentation such as program manuals, marketing materials, application forms, tracking sheets, and any other information on changes made to program components since the previous evaluation. Additionally, the Evaluator used annual staff interviews to follow up on past evaluation recommendations and become aware of any program component improvements and changes.

### **Data-collection Tool Development and Sampling Strategy**

As described in Subsection 2.1.2 above, the Evaluator used an integrated approach to developing data-collection tools that serve all evaluation types where possible. For instance, survey instruments and interview guides included questions for process, market, and impact evaluations. This approach reduces respondent burden and ensures that evaluation results are integrated.

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<sup>12</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO<sub>2</sub> eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).



## Data Collection

This subsection describes the data-collection activities conducted for the process and market evaluations. As discussed above, surveys and interviews were integrated where applicable to collect information for the impact, process, and market evaluations.

- › **Secondary data** were used to inform analysis of New Construction participation across building types and regions.
- › **In-depth interviews** were conducted with program staff, Business Development Managers, participants, partners, and trade allies to collect data on their involvement in a given program component as well as their experience and satisfaction with it, among other things. Unlike participant surveys that require interviewers to ask questions in the exact same way, in-depth interviews are semi-directed, thus allowing for more flexibility and discussion. They are a great option for evaluations that require exploring certain research areas or asking in-depth and complex questions that are not suited to a survey. The number of completed interviews for each program component is presented in Table 3, Subsection 2.1.3 above.
- › **Participant surveys** conducted by phone between October and November 2024 with participants in New Construction, Affordable Single-family Homes, as well Business Energy Rebates – Instant Rebates served to collect information on their perspectives about the program components and service. The number of completed surveys is presented in Table 2, Subsection 2.1.3 above.

## Jurisdictional Scan

The Evaluator conducted a jurisdictional scan across other jurisdictions throughout Canada and the United States (US) to identify other measures that could be installed by electricians under Efficient Product Installation. In addition, the Evaluator conducted a jurisdictional scan examining characteristics of new construction programs across North America.

## Logic Model Update

The Evaluator reviewed the Custom New Construction logic model to assess how well the program logic and theory of change address barriers to achieving program objectives. To do so, the Evaluator reviewed the most recent program logic model and underlying theory of change provided by E1 to examine program objectives and barriers.

## Analysis

The results of the process and market evaluation activities were analyzed in relation to the research objectives identified in Subsection 1.2 above. The results from all evaluation activities were consolidated and triangulated to ensure that findings were based on a preponderance of results.

## 3 Impact Evaluation Results

This section presents an analysis of the impact evaluation results for all program components by comparing 2024 tracked electrical energy and peak demand savings with evaluated electrical energy and peak demand savings. Evaluated NTGRs, lifetime electrical energy savings, and GHG emission reductions are also presented in the subsections below.

### 3.1 Individual Impact Evaluation Results

Table 5 and Table 6 below respectively list the evaluated electrical energy and peak demand savings as well as the corresponding savings tracked by E1 for each program component offered in 2024. Net savings were calculated by multiplying gross savings by the NTGR. Lifetime energy savings are equal to the savings generated by efficiency measures over their EUL. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>13</sup>

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<sup>13</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

**Table 5: Comparison of 2024 Evaluated and Tracked Energy Savings at the Generator <sup>a</sup>**

| DSM Program                           | Program Component                            | Tracked Results            |                          | Evaluated Results          |                   |                          |                                   | Difference in Net Savings (GWh) | Net Realization Rate |
|---------------------------------------|----------------------------------------------|----------------------------|--------------------------|----------------------------|-------------------|--------------------------|-----------------------------------|---------------------------------|----------------------|
|                                       |                                              | Annual Gross Savings (GWh) | Annual Net Savings (GWh) | Annual Gross Savings (GWh) | NTGR <sup>b</sup> | Annual Net Savings (GWh) | Lifetime Net Energy Savings (GWh) |                                 |                      |
| Residential                           |                                              |                            |                          |                            |                   |                          |                                   |                                 |                      |
| Residential Efficient Product Rebates | Appliance Retirement                         | 4.212                      | 2.374                    | 4.195                      | 0.56              | 2.365                    | 9.433                             | -0.009                          | 100%                 |
|                                       | Instant Savings                              | 29.151                     | 19.129                   | 26.884                     | 0.83              | 22.252                   | 97.841                            | 3.124                           | 116%                 |
| Existing Residential                  | Affordable Multifamily Housing               | 1.158                      | 1.158                    | 1.159                      | 1.00              | 1.159                    | 19.397                            | 0.001                           | 100%                 |
|                                       | Affordable Single-family Homes               | 4.693                      | 4.693                    | 3.719                      | 1.00              | 3.719                    | 74.428                            | -0.974                          | 79%                  |
|                                       | Efficient Product Installation               | 9.516                      | 9.519                    | 9.093                      | 0.98              | 8.948                    | 52.525                            | -0.571                          | 94%                  |
|                                       | Green Heat                                   | 4.711                      | 2.478                    | 1.651                      | 0.53              | 0.872                    | 15.697                            | -1.606                          | 35%                  |
|                                       | Home Energy Assessment                       | 41.992                     | 29.552                   | 38.984                     | 0.82              | 31.962                   | 859.594                           | 2.410                           | 108%                 |
|                                       | Mi'kmaw Home Energy Efficiency Project       | 0.578                      | 0.578                    | 0.401                      | 1.00              | 0.401                    | 8.141                             | -0.177                          | 69%                  |
|                                       | Residential Behaviour <sup>c</sup>           |                            |                          |                            |                   | 6.270                    | 6.270                             |                                 |                      |
| Residential Subtotal                  |                                              | 96.012                     | 69.480                   | 86.086                     | 0.91              | 77.948                   | 1,143.326                         | 2.198                           | 103% <sup>e</sup>    |
| BNI                                   |                                              |                            |                          |                            |                   |                          |                                   |                                 |                      |
| Efficient Products Rebates            | Business Energy Rebates                      | 47.777                     | 38.557                   | 46.852                     | 0.84              | 39.529                   | 609.885                           | 0.973                           | 103%                 |
| Custom Incentives                     | Custom                                       | 48.969                     | 36.918                   | 49.825                     | 0.80              | 39.951                   | 488.215                           | 3.033                           | 108%                 |
|                                       | Strategic Energy Management                  | 4.480                      | 4.480                    | 4.478                      | 1.00              | 4.478                    | 11.581                            | -0.002                          | 100%                 |
| Direct Installation                   | Small Business Energy Solutions <sup>d</sup> | 12.936                     | 10.426                   | 13.459                     | 0.81              | 10.854                   | 177.557                           | 0.428                           | 104%                 |
| BNI Subtotal                          |                                              | 114.161                    | 90.380                   | 114.615                    | 0.83              | 94.812                   | 1,287.239                         | 4.432                           | 105%                 |
| Portfolio Total                       |                                              | 210.173                    | 159.860                  | 200.700                    | 0.86              | 172.760                  | 2,430.564                         | 6.630                           | 104% <sup>e</sup>    |

<sup>a</sup> Numbers may not add up due to rounding.

<sup>b</sup> Subtotal NTGR values represent average values for the Residential and BNI portfolios. The Portfolio Total NTGR value represents an average value for all programs. There were no tracked savings for Residential Behaviour.

<sup>d</sup> Evaluated gross and net electrical energy savings at the generator include 0.135 GWh generated by the Commercial Direct Install Pilot.

<sup>e</sup> Residential Behaviour was excluded from the evaluated net savings used to calculate the realization rate, as there were no tracked savings.

**Table 6: Comparison of 2024 Evaluated and Tracked Peak Demand Savings at the Generator <sup>a</sup>**

| DSM Program                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Program Component                            | Tracked Results           |                         |                         | Evaluated Results         |                   |                         |                         | Difference in Net Savings (MW) | Difference in Available Capacity (MW) | Net Realization Rate |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------|-------------------------|-------------------------|---------------------------|-------------------|-------------------------|-------------------------|--------------------------------|---------------------------------------|----------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                              | Annual Gross Savings (MW) | Annual Net Savings (MW) | Available Capacity (MW) | Annual Gross Savings (MW) | NTGR <sup>b</sup> | Annual Net Savings (MW) | Available Capacity (MW) |                                |                                       |                      |
| Residential                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                              |                           |                         |                         |                           |                   |                         |                         |                                |                                       |                      |
| Residential Efficient Product Rebates                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Appliance Retirement                         | 0.602                     | 0.339                   |                         | 0.598                     | 0.56              | 0.337                   |                         | -0.002                         |                                       | 99%                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Instant Savings                              | 3.585                     | 2.206                   |                         | 2.956                     | 0.82              | 2.428                   |                         | 0.221                          |                                       | 110%                 |
| Existing Residential                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Affordable Multifamily Housing               | 0.580                     | 0.580                   |                         | 0.570                     | 1.00              | 0.570                   |                         | -0.010                         |                                       | 98%                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Affordable Single-family Homes               | 2.160                     | 2.160                   |                         | 2.089                     | 1.00              | 2.089                   |                         | -0.071                         |                                       | 97%                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Efficient Product Installation               | 0.879                     | 0.872                   |                         | 0.898                     | 0.98              | 0.880                   |                         | 0.007                          |                                       | 101%                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Green Heat                                   | 3.915                     | 2.143                   |                         | 2.748                     | 0.56              | 1.529                   |                         | -0.614                         |                                       | 71%                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Home Energy Assessment                       | 10.518                    | 5.367                   |                         | 9.698                     | 0.90              | 8.681                   |                         | 3.314                          |                                       | 162%                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Mi'kmaw Home Energy Efficiency Project       | 0.420                     | 0.420                   |                         | 0.481                     | 1.00              | 0.481                   |                         | 0.061                          |                                       | 115%                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Residential Behaviour                        | 0.000                     | 0.000                   |                         | 0.000                     | -                 | 0.000                   |                         | -                              |                                       | -                    |
| Residential Subtotal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                              | 22.659                    | 14.087                  |                         | 20.038                    | 0.85              | 16.994                  |                         | 2.907                          |                                       | 121%                 |
| BNI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |                           |                         |                         |                           |                   |                         |                         |                                |                                       |                      |
| Efficient Products Rebates                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Business Energy Rebates                      | 6.752                     | 5.479                   |                         | 6.756                     | 0.85              | 5.746                   |                         | 0.267                          |                                       | 105%                 |
| Custom Incentives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Custom                                       | 6.782                     | 5.017                   |                         | 6.774                     | 0.78              | 5.255                   |                         | 0.239                          |                                       | 105%                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Strategic Energy Management                  | 0.537                     | 0.537                   |                         | 0.538                     | 1.00              | 0.538                   |                         | 0.001                          |                                       | 100%                 |
| Direct Installation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Small Business Energy Solutions <sup>c</sup> | 2.521                     | 2.033                   |                         | 2.679                     | 0.80              | 2.155                   |                         | 0.122                          |                                       | 106%                 |
| BNI Subtotal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              | 16.592                    | 13.065                  |                         | 16.748                    | 0.82              | 13.694                  |                         | 0.629                          |                                       | 105%                 |
| Demand Response (DR) Program                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              |                           |                         |                         |                           |                   |                         |                         |                                |                                       |                      |
| Residential Demand Response <sup>d</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              |                           |                         |                         |                           |                   |                         | 0.057                   |                                |                                       |                      |
| BNI Demand Response                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |                           |                         | 8.067                   |                           |                   |                         | 8.034                   |                                | -0.033                                | 100%                 |
| DR Program Subtotal <sup>e</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                              |                           |                         | 8.067                   |                           |                   |                         | 8.091                   |                                | -0.033                                | 100%                 |
| Portfolio Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                              | 39.251                    | 27.152                  | 8.067                   | 36.785                    | 0.83              | 30.688                  | 8.091                   | 3.536                          | -0.033                                | 113% <sup>f</sup>    |
| <sup>a</sup> Numbers may not add up due to rounding.<br><sup>b</sup> Subtotal NTGR values represent average values for the Residential and BNI portfolios. The Portfolio Total NTGR value represents an average value for all programs.<br><sup>c</sup> Evaluated gross and net peak demand savings at the generator include 0.020 MW generated by the Commercial Direct Install Pilot.<br><sup>d</sup> Tracked results weren't fully compiled since multiple methodologies on how to establish the available DR capacity of the measures included in 2024 were being considered.<br><sup>e</sup> Residential DR was not considered in the difference in available capacity (MW) or in the realization rate calculation, as there were no tracked savings.<br><sup>f</sup> This net realization rate does not include the DR program. |                                              |                           |                         |                         |                           |                   |                         |                         |                                |                                       |                      |



The following subsections discuss how evaluated savings compared to E1 tracked savings, and participation for each program and component.

### 3.1.1 Residential DSM Programs

#### Residential Efficient Product Rebates

In 2024, Residential Efficient Product Rebates achieved net electrical energy and peak demand savings of 24.617 GWh and 2.765 MW respectively at the generator. The two components under this program are Appliance Retirement (ARet) and Instant Savings. The results of each program component are provided below.

##### Appliance Retirement

- › The evaluated net electrical energy savings and peak demand savings determined by the Evaluator were respectively equal to and slightly lower than the net savings and peak demand savings tracked by E1.
- › Program participation levels in 2024 increased by 39% compared to 2023, with refrigerator and freezer retirements remaining, as was the case in 2023, the largest drivers of participation and savings.

##### Instant Savings

- › Participation levels in 2024 increased by 82% compared to 2023 levels, likely driven by E1's Lights Out campaign, with ENERGY STAR® certified LED fixtures and ENERGY STAR certified non-A-type LED lamps being the largest drivers of participation.
- › Savings from products other than lighting increased in 2024 compared to 2023 levels, and most savings continued, as was the case in 2023, to come from LED lighting products.
- › The free-ridership level for both LED lamps and LED fixtures decreased in 2024 compared to 2023 levels.
- › The evaluated net electrical energy savings and net peak demand savings determined by the Evaluator were higher than the net savings tracked by E1.

#### Existing Residential

In 2024, the net electrical energy savings for Existing Residential reached 53.331 GWh at the generator, while the net peak demand savings amounted to 14.229 MW at the generator. Existing Residential is comprised of Affordable Multifamily Housing, Affordable Single-family Homes, Efficient Product Installation, Green Heat, Home Energy Assessment, the Mi'kmaw Home Energy Efficiency Project, and Residential Behaviour. The results of these seven program components are discussed below.

##### Affordable Multifamily Housing

- › Despite a slight increase (5%) in participation compared to 2023 levels, AMH achieved lower gross electrical energy and peak demand savings than in 2023.
- › In 2024, prescriptive projects generated the most gross electrical energy savings (80%) and the most gross peak demand savings (88%) since inception.
- › Following project reviews, the Evaluator made an overall upward adjustment to electrical energy savings and a downward adjustment to peak demand savings. For electrical energy savings, a small upward adjustment ratio applied to prescriptive heat pump projects (1.016) was almost cancelled out by a one-time downward adjustment (0.010 GWh) from comprehensive projects. For peak demand savings, one-time downward adjustments were calculated for both prescriptive lighting and comprehensive projects (0.003 MW and 0.006 MW respectively).



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- › The net evaluated electrical energy savings were nearly the same as those tracked by E1 and the net evaluated peak demand savings were slightly lower than those tracked by E1. These differences are due to the adjustments applied by the Evaluator following the project reviews.

### Affordable Single-family Homes

- › In 2024, 1,210 homes participated in Affordable Single-family Homes and 1,193 of them generated electrical energy savings.
- › The net electrical energy and peak demand savings determined by the Evaluator were respectively 21% lower and 3% lower than the initial savings tracked by E1. These were mainly due to revisions to the adjustment ratios as a result of the billing analysis performed for HEA using HOT2000.

### Efficient Product Installation

- › Compared to 2023 levels, participation in 2024 increased by 2% while average electrical energy savings per participant decreased by 6.3%. This reduction in savings per participant was mainly due to the update to the 2024-2025 DSM MA, notably downward adjustments to smart thermostat and LED lamp unitary savings.
- › The evaluated net electrical energy savings were 6% lower than the tracked net electrical energy savings, while the evaluated net peak demand savings were 1% higher than the tracked net peak demand savings mostly due to updates made to the 2024-2025 DSM MA and to NTGR levels.

### Green Heat

- › Green Heat participation levels decreased by 21% compared to 2023 levels, particularly for MSHPs and demand reduction measures for which participation decreased by 36% and 19% respectively.
- › The net evaluated electrical energy and peak demand savings were significantly lower than the savings tracked by E1 due to the update to unitary savings for MSHPs and biomass measures as a result of the billing analysis completed as part of the 2024 evaluation.

### Home Energy Assessment

- › With 5,367 projects, the 2024 participation level was the highest observed since the program component was launched. The average gross electrical energy savings per home slightly decreased compared to 2023 levels, although they remained high compared to previous years. These high results were driven by the integration of the Canada Greener Homes Grant (CGH Grant).
- › The Evaluator undertook a billing analysis in 2024 and determined updated adjustment ratios (ARs) for modelled savings.
- › The evaluated electrical energy and peak demand savings were higher than the savings tracked by E1 due to updates made to the 2024-2025 DSM MA and results of the billing analysis conducted as part of the 2024 evaluation.

### Mi'kmaw Home Energy Efficiency Project

- › While MHEEP achieved the highest participation since its inception with an increase of 19%, the average energy savings per participant decreased by 41%, generating 31% lower gross energy savings and 29% higher gross peak demand savings in 2024 compared to 2023 levels.
- › The evaluated net electrical energy and peak demand savings determined by the Evaluator were respectively lower and higher than the initial net savings tracked by E1.





## Residential Behaviour

- › E1 did not track savings for Residential Behaviour, which relies on a random selection of treatment group of participants among all residential customers in 2024. Therefore, the program component does not have a tracking sheet, and there is no realization rate.

### 3.1.2 Business, Non-profit, and Institutional DSM Programs

#### Efficient Product Rebates

Efficient Product Rebates is comprised of one program component, Business Energy Rebates, which is further comprised of two services, namely Application Rebates and Instant Rebates. In 2024, Business Energy Rebates achieved 39.529 GWh in net electrical energy savings at the generator and 5.746 MW in net peak demand savings at the generator. The results of the program are provided below.

#### Business Energy Rebates

- › In 2024, Instant Rebates participation decreased by 26% compared to 2023 levels. Application Rebates participation increased by 18% in 2024, while gross electrical energy savings per Application Rebates participant increased by 16% compared to 2023 levels.
- › The Instant Rebates free-ridership algorithm was updated in 2024, LED linear fixture free-ridership decreased from 14% in 2022 to 8%, LED linear lamp free-ridership decreased from 27% in 2022 to 15%, and LED outdoor fixtures decreased from 18% in 2022 to 15%. The increase in the NTGR and the increase in both unitary energy and peak demand savings for indoor (fixture-mounted or wall-switch) and outdoor occupancy/motion sensors resulted in evaluated net electrical energy and peak demand savings being slightly higher than the values tracked by E1.
- › Both evaluated net electrical energy savings and peak demand savings were identical to the values tracked by E1 for Application Rebates. Evaluated net electrical energy and peak demand savings were both 4% and 6% higher respectively than tracked results for Instant Rebates.

#### Custom Incentives

In 2024, Custom Incentives achieved 44.429 GWh in net electrical energy savings and 5.793 MW in net peak demand savings at the generator through its two components, namely Custom and Strategic Energy Management. Custom comprises four services, Retrofit, Pay-for-Performance, New Construction, and Building Optimization. The results of both program components are provided below.

#### Custom

- › Compared to 2023, Custom participation decreased in 2024. While Retrofit and Building Optimization participation levels decreased, New Construction participation significantly increased in 2024.
- › Following the project reviews, the Evaluator adjusted the electrical energy and peak demand savings for Retrofit, New Construction, and Building Optimization.
- › Retrofit free-ridership levels decreased for regular Retrofit and New Construction projects and was established at 15% and 28% respectively. Retrofit spillover was nil for regular Retrofit projects, and free-ridership and spillover were not measured for Building Optimization; 2023 levels were therefore maintained and used for the 2024 evaluation.
- › Evaluated net electrical energy and peak demand savings determined by the Evaluator were respectively 8% and 5% higher than the savings tracked by E1.



## Strategic Energy Management

- › The SEM participation level has remained stable over the past five years. Electrical energy savings per participant were similar to those in 2023.
- › The measurement and verification (M&V) methodologies applied to quantify savings were generally appropriate and accurate. The quality of peak demand savings estimates was greatly improved compared to previous years.
- › The evaluated net electrical energy and peak demand savings determined by the Evaluator were almost equal to the initial net savings tracked by E1.

## Direct Installation

Direct Installation consists of one program component, namely Small Business Energy Solutions. In 2024, Direct Installation achieved 10.644 GWh in net electrical energy savings at the generator and 2.151 MW in net peak demand savings at the generator. The results of the program are provided below.

### Small Business Energy Solutions

- › In 2024, the number of units rebated under Small Business Energy Solutions increased by 53% compared to 2023 levels, with the DIY path remaining the most popular and accounting for 98% of all units rebated.
- › Based on the results of a survey conducted with 30 businesses, non-participant spillover was found to be nil.
- › The evaluated gross and net electrical energy and peak demand savings were slightly higher (by 1% and 5% respectively) than the savings tracked by E1 due to updates made to the 2024-2025 DSM MA.

## 3.1.3 Demand Response DSM Programs

### Demand Response

Demand Response is comprised of two program components, Residential Demand Response, and Business, Non-profit, and Institutional Demand Response. In 2024, Demand Response achieved 8.091 MW in available demand response capacity. The results of each program component are provided below.

#### Residential Demand Response

- › Tracked results were not fully compiled, as multiple methodologies for establishing the available DR capacity of the measures included in 2024 were being considered. The Evaluator decided on the final methodology to be used as part of the 2024 evaluation. Therefore, the program component does not have tracked results, nor realization rate.

#### Business, Non-profit, and Institutional Demand Response

- › Participation grew over 700% from nine participants last year to 76 participants this year. The available DR capacity per participant decreased from 263 kW in 2023 to 106 kW in 2024.
- › The evaluated new and total available DR capacities were 1% and less than 1% lower than the values tracked by E1 respectively. The differences are due to the adjustments made through the project reviews.

## 3.2 Net-to-gross Ratios

The NTGRs outlined in Table 7 below were applied to gross savings to estimate net savings. NTGRs were established based on the free-ridership levels and spillover in some cases. Based on the established free-ridership and spillover levels, NTGRs were calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Spillover})$$

NTGR estimations were based on a self-reporting approach and the methodology described in Subsection 2.1.6 above.

Table 7 summarizes the free-ridership and spillover levels used in the 2024 evaluation as well as the resulting NTGRs for each program component.

**Table 7: 2024 Free-ridership, Spillover, and NTGRs**

| Program Component and Measure Type  |                            | Free-ridership Levels | Spillover Levels | NTGR |
|-------------------------------------|----------------------------|-----------------------|------------------|------|
| <b>Residential</b>                  |                            |                       |                  |      |
| Appliance Retirement <sup>a</sup>   | Refrigerators              | 43%                   | 0%               | 0.57 |
|                                     | Freezers                   | 45%                   |                  | 0.55 |
|                                     | Air Conditioners           | 47%                   |                  | 0.53 |
|                                     | Small Refrigerators        | 32%                   |                  | 0.68 |
|                                     | Small Freezers             | 32%                   |                  | 0.68 |
|                                     | Dehumidifiers              | 0%                    |                  | 1.00 |
| Instant Savings                     | LED Lamps                  | 39%                   | 9%               | 0.70 |
|                                     | LED Fixtures               | 26%                   | 2%               | 0.76 |
|                                     | All Other Products         | -                     | -                | 1.00 |
| Home Energy Assessment <sup>a</sup> | Solar PV Measures          | 26%                   | 1%               | 0.75 |
|                                     | Other Measures             | 17%                   | 1%               | 0.84 |
| Green Heat <sup>a</sup>             | MSHPs                      | 48%                   | -                | 0.52 |
|                                     | Demand Reduction           | 9%                    |                  | 0.91 |
|                                     | Solar and Biomass Measures | 47%                   |                  | 0.53 |
|                                     | CASHPs and AWHPs           | 33%                   |                  | 0.67 |

| Program Component and Measure Type                         |                                                                       | Free-ridership Levels | Spillover Levels | NTGR |
|------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------|------------------|------|
| Efficient Product Installation                             | LED Lamps and Lighting-related Products – Non-low-income Participants | 16%                   | 8%               | 0.92 |
|                                                            | Smart and Advanced Learning Thermostats – Non-low-income Participants | 9%                    | 8%               | 0.99 |
|                                                            | DHW Products – Non-low-income Participants                            | 11%                   | 8%               | 0.97 |
|                                                            | Air Sealing Products – Non-low-income Participants                    | 12%                   | 8%               | 0.96 |
|                                                            | Smart Power Controllers – Non-low-income Participants                 | 3%                    | 8%               | 1.05 |
|                                                            | Humidity Sensors – Non-low-income Participants                        | 0%                    | 8%               | 1.08 |
|                                                            | All Measures – Low-income Participants                                | 0%                    | 0%               | 1.00 |
| Mi'kmaw Home Energy Efficiency Project                     |                                                                       | -                     | -                | 1.00 |
| Affordable Multifamily Housing                             |                                                                       | -                     | -                | 1.00 |
| Affordable Single-family Homes                             |                                                                       | -                     | -                | 1.00 |
| Residential Behaviour                                      |                                                                       |                       |                  |      |
| <b>BNI</b>                                                 |                                                                       |                       |                  |      |
| Business Energy Rebates – Application Rebates <sup>a</sup> |                                                                       | 26%                   | 0%               | 0.74 |
| Business Energy Rebates – Instant Rebates                  | LED Linear Fixtures                                                   | 8%                    | -                | 0.92 |
|                                                            | LED Linear Lamps                                                      | 15%                   |                  | 0.85 |
|                                                            | LED Outdoor Fixtures                                                  | 15%                   |                  | 0.85 |
|                                                            | Other Measures                                                        | -                     |                  | 1.00 |
| Custom Retrofit                                            | Regular Retrofit Projects                                             | 15%                   | 0%               | 0.85 |
|                                                            | Solar PV Projects <sup>a</sup>                                        | 38%                   | 1%               | 0.63 |
|                                                            | Compressed Air Leak Audit Projects <sup>a</sup>                       | 16%                   | 0%               | 0.84 |
| Custom Pay-for-Performance <sup>a</sup>                    |                                                                       | 14%                   | -                | 0.86 |
| Custom New Construction                                    |                                                                       | 28%                   | -                | 0.72 |
| Custom Building Optimization <sup>a</sup>                  |                                                                       | 9%                    | 0%               | 0.91 |
| Strategic Energy Management                                |                                                                       | -                     | -                | 1.00 |
| Small Business Energy Solutions                            | Audit Path <sup>a</sup>                                               | 12%                   | 0%               | 0.88 |
|                                                            | DIY Path <sup>a</sup>                                                 | 20%                   | 0%               | 0.80 |
|                                                            | Commercial Direct Install Pilot                                       | -                     | -                | 1.00 |

<sup>a</sup> Net-to-gross ratios were determined based on the results of past evaluations.

### 3.3 Lifetime Energy Savings

The Evaluator reviewed the EUL values of all measures offered by E1 and their associated lifetime electrical energy savings. The Evaluator found that the DSM portfolio generated 2,424.024 GWh in lifetime net

electrical energy savings.<sup>14</sup> As presented in Table 8 below, the weighted average EUL of measures offered in the E1 DSM portfolio is 14.1 years. Program components with measures affecting building envelopes, such as insulation, generate significant lifetime savings due to the persistence of these types of measures. For example, Home Energy Assessment has an average EUL of 26.9 years and, while it contributes to 19% of annual electrical energy savings of the DSM portfolio, it generates 35% of lifetime energy savings. Program components composed of mainly lighting measures, such as Instant Savings and Efficient Product Installation, generate lower lifetime electrical energy savings compared to annual savings due to the shorter equivalent EUL of these types of measures.

**Table 8: 2024 Evaluated Net Lifetime Electrical Energy Savings at the Generator**

| DSM Program                               | Program Component                      | Annual Net Energy Savings (GWh) | Lifetime Net Energy Savings (GWh) | Weighted Average EUL (years) | Share of Annual Net Energy Savings (%) | Share of Lifetime Net Energy Savings (%) |
|-------------------------------------------|----------------------------------------|---------------------------------|-----------------------------------|------------------------------|----------------------------------------|------------------------------------------|
| <b>Residential</b>                        |                                        |                                 |                                   |                              |                                        |                                          |
| Residential Efficient Product Rebates     | Appliance Retirement                   | 2.365                           | 9.433                             | 4.0                          | 1%                                     | 0%                                       |
|                                           | Instant Savings                        | 22.252                          | 97.841                            | 4.4                          | 13%                                    | 4%                                       |
| Existing Residential                      | Affordable Multifamily Housing         | 1.159                           | 19.397                            | 16.7                         | 1%                                     | 1%                                       |
|                                           | Affordable Single-family Homes         | 3.719                           | 74.428                            | 20.0                         | 2%                                     | 3%                                       |
|                                           | Efficient Product Installation         | 8.948                           | 52.525                            | 5.9                          | 5%                                     | 2%                                       |
|                                           | Green Heat                             | 0.872                           | 15.697                            | 18.0                         | 1%                                     | 1%                                       |
|                                           | Home Energy Assessment                 | 31.962                          | 859.594                           | 26.9                         | 19%                                    | 35%                                      |
|                                           | Mi'kmaw Home Energy Efficiency Project | 0.401                           | 8.141                             | 20.3                         | 0%                                     | 0%                                       |
|                                           | Residential Behaviour                  | 6.270                           | 6.270                             | 1.0                          | 4%                                     | 0%                                       |
| <b>Residential Subtotal</b>               |                                        | <b>77.948</b>                   | <b>1,143.326</b>                  | <b>14.7</b>                  | <b>45%</b>                             | <b>47%</b>                               |
| <b>BNI</b>                                |                                        |                                 |                                   |                              |                                        |                                          |
| Efficient Product Rebates                 | Business Energy Rebates                | 39.529                          | 609.885                           | 15.4                         | 23%                                    | 25%                                      |
| Custom Incentives                         | Custom                                 | 39.951                          | 488.215                           | 12.2                         | 23%                                    | 20%                                      |
|                                           | Strategic Energy Management            | 4.478                           | 11.581                            | 2.6                          | 3%                                     | 0%                                       |
| Direct Installation                       | Small Business Energy Solutions        | 10.854                          | 177.557                           | 16.4                         | 6%                                     | 7%                                       |
| <b>BNI Subtotal</b>                       |                                        | <b>94.812</b>                   | <b>1,287.239</b>                  | <b>13.6</b>                  | <b>55%</b>                             | <b>53%</b>                               |
| <b>Portfolio Total</b>                    |                                        | <b>172.760</b>                  | <b>2,430.564</b>                  | <b>14.1</b>                  | <b>100%</b>                            | <b>100%</b>                              |
| * Numbers may not add up due to rounding. |                                        |                                 |                                   |                              |                                        |                                          |

<sup>14</sup> The Demand Response program is not included since no electrical energy savings were generated, and it generated available demand response capacity only.

### 3.4 Greenhouse Gas Emission Reductions

The Evaluator established the reduced GHG emissions due to the DSM portfolio at 81,327 tonnes of CO<sub>2</sub> eq in terms of annually avoided net GHG emissions. Table 9 below presents the GHG emission reductions of each program component in 2024 as well as those for the portfolio as a whole.<sup>15</sup>

**Table 9: 2024 Evaluated GHG Emission Reductions**

| DSM Program                             | Program Component                      | Gross Annual Avoided GHG Emissions in CO <sub>2</sub> eq Tonnes | Net Annual Avoided GHG Emissions in CO <sub>2</sub> eq Tonnes |
|-----------------------------------------|----------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|
| Residential Efficient Product Rebates   | Appliance Retirement                   | 1,981                                                           | 1,117                                                         |
|                                         | Instant Savings                        | 12,695                                                          | 10,508                                                        |
| Existing Residential<br>New Residential | Affordable Multifamily Housing         | 547                                                             | 547                                                           |
|                                         | Affordable Single-family Homes         | 1,756                                                           | 1,756                                                         |
|                                         | Efficient Product Installation         | 4,294                                                           | 4,225                                                         |
|                                         | Green Heat                             | 780                                                             | 412                                                           |
|                                         | Home Energy Assessment                 | 18,408                                                          | 15,093                                                        |
|                                         | Mi'kmaw Home Energy Efficiency Project | 189                                                             | 189                                                           |
|                                         | Residential Behaviour                  | -                                                               | 2,961                                                         |
| Residential Subtotal                    |                                        | <b>40,650</b>                                                   | <b>36,807</b>                                                 |
| Efficient Product Rebates               | Business Energy Rebates                | 22,124                                                          | 18,666                                                        |
| Custom Incentives                       | Custom                                 | 23,527                                                          | 18,865                                                        |
|                                         | Strategic Energy Management            | 2,114                                                           | 2,114                                                         |
| Direct Installation                     | Small Business Energy Solutions        | 6,356                                                           | 5,125                                                         |
| <b>BNI Subtotal</b>                     |                                        | <b>54,121</b>                                                   | <b>44,770</b>                                                 |
| <b>Portfolio Total</b>                  |                                        | <b>94,771</b>                                                   | <b>81,577</b>                                                 |

<sup>15</sup> Ibid.

## 4 DSM Portfolio Performance

This section presents a comparison of evaluated savings with E1 planned savings at the program and component levels. It also presents satisfaction results, annual savings performance, as well as the historical performance and contribution of individual program components to portfolio savings.

### 4.1 Participant and Partner Satisfaction

The 2024 evaluation revealed high participant satisfaction with E1 and its programs. Affordable Multifamily Housing, Affordable Single-family Homes, Efficient Product Installation, Custom (New Construction), and Business Energy Rebate – Instant Rebates received, on average, participant satisfaction scores of 7.9 or higher. The Evaluator interviewed program partners for two program components. Program partners were generally satisfied with the program components, while they were less satisfied than participants. Table 10 presents the 2024 average participant and partner satisfaction scores for program components for which this metric was measured. A 0-to-10 scale is used to score satisfaction, where 0 means “Not at all satisfied” and 10 means “Completely satisfied”.

**Table 10: 2024 Satisfaction Results**

| DSM Program                | Program Component                        | Participant Satisfaction          | Partner Satisfaction                       |
|----------------------------|------------------------------------------|-----------------------------------|--------------------------------------------|
| <b>Residential</b>         |                                          |                                   |                                            |
| Existing Residential       | Affordable Multifamily Housing           | 9.7                               | -                                          |
|                            | Affordable Single-family Home            | 9.4 (Heat Pump)<br>8.9 (Modelled) | 7.0 (Contractors)<br>7.5 (Delivery Agents) |
|                            | Efficient Product Installation           | 9.4                               | -                                          |
| <b>BNI</b>                 |                                          |                                   |                                            |
| Custom Incentives          | Custom - New Construction                | 7.9                               | -                                          |
| Efficient Products Rebates | Business Energy Rebate – Instant Rebates | 9.1                               | 8.3                                        |

### 4.2 Annual Savings Performance by Program Component

Table 11 below presents E1 planned savings,<sup>16</sup> evaluated results, and the variances between them.

<sup>16</sup> E1's 2023 Q1 Demand-side Management (DSM) Report (M11148), page 3, Table 1: 2023 Approved Plan, Mid-Course Adjustments and Q1 Results [filed May 25, 2023].

**Table 11: 2024 Planned Net Savings and Evaluated Results**

| Program Component and DSM Program                                                                        | Planned Savings*         |                              |                            | Evaluated Results**      |                              |                            | Variance   |             |
|----------------------------------------------------------------------------------------------------------|--------------------------|------------------------------|----------------------------|--------------------------|------------------------------|----------------------------|------------|-------------|
|                                                                                                          | Net Energy Savings (GWh) | Net Peak Demand Savings (MW) | Available DR Capacity (MW) | Net Energy Savings (GWh) | Net Peak Demand Savings (MW) | Available DR Capacity (MW) | GWh (%)    | MW (%)      |
| <b>Residential</b>                                                                                       |                          |                              |                            |                          |                              |                            |            |             |
| <b>Residential Efficient Product Rebates</b>                                                             | <b>14.481</b>            | <b>1.967</b>                 |                            | <b>24.617</b>            | <b>2.765</b>                 |                            | <b>70%</b> | <b>41%</b>  |
| Appliance Retirement                                                                                     | 1.937                    | 0.287                        |                            | 2.365                    | 0.337                        |                            | 22%        | 18%         |
| Instant Savings                                                                                          | 12.544                   | 1.680                        |                            | 22.252                   | 2.428                        |                            | 77%        | 44%         |
| <b>Existing Residential</b>                                                                              | <b>46.523</b>            | <b>11.495</b>                |                            | <b>53.331</b>            | <b>14.229</b>                |                            | <b>15%</b> | <b>24%</b>  |
| Affordable Multifamily Housing                                                                           | 1.900                    | 1.581                        |                            | 1.159                    | 0.570                        |                            | -39%       | -64%        |
| Affordable Single-family Homes                                                                           | 2.825                    | 1.046                        |                            | 3.719                    | 2.089                        |                            | 32%        | 100%        |
| Efficient Product Installation                                                                           | 10.569                   | 1.127                        |                            | 8.948                    | 0.880                        |                            | -15%       | -22%        |
| Green Heat                                                                                               | 3.600                    | 2.775                        |                            | 0.872                    | 1.529                        |                            | -76%       | -45%        |
| Home Energy Assessment                                                                                   | 19.012                   | 4.799                        |                            | 31.962                   | 8.681                        |                            | 68%        | 81%         |
| Mi'kmaw Home Energy Efficiency Project                                                                   | 0.618                    | 0.167                        |                            | 0.401                    | 0.481                        |                            | -35%       | 189%        |
| Residential Behaviour                                                                                    | 8.000                    | 0.000                        |                            | 6.270                    | 0.000                        |                            | -22%       |             |
| <b>Residential Subtotal</b>                                                                              | <b>61.004</b>            | <b>13.462</b>                |                            | <b>77.948</b>            | <b>16.994</b>                |                            | <b>28%</b> | <b>26%</b>  |
| <b>BNI</b>                                                                                               |                          |                              |                            |                          |                              |                            |            |             |
| <b>Efficient Product Rebates</b>                                                                         | <b>39.747</b>            | <b>5.107</b>                 |                            | <b>39.529</b>            | <b>5.746</b>                 |                            | <b>-1%</b> | <b>13%</b>  |
| Business Energy Rebates                                                                                  | 39.747                   | 5.107                        |                            | 39.529                   | 5.746                        |                            | -1%        | 13%         |
| <b>Custom Incentives</b>                                                                                 | <b>31.258</b>            | <b>4.571</b>                 |                            | <b>44.428</b>            | <b>5.793</b>                 |                            | <b>42%</b> | <b>27%</b>  |
| Custom                                                                                                   | 27.036                   | 4.101                        |                            | 39.951                   | 5.255                        |                            | 48%        | 28%         |
| Strategic Energy Management                                                                              | 4.222                    | 0.470                        |                            | 4.478                    | 0.538                        |                            | 6%         | 14%         |
| <b>Direct Installation</b>                                                                               | <b>10.592</b>            | <b>2.558</b>                 |                            | <b>10.854</b>            | <b>2.155</b>                 |                            | <b>2%</b>  | <b>-16%</b> |
| Small Business Energy Solutions                                                                          | 10.592                   | 2.558                        |                            | 10.854                   | 2.155                        |                            | 2%         | -16%        |
| <b>BNI Subtotal</b>                                                                                      | <b>81.596</b>            | <b>12.236</b>                |                            | <b>94.812</b>            | <b>13.694</b>                |                            | <b>16%</b> | <b>12%</b>  |
| <b>Demand Response (DR)</b>                                                                              |                          |                              |                            |                          |                              |                            |            |             |
| <b>Demand Response</b>                                                                                   |                          |                              | <b>7.240</b>               |                          |                              | <b>8.091</b>               |            | <b>12%</b>  |
| Residential Demand Response                                                                              |                          |                              | 0.210                      |                          |                              | 0.057                      |            | -73%        |
| BNI Demand Response                                                                                      |                          |                              | 7.030                      |                          |                              | 8.034                      |            | 14%         |
| <b>DR Program Subtotal</b>                                                                               |                          |                              | <b>7.240</b>               |                          |                              | <b>8.091</b>               |            | <b>12%</b>  |
| <b>Portfolio Total</b>                                                                                   | <b>142.601</b>           | <b>25.697</b>                | <b>7.240</b>               | <b>172.760</b>           | <b>30.688</b>                | <b>8.091</b>               | <b>21%</b> | <b>19%</b>  |
| * Planned savings correspond to E1 mid-course adjustments.<br>** Numbers may not add up due to rounding. |                          |                              |                            |                          |                              |                            |            |             |



The E1 DSM portfolio of program components achieved 172.760 GWh in total net electrical energy savings at the generator and 30.688 MW in total net peak demand savings at the generator, representing 21% higher savings than planned electrical energy savings and 20% higher savings than planned peak demand savings for 2024. Residential Efficient Product Rebates, Existing Residential, and Custom Incentives exceeded their planned electrical energy and peak demand targets in 2024, while Efficient Product Rebates and Direct Installation fell just short of targets.

E1 residential programs achieved 77.948 GWh in net electrical energy savings at the generator and 16.994 MW in net peak demand savings at the generator. Residential energy savings were 28% higher than planned, with all programs exceeding their targets. The results were as follows: Residential Efficient Product Rebates and Existing Residential surpassed their targets by 70% and 15% respectively. All residential programs also exceeded their peak demand savings targets, with Residential Efficient Product Rebates exceeding the target by 41% and Existing Residential by 24%. As a result, residential net peak demand savings were 26% above the planned values.

E1 BNI programs achieved 94,812 GWh in net electrical energy savings at the generator and 13.694 MW in net peak demand savings at the generator in 2024, thus exceeding planned electrical energy savings and planned peak demand savings by 16% and 12% respectively. Efficient Product Rebates narrowly missed their electrical energy savings target by 1%, while Custom Incentives and Direct Installation exceeded their electrical energy savings target by 42% and 2% respectively. Efficient Product Rebates and Custom Incentives exceeded their planned peak demand savings target by 13% and 27% respectively, while Direct Installation missed its target by 16%.

## 4.3 Historical Portfolio Analysis

This subsection presents year-over-year program performance (GWh energy savings) and the contribution of individual program components to portfolio savings (% energy savings). Table 12, Table 13, and Table 14 below provide a historical overview of program component performance and changes in DSM portfolio composition from 2020 to 2024.

**Table 12: Evaluated Net Electrical Energy Savings at the Generator, 2020-2024**

| DSM Program                                                                                                                                                      | Program Component                           | Energy Savings (GWh) |         |         |         |         | Energy Savings (%) |      |      |      |      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------|---------|---------|---------|---------|--------------------|------|------|------|------|
|                                                                                                                                                                  |                                             | 2020                 | 2021    | 2022    | 2023    | 2024    | 2020               | 2021 | 2022 | 2023 | 2024 |
| Residential                                                                                                                                                      |                                             |                      |         |         |         |         |                    |      |      |      |      |
| Residential Efficient Product Rebates                                                                                                                            | Appliance Retirement                        | 2.111                | 2.474   | 2.051   | 1.698   | 2.365   | 2%                 | 2%   | 2%   | 1%   | 1%   |
|                                                                                                                                                                  | Instant Savings                             | 10.533               | 14.314  | 13.741  | 11.476  | 22.252  | 11%                | 13%  | 11%  | 9%   | 13%  |
| Existing Residential                                                                                                                                             | Affordable Multifamily Housing              | 0.676                | 0.402   | 0.920   | 1.460   | 1.159   | 1%                 | 0%   | 1%   | 1%   | 1%   |
|                                                                                                                                                                  | Affordable Single-family Homes <sup>a</sup> |                      |         |         | 1.444   | 3.719   |                    |      |      | 1%   | 2%   |
|                                                                                                                                                                  | Efficient Product Installation              | 7.402                | 7.812   | 8.315   | 9.357   | 8.948   | 8%                 | 7%   | 7%   | 7%   | 5%   |
|                                                                                                                                                                  | Green Heat                                  | 5.407                | 6.795   | 3.755   | 2.918   | 0.872   | 6%                 | 6%   | 3%   | 2%   | 1%   |
|                                                                                                                                                                  | Home Energy Assessment                      | 3.823                | 3.481   | 11.377  | 25.966  | 31.962  | 4%                 | 3%   | 9%   | 20%  | 19%  |
|                                                                                                                                                                  | Mi'kmaw Home Energy Efficiency Project      | 0.088                | 0.316   | 0.380   | 0.577   | 0.401   | 0%                 | 0%   | 0%   | 0%   | 0%   |
|                                                                                                                                                                  | Residential Behaviour <sup>b</sup>          |                      |         |         |         | 6.270   |                    |      |      |      | 4%   |
| New Residential                                                                                                                                                  | New Home Construction                       | 5.867                | 5.683   | 6.479   | 5.281   |         | 6%                 | 5%   | 5%   | 4%   |      |
| Residential Subtotal                                                                                                                                             |                                             | 35.908               | 41.276  | 47.019  | 60.177  | 77.948  | 38%                | 38%  | 39%  | 46%  | 45%  |
| BNI                                                                                                                                                              |                                             |                      |         |         |         |         |                    |      |      |      |      |
| Efficient Product Rebates                                                                                                                                        | Business Energy Rebates                     | 33.687               | 33.491  | 37.046  | 38.814  | 39.529  | 35%                | 31%  | 30%  | 30%  | 23%  |
| Custom Incentives                                                                                                                                                | Custom <sup>c</sup>                         | 17.790               | 23.293  | 23.588  | 21.746  | 39.951  | 19%                | 21%  | 19%  | 17%  | 23%  |
|                                                                                                                                                                  | Energy Management Information Systems       | 0.605                | 0.027   |         |         |         | 1%                 | 0%   |      |      |      |
|                                                                                                                                                                  | Strategic Energy Management <sup>d</sup>    | 2.120                | 1.845   | 3.177   | 3.381   | 4.478   | 2%                 | 2%   | 3%   | 3%   | 3%   |
| Direct Installation                                                                                                                                              | Small Business Energy Solutions             | 5.415                | 9.486   | 11.069  | 7.451   | 10.854  | 6%                 | 9%   | 9%   | 6%   | 6%   |
| BNI Subtotal                                                                                                                                                     |                                             | 59.616               | 68.142  | 74.880  | 71.392  | 94.812  | 62%                | 62%  | 61%  | 54%  | 55%  |
| Portfolio Total                                                                                                                                                  |                                             | 95.524               | 109.418 | 121.899 | 131.569 | 172.760 | 100%               | 100% | 100% | 100% | 100% |
| <sup>a</sup> Affordable Single-family Homes was launched in 2023.                                                                                                |                                             |                      |         |         |         |         |                    |      |      |      |      |
| <sup>b</sup> Residential Behaviour was introduced in 2024.                                                                                                       |                                             |                      |         |         |         |         |                    |      |      |      |      |
| <sup>c</sup> Custom includes four services: Retrofit, Pay-for-Performance, New Construction, and Building Optimization.                                          |                                             |                      |         |         |         |         |                    |      |      |      |      |
| <sup>d</sup> Strategic Energy Management includes Energy Management Information System since 2022 when the two program components were merged into a single one. |                                             |                      |         |         |         |         |                    |      |      |      |      |

**Table 13: Evaluated Net Peak Demand Savings at the Generator, 2020-2024**

| DSM Program <sup>a</sup>                                                                                                                                    | Program Component                           | Peak Demand Savings (MW) |        |        |        |        | Peak Demand Savings (%) |      |      |      |      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------------------|--------|--------|--------|--------|-------------------------|------|------|------|------|
|                                                                                                                                                             |                                             | 2020                     | 2021   | 2022   | 2023   | 2024   | 2020                    | 2021 | 2022 | 2023 | 2024 |
| Residential                                                                                                                                                 |                                             |                          |        |        |        |        |                         |      |      |      |      |
| Residential Efficient Product Rebates                                                                                                                       | Appliance Retirement                        | 0.309                    | 0.357  | 0.298  | 0.243  | 0.337  | 1%                      | 1%   | 1%   | 1%   | 1%   |
|                                                                                                                                                             | Instant Savings                             | 1.206                    | 1.629  | 1.771  | 1.459  | 2.428  | 6%                      | 6%   | 6%   | 5%   | 8%   |
| Existing Residential                                                                                                                                        | Affordable Multifamily Housing              | 0.181                    | 0.186  | 0.447  | 0.741  | 0.570  | 1%                      | 1%   | 1%   | 3%   | 2%   |
|                                                                                                                                                             | Affordable Single-family Homes <sup>b</sup> |                          |        |        | 0.627  | 2.089  |                         |      |      | 2%   | 7%   |
|                                                                                                                                                             | Efficient Product Installation              | 1.007                    | 1.098  | 0.864  | 0.920  | 0.880  | 5%                      | 4%   | 3%   | 3%   | 3%   |
|                                                                                                                                                             | Green Heat                                  | 4.741                    | 6.451  | 3.424  | 2.561  | 1.529  | 22%                     | 23%  | 11%  | 9%   | 5%   |
|                                                                                                                                                             | Home Energy Assessment                      | 1.823                    | 1.495  | 6.703  | 7.820  | 8.681  | 9%                      | 5%   | 21%  | 28%  | 28%  |
|                                                                                                                                                             | Mi'kmaw Home Energy Efficiency Project      | 0.026                    | 0.147  | 0.194  | 0.373  | 0.481  | 0%                      | 1%   | 1%   | 1%   | 2%   |
|                                                                                                                                                             | Residential Behaviour                       |                          |        |        |        | -      |                         |      |      |      | 0%   |
| New Residential                                                                                                                                             | New Home Construction                       | 2.397                    | 2.285  | 2.358  | 1.909  |        | 11%                     | 8%   | 8%   | 7%   |      |
| Residential Subtotal                                                                                                                                        |                                             | 11.689                   | 13.649 | 16.059 | 16.653 | 16.994 | 55%                     | 50%  | 51%  | 60%  | 55%  |
| BNI                                                                                                                                                         |                                             |                          |        |        |        |        |                         |      |      |      |      |
| Efficient Product Rebates                                                                                                                                   | Business Energy Rebates                     | 5.711                    | 5.401  | 5.762  | 6.014  | 5.746  | 27%                     | 20%  | 18%  | 22%  | 19%  |
| Custom Incentives                                                                                                                                           | Custom <sup>c</sup>                         | 2.427                    | 6.105  | 6.931  | 3.053  | 5.255  | 11%                     | 22%  | 22%  | 11%  | 17%  |
|                                                                                                                                                             | Energy Management Information Systems       | -                        | 0.003  |        |        |        | 0%                      | 0%   |      |      |      |
|                                                                                                                                                             | Strategic Energy Management <sup>d</sup>    | 0.241                    | 0.282  | 0.373  | 0.366  | 0.538  | 1%                      | 1%   | 1%   | 1%   | 2%   |
| Direct Installation                                                                                                                                         | Small Business Energy Solutions             | 1.120                    | 2.045  | 2.222  | 1.491  | 2.155  | 5%                      | 7%   | 7%   | 5%   | 7%   |
| BNI Subtotal                                                                                                                                                |                                             | 9.500                    | 13.835 | 15.288 | 10.924 | 13.694 | 45%                     | 50%  | 49%  | 40%  | 45%  |
| Portfolio Total                                                                                                                                             |                                             | 21.189                   | 27.484 | 31.347 | 27.577 | 30.688 | 100%                    | 100% | 100% | 100% | 100% |
| <sup>a</sup> Residential Behaviour is not included.                                                                                                         |                                             |                          |        |        |        |        |                         |      |      |      |      |
| <sup>b</sup> Affordable Single-family Homes was introduced in 2024.                                                                                         |                                             |                          |        |        |        |        |                         |      |      |      |      |
| <sup>c</sup> Custom includes four services: Retrofit, Pay-for-Performance, New Construction, and Building Optimization.                                     |                                             |                          |        |        |        |        |                         |      |      |      |      |
| <sup>d</sup> Strategic Energy Management includes Energy Management Information Systems. In 2023, the two program components were merged into a single one. |                                             |                          |        |        |        |        |                         |      |      |      |      |

**Table 14: Evaluated Net Available DR Capacity, 2023-2024**

| DSM Program              | Program Component           | Available DR Capacity (MW) |       | Available DR Capacity (%) |      |
|--------------------------|-----------------------------|----------------------------|-------|---------------------------|------|
|                          |                             | 2023                       | 2024  | 2023                      | 2024 |
| Demand Response (DR)     |                             |                            |       |                           |      |
| Demand Response          | Residential Demand Response | 0.058                      | 0.057 | 2%                        | 1%   |
|                          | BNI Demand Response         | 2.365                      | 8.034 | 98%                       | 99%  |
| Demand Response Subtotal |                             | 2.423                      | 8.091 | 100%                      | 100% |

In 2024, E1 achieved a total of 172.760 GWh in net electrical energy savings at the generator and 30.688 MW in net peak demand savings at the generator. Both net electrical energy and peak demand savings increased compared to 2023 levels. Residential programs had increases in net electrical energy and peak demand savings of 30% and 2% respectively compared to 2023 levels, while BNI programs had 33% and 25% increases in net electrical energy and peak demand savings respectively.

In 2024, the residential sector accounted for 45% of net electrical energy savings and the BNI sector accounted for 55% of net electrical energy savings. Compared to 2023, while the share of lighting in residential programs increased from 6% to 10% in 2024, largely driven by Instant Savings, the share of lighting in BNI programs decreased from 30% to 24%. For the overall portfolio, savings from lighting slightly decreased from 36% to 34% in 2024.

The residential sector accounted for 55% of net peak demand savings, while the BNI sector accounted for the other 45%. In 2024, the program components that generated the largest shares of peak demand savings were Home Energy Assessment (28%), Business Energy Rebates (19%), and Custom (17%).

As presented in Table 14 above, the Demand Reduction program, introduced in 2023, resulted in 8.091 MW in available demand response capacity in 2024.



## 5 Process Evaluation Results

For the 2024 evaluation, the Evaluator conducted four process evaluations for Affordable Multifamily Housing, Affordable Single-family Homes, Business Energy Rebates – Instant Rebates, and Custom New Construction.

### Affordable Multifamily Housing

To collect information on participant and distributor perspectives, the Evaluator conducted interviews with program staff, energy auditors (EAs), and participants.

The key findings specific to the Affordable Multifamily Housing process evaluation are outlined below:

› **The Evaluator surveyed high levels of satisfaction overall.**

All 10 interviewed participants said that they were highly satisfied with Affordable Multifamily Housing and “would definitely” recommend the program component to other housing providers or affordable multifamily residential building owners (Net Promoter Score of 100). Everyone agreed that AMH is simple to understand and easy to complete. EAs were also satisfied with Affordable Multifamily Housing overall, particularly with the selection of upgrades.

› **Incentive calculations can cause confusion among participants.**

Participants do not always realize that they must pay tax on overall project expenditures and that the program component only covers up to 80% of pre-tax costs. E1 provides verbal and written explanations to participants on how incentives are determined and is working on wording to make things clearer, but participants still have difficulty understanding how much rebate they will be granted and how the rebate is calculated. Furthermore, some participants believe that the estimated incentive for the upgrades presented in the preapproval report is the amount they will receive at the end of their project, although this amount can change based on whether all the proposed equipment is installed.

› **Some participants would benefit from project management support.**

Based on comments from E1, Energy Auditors (EAs) and participants, project management assistance, technical/maintenance support, and help finding contractors would be useful for participants. Without this assistance, project delays are said to occur. Not being able to find a contractor was also cited as a reason for withdrawing from the program component.

Some participants consider that having more information on the upgrades installed (many energy efficiency questions from participants concern heat pumps and insulation) and case studies would also be valuable.

› **Among EAs, satisfaction is low with the audit reporting templates.**

The audit reporting templates generate lower satisfaction levels among EAs, particularly the one for the initial audit. EAs consider that the templates are lengthy and awkward to fill out and would prefer them to be Excel-based rather than Word-based for more data entry flexibility.



› **Costs and lack of budget are barriers to participation.**

Financial barriers constitute the main reasons most interviewed dropped-out participants withdrew from the program component. The majority had no budget available for building maintenance and efficiency upgrades, a situation that was echoed among most interviewed non-participants and half of Affordable Multifamily Housing participants. Necessary repairs and upgrades are dealt with on an ad-hoc basis. Half of interviewed dropped-out participants also had issues with the operating agreement, specifically that the rental rates were too low (see the next finding below). In view of the constraints faced by many affordable multifamily housing providers, it is not surprising that participants choose co-funding and low-interest financing as tools and support that would be most helpful to them.

Less frequent mentions for withdrawing from Affordable Multifamily Housing included building ineligibility and the desired upgrades not being included (roof repairs, electrical panel upgrades).

› **Rental rates in the operating agreement cause division among dropped-out participants and non-participants.**

Opinions on the operating agreement among dropped-out participants and non-participants were polarized. Negative perceptions were due to the rental rates in the agreement being lower than what dropped-out participants and non-participants currently charge and were therefore a barrier to participation (see the next finding above). Modifications to the proposed rental rates (i.e. making them more in line with current market rates) were seen as critical in changing these negative perceptions about Affordable Multifamily Housing among dropped-out participants and non-participants. E1 regularly reviews rental rates to align with current market conditions.

› **Term lengths are not a significant problem.**

No participants, dropped-out participants, or non-participants expressed significant concern about Affordable Multifamily Housing term lengths. Reducing the agreement terms from 12 years to 10 years (for comprehensive projects) and from six years to five years (for prescriptive projects) had minimal impact on their opinions of the covenant. The Evaluator is therefore of the opinion that E1 does not need to revise the term lengths of the operating agreement.

## **Affordable Single-family Homes**

To collect information on program staff, partner, and participant perspectives, the Evaluator conducted surveys with participants as well as interviews with heat pump contractors, program staff, and delivery agents.

The key findings specific to the Affordable Single-family Homes process evaluation are outlined below:

› **Participants see the value of the program.**

The energy efficient retrofits installed at no cost through Affordable Single-family Homes are perceived by participants to be making their homes more comfortable and warmer in winter and less expensive to heat.

› **Overall satisfaction with Affordable Single-family Homes is high.**

Surveyed participants as well as interviewed DAs and heat pump contractors are generally satisfied with Affordable Single-family Homes. Participants consider it easy and worthwhile to participate and would highly recommend the program to others. Although DAs and contractors make suggestions for improvements to the program, they widely agree that it is worthwhile being involved.



› **Despite overall satisfaction, there are three irritants with the program component.**

Long wait times (participants, DAs, and heat pump contractors), insufficient program and product information (participants), and reporting processes and lack of user-friendly software tools (DAs and heat pump contractors) are causing some dissatisfaction. These are expanded upon below.

› **Long wait times cause discontent at various program stages and for various stakeholders.**

- › Modelled participants are particularly dissatisfied with the wait time between their enrollment in ASFH and the initial home energy assessment. DAs and heat pump contractors are dissatisfied with the time it takes E1 to approve proposed upgrades.
- › Additionally, heat pump contractors mention untimely responses from E1 to email enquiries, hindered by a perceived lack of direct access to a contact person or mailbox..
- › E1 is cognisant of dissatisfaction with wait times and have put strategies in place. They report that they have expanded the number of staff members and are catching up with the backlog. It should be noted that a mailbox for heat pump contractors is already available and E1 recently provided training to improve contractor knowledge about and engagement with Affordable Single-family Homes.

› **Participants would like more information to be provided about the program steps.**

Limited participant knowledge about Affordable Single-family Homes can cause participant confusion and frustration during the initial DA/contractor visit, particularly if participants are considering taking part in multiple programs (such as Affordable Single-family Homes and Oil to Heat Pump Program [OHPA]).

› **More product information would be helpful for participants.**

Some participants say they did not receive information about the products installed and some still have doubts about how to operate and maintain their new equipment (especially heat pumps) even though contractors report reviewing this with participants after installation. Note that most questions fielded by DAs and contractors concern heat pump usage. This situation could potentially create barriers to proper equipment use and affect energy savings.

› **Record keeping/reporting is time consuming.**

Having to use two platforms for filling out the required record keeping/reporting forms (CIS) and uploading documentation (SharePoint) is said to lead to repetitive data entry and unclear requirements for DAs and heat pump contractors. While SharePoint is considered to be an adequate file sharing tool, the CIS is said not to provide effective project management. Furthermore, DAs report many changes since the original training on processes and system use, which have never been formally communicated and lead to a lot of back and forth with E1 to resolve issues.



## Business Energy Rebates – Instant Rebates

To collect information on participant and distributor perspectives, the Evaluator conducted surveys with participants as well as interviews with distributors.

The key finding specific to the Business Energy Rebates – Instant Rebates process evaluation is outlined below:

- › **Overall satisfaction with BER Instant Rebates is high among both participants and distributors.**  
For Instant Rebates, average satisfaction ratings of 9.1 and 8.3 out of 10 were reported by participants and distributors respectively. Participants reported being very satisfied with the interaction and communication with distributors and with the rebate amounts (average ratings of 9.0). Distributors were highly satisfied with the service support and communications provided by E1 (average rating of 9.3) and were generally satisfied with rebate processing, tracking, and reporting (average rating of 8.4).

## Custom New Construction

To explore opportunities to expand service presence outside of the electrically heated MURB market, the Evaluator analyzed the tracking sheet, performed secondary research, conducted interviews with participants, modellers, and program staff, and carried out a jurisdictional scan. The Evaluator also reviewed the logic model.

The key findings specific to the Custom New Construction process evaluation are outlined below:

- › **The service has been more successful in reaching Multi-Unit Residential Buildings (MURBs) than non-MURBs.**  
MURBs have comprised the majority of New Construction projects since 2022, and MURBs made up 24 of the 27 completed projects in 2024. Analysis of Halifax Regional Municipality (HRM) building permits suggests that there is potential for the service to capture more non-MURB buildings. Architectural and engineering firms, together with design-build firms and government stakeholders are key influencers in the design and construction of large non-MURB projects.
- › **The service has a higher portion of projects inside the HRM, which is to be expected. Targeting a higher number of buildings outside the HRM may require a change in building size eligibility criteria.**

The HRM contains about half of the province's population, so a higher proportion of projects inside the HRM is expected given the density of the population in the city. In addition, building rules inside the HRM streamline permitting processes and encourage larger and faster-built buildings, whereas conditions outside the HRM are less favourable for larger buildings. The jurisdictional scan found some programs with smaller building size requirements (i.e. aligned with National Energy Code of Canada for Buildings [NECB] 2020 Part 9 buildings); such an approach could be considered by E1 if the program wishes to capture a higher proportion of projects outside the HRM.

- › **Participants are satisfied with the program overall, particularly in terms of E1's responsiveness, and are moderately satisfied with the value of the program for their business.**

E1's responsiveness and speed of application approval received the highest satisfaction ratings. Participants reported lower satisfaction on elements related to the value of the program given the time and costs requirements for builders, and the ability to estimate a return on investment associated with the program.



- 
- › **Non-participant modellers are aware of and somewhat familiar with New Construction service, including those that work on non-MURB projects.**

All three non-participant modellers interviewed work on buildings that would be eligible for New Construction (i.e. electrically heated and 15,000 square feet or larger). Only one of the three non-participant modellers said they had discussed the service with their clients.

- › **Decarbonization is a motivator for participating in New Construction service.**

Almost all participants answering questions about decarbonization (five out of six) reported that GHG emissions were important to their company and three said that it motivated them to participate in the service.

- › **Financial factors are the primary barriers for energy efficient new construction projects (higher costs of energy efficient measures, cost of energy modelling), as well as builder awareness and understanding of the benefits of energy efficient construction, and insufficient modeller participation in the service.**

These barriers appear to be consistent across both MURB and non-MURB markets.

- › **The share of modelling costs covered by the program's modelling incentive may be insufficient to motivate some builders.**

Both staff and modellers noted that modelling costs are increasing and that these costs can be a barrier, notably for smaller eligible projects. Further, 30% of projects hit the modelling cap in 2024, implying that for 3 out of 10 participants, the modelling incentive is not covering half their modelling costs. The jurisdictional scan indicated that several jurisdictions have higher modelling incentive offers (either in portion of costs covered or cap) than E1.

- › **The program component would benefit from additional supporting energy modellers.**

Historically one energy modeller supported most of the New Construction service projects. E1 has worked to bring in more modellers to the program and in 2024, five energy modellers participated in the program. Further efforts should be taken to ensure a diverse group of modellers are aware of and engaged in the program.

- › **The program component should prepare for the shift to NECB 2020 in Nova Scotia. Builders will need to adjust designs, plan for higher efficiency technologies and higher upfront costs, and work closely with energy modellers under the new code.**

Nova Scotia will phase in Tiers 1, 2, and 3 of NECB 2020 over 2025–2029. The jurisdictional scan noted three programs that have aligned with NECB 2020 code adopted in their province. Participants and modellers are mixed in terms of how the code could impact program participation. Three jurisdictions scanned (BC Hydro, New Brunswick Power, and Efficiency Manitoba) all do this.

- › **The logic model is out of date and does not sufficiently document the program barriers or the activities currently being undertaken by the program to address these barriers.**

The Evaluator found that the program's activities are aligned with the barriers identified in the evaluation. However, the logic model and theory of change do not reflect this and needs to be updated to capture the reality of the market barriers and program activities today.



## 6 Market Evaluation Results

For the 2024 evaluation, the Evaluator conducted two market evaluations. The first was for Efficient Product Installation and was focused on electrician-installed measures, and the second was for Business Energy Rebates – Instant Rebates and was focused on the BNI lighting market.

### Efficient Product Installation: Electrician-installed Measures

To identify opportunities for other measures that could be installed by electricians under the program component, the Evaluator performed a jurisdictional scan across 15 jurisdictions throughout Canada and the US.

- › **The jurisdictional scan revealed several appropriate products to be considered for the Efficient Product Installation electrician-installed measure offer.**

The 2024 jurisdictional scan allowed the Evaluator to identify several measures that would be appropriate for the electrician-installed measures offered through Efficient Product Installation, namely advanced heat recovery ventilator controls, bathroom fans, block heater timers, and heat reflector panels or rolls.

### Business Energy Rebates – Instant Rebates: BNI Lighting

To analyze the evolution of the BNI lighting market, the Evaluator completed a market characterization study to assess the state of the lighting market and review whether updates to any baselines for BNI lighting products should be recommended.

The key findings specific to the Business Energy Rebates – Instant Rebates market evaluation are outlined below.

- › **According to participating BER-IR distributors, the fixture market has been transformed to LED. Distributors indicate that non-LED options for fixtures are now rare, reporting that their entire stock of fixtures is LED.**  
Distributors reported that 100% of their stock was LED for linear and high-bay fixtures and 99% for outdoor fixtures. They reported that manufacturers no longer supply non-LED alternatives and that this market share would be stable even in the absence of E1 incentives.
- › **Most purchases rebated through BER-IR are for new construction or products at the end of their useful life, which validates the use of a replace-on-burnout baseline for this program component.**
- › **The market evaluation results indicate that the market practice for BNI fixtures is LED technology, indicating that an update to the baseline for fixtures sold through BER-IR is imminent.**
- › **The LED market practice baseline for BNI fixtures also applies to new construction projects incented through BER-AR.**
- › **Distributors reported that the majority of their fixture stock is either DLC Premium or DLC standard.**
- › **Distributors still carry a small percentage of non-LED lamps for a subset of customers. They forecast this share to diminish even more over the next two years as more fixtures are replaced with LEDs.**
- › **Lighting retrofit opportunities remain for early replacements and particularly in some subsectors where capital funding is limited, like institutional and government buildings and to a lesser extent property management companies.**
- › **Distributors report that control products continue to evolve.**
- › **There is an increase in multi-wattage and multi-voltage fixture products available on the market.**  
For these products, the tracked wattage may not necessarily be the wattage used for all applications.

## CONCLUSIONS AND RECOMMENDATIONS

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Overall, 2024 evaluated net electrical energy savings and peak demand savings achieved in the E1 DSM portfolio were respectively 6.630 GWh and 3.536 MW above the values tracked by E1, while available DR capacity was 0.033 MW below E1 tracked values, as illustrated in Table 5 and Table 6 above.

The Evaluator did not make any cross-cutting recommendations for 2024. The Evaluator's recommendations on individual program components are outlined in individual reports as well as in Table 15 and Table 16 below.

**Table 15: 2024 Recommendations on Residential Program Components**

| No.                 | Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AMH – R1            | To further aid understanding, consider providing participants with case study examples of incentive calculations to show pre-tax costs and how incentive amounts may change based on supplier quotes and/or equipment installed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| AMH – R2            | Ensure that support and handholding are available for participants who may need help navigating the program component and finding various contractors. Make technical guides available, providing general advice to help participants through the program component.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| AMH – R3            | Investigate the possibility of improving the audit reporting templates to improve time efficiencies for EAs, for example by streamlining the reports as much as possible.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| AMH – R4            | In the early stages of participant engagement, ensure that participants are aware of the co-financing options listed in E1's agreement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| ASFH – R1           | To assess progress with participant wait times, E1 could track wait times as well as program delivery satisfaction levels (e.g. in quarterly customer satisfaction surveys) throughout 2025 to determine how strategies are performing and make adjustments if necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| ASFH – R2           | <p>Provide participants with more information about ASFH to help them understand program options, eligible measures, and participation steps by implementing the following:</p> <p>a) Investigate ways to inform participants about all ASFH options (eligible measures and program processes). Ensure that other options (i.e. OHPA) are clear and presented to participants verbally and through marketing materials.</p> <p>b) Review the application template for clarity and adapt it to confirm with participants to which program they are applying (i.e. ASFH, OHPA). Ensure that the information in the application is shared with DAs/contractors.</p> <p>c) Once the participant has submitted the application, clearly communicate (perhaps using a visual) the participant touchpoints that will occur along their journey (e.g. who will be contacting them, at what point, and what to expect).</p> |
| ASFH – R3           | Reinforce participant awareness of the Energy Solution Advisor's role as E1 program navigator to help participants better understand and navigate E1's programs (including ASFH).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| ASFH – R4           | To maximize energy savings, ensure that all participants receive the necessary information to operate and maintain the equipment installed in language that is easy to understand. Implement checklists for DAs and heat pump contractors if necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| ASFH – R5           | Ensure that DAs/contractors provide a leave-behind so that participants know who to contact in case of questions or difficulties or to better understand how to operate and maintain their heat pump.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| ASFH – R6           | Look for opportunities to streamline record keeping/reporting processes to reduce the administrative burden for DAs and contractors, taking into account program tracking and evaluation needs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| ASFH – R7           | Update the DA/contractor training guides on the record keeping/reporting processes and use of the software tools to reflect current practices and offer regular training sessions to provide updates on any changes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| EPI – R1            | <p>To improve the smart thermostat installation rate, explore and implement strategies to reduce the number of participants disconnecting this product due to dissatisfaction.</p> <p>For example, follow-up calls could be conducted, installers could educate participants more on this product, or additional educational material on this product could be shared with participants.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Green Heat – R1     | In light of their very low savings and considering their low uptake, consider removing wood fireplace inserts and pellet fireplace inserts from the Green Heat offer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| HEA – R1            | In light of their very low savings and considering their low uptake, consider removing wood fireplace inserts and pellet fireplace inserts from the HEA offer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Residential DR – R1 | Gather and analyze the Eco Shift Pilot data again in 2025 to improve the unitary available DR capacity value accuracy and ensure it is consistent over multiple years.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**Table 16: 2024 Recommendations on Business, Non-profit, and Institutional Program Components**

| No.                          | Recommendation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BER – R1                     | Undertake additional research to further validate the market evaluation results to establish, no later than Q3, when the LED baseline for BER-IR LED fixtures should take effect. Research should focus on the potential risk of the fixture market rebounding from reducing or removing the Instant incentives in the Nova Scotia market.                                                                                                                                                                       |
| BER – R2                     | Review the eligibility criteria for LED lighting in new construction projects in BER-AR given evidence that LEDs are the baseline for this market.                                                                                                                                                                                                                                                                                                                                                               |
| BER – R3                     | In line with Recommendation #1, research should also investigate the efficiency level of an LED baseline for LED fixtures.                                                                                                                                                                                                                                                                                                                                                                                       |
| BER – R4                     | The current non-LED baseline for lamps should be maintained for BER-IR and reassessed in 2026. Given trends, E1 should plan for a baseline change starting in 2027.                                                                                                                                                                                                                                                                                                                                              |
| BER – R5                     | Plan for a shift in the product offer for LED fixtures from BER-IR to BER-AR to capture remaining retrofit opportunities once LED baseline is adopted for BER-IR.                                                                                                                                                                                                                                                                                                                                                |
| BER – R6                     | Focus efforts on BER-AR to target market laggards for early replacement retrofits of their lighting.                                                                                                                                                                                                                                                                                                                                                                                                             |
| BER – R7                     | A LED baseline should also be applied to the EUL of LED fixtures rebated through BER-AR and SBES to reflect the fact that existing fixtures would have been replaced with LED fixtures at the end of their life. The baseline should consider the proportion of projects targeted for early replacement versus replace on burn-out as well as an estimated remaining EUL.                                                                                                                                        |
| BER – R8                     | Analyze opportunities for increasing interest around controlled lighting products.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| BER – R9                     | Ensure that multi-wattage products are identified in the tracking sheet and select the middle wattage (i.e. not the lowest or highest) as the tracked wattage.                                                                                                                                                                                                                                                                                                                                                   |
| Custom New Construction – R1 | Review the demand savings script used for projects modelled in eQuest to ensure accurate results and favour an approach that can be applied consistently across a variety of modelling software.                                                                                                                                                                                                                                                                                                                 |
| Custom New Construction – R2 | Amend section 7.10 of the New Construction program guide to require M&V for large industrial New Construction projects.                                                                                                                                                                                                                                                                                                                                                                                          |
| Custom New Construction – R3 | Investigate the impact of increasing modelling incentives (the share of modelling costs covered as well as the incentive cap) on the service.                                                                                                                                                                                                                                                                                                                                                                    |
| Custom New Construction – R4 | Endeavour to recruit new energy modellers through targeted outreach; modellers put a premium on networking opportunities with builders.                                                                                                                                                                                                                                                                                                                                                                          |
| Custom New Construction – R5 | Consider collaborating with educational institutions and professional associations for energy modelling to build a stronger pipeline of qualified and engaged energy modellers across Nova Scotia.                                                                                                                                                                                                                                                                                                               |
| Custom New Construction – R6 | The program should increase targeted outreach and educational activities for builders and energy modellers related to the code shift and its impacts, particularly those involving technologies (including electrification), costs, and energy efficiency improvements. By providing practical guidance on meeting new requirements and exceeding them with the program's support, the program can position itself as a valuable resource while increasing program awareness and encouraging more participation. |
| Custom New Construction – R7 | Review the program guidelines and update to align with NECB 2020, which will be adopted in April 2025.                                                                                                                                                                                                                                                                                                                                                                                                           |
| Custom New Construction – R8 | Investigate aligning implementation incentives with NECB 2020 Tiers. Such alignment would need to consider the phased-in adoption of NECB 2020 Tiers 1–3 over 2025-29.                                                                                                                                                                                                                                                                                                                                           |
| Custom New Construction – R9 | E1 should update the Custom New Construction logic model to document and address current barriers and update the theory of change to include all activities being carried out to address these barriers.                                                                                                                                                                                                                                                                                                         |
| BNI DR – R1                  | Update the BNI DR Baseline Considerations document to properly address all situations encountered through the project reviews. <ul style="list-style-type: none"> <li>› Clearly define how to identify building operating hours and when to set the available DR capacity to zero.</li> </ul>                                                                                                                                                                                                                    |

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- › Ensure that lookback windows are moved consistently across all similar events unless they are moved due to an abnormal load.
  - › Clearly state in the document that certain events may be excluded on a per-participant basis due to missing AMI metering data because of technical issues or events not being called for participants identified as morning-only or evening-only participants.
- 

|                    |                                                                                                                            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------|
| <b>BNI DR – R2</b> | <b>In the next evaluation, continue to use project reviews to establish tracked and evaluated available DR capacities.</b> |
|--------------------|----------------------------------------------------------------------------------------------------------------------------|

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## LIST OF APPENDICES

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The following are presented in the 2024 DSM Programs Evaluation Executive Summary – Appendices document.

Appendix I: Bibliography

Appendix II: Calculations of Margins of Error

Appendix III: NTGR Calculations



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# 2024 DSM PROGRAMS EVALUATION

Appendix Report

## EXECUTIVE SUMMARY

March 21, 2025

In Collaboration with





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## APPENDIX I

### Bibliography

| Program Components | Bibliographic References                                                                                                                                                                                                                                                                                                                                                                                                                                                |
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## APPENDIX II

### Calculation of Margins of Error

This appendix presents some examples of how the Evaluator established the margins of error for participant surveys, adjustment ratios, installation rates, and free-ridership levels. For participant survey margins of error, the example is drawn from the 2024 Green Heat evaluation. For the adjustment ratio margins of error, the example is drawn from the 2024 Custom Retrofit Evaluation. For the free-ridership level margins of error, the example is drawn from the Efficient Product Installation (EPI) evaluation.

#### Survey Margins of Error

The 2024 Green Heat past participant survey margins of error were established by using the following formula that correspond to the margin of error calculation for a proportion (i.e. a value between 0% and 100%).

$$\text{Margin of Error } (e) = Z\alpha \times \sqrt{\frac{p \times (1 - p)}{n}} \times \sqrt{\frac{N - n}{N - 1}}$$

Where:

$Z\alpha$  is the coefficient used at a specific confidence level.

$p$  is the proportion (typically established conservatively at 0.50, which yields the maximum error).

$N$  is the population or, in this case, the total number of unique participants.

$n$  is the sample size.

The sample size for this example is 204 participants who installed a mini-split heat pump (MSHP) and that were sampled for a past participant survey. Therefore, assuming a confidence level of 90%, a  $Z\alpha$  coefficient of 1.645 is used as presented in Table 1.

**Table 1: Distribution of Coefficients  $t$**

| Sample size | Confidence Level |       |       |
|-------------|------------------|-------|-------|
|             | 95%              | 90%   | 80%   |
| 2           | 12.710           | 6.314 | 3.078 |
| 5           | 2.776            | 2.132 | 1.533 |
| 10          | 2.262            | 1.833 | 1.383 |
| 15          | 2.145            | 1.761 | 1.345 |
| 20          | 2.093            | 1.729 | 1.328 |
| 30          | 2.045            | 1.699 | 1.311 |
| 100         | 1.984            | 1.660 | 1.290 |
| $\infty^*$  | 1.960            | 1.645 | 1.282 |

\* Coefficient z corresponds to the value of coefficient t for an infinite sample size and is used for samples larger than 30.



By using the formula presented above and assuming a confidence level of 90%, a proportion of 0.50 and a total number of 1,132 participants who installed a MSHP for the period studied, the margin of error was established at 5.2%.

$$\text{Margin of Error} = 1.645 \times \sqrt{\frac{0.50 \times (1 - 0.50)}{204}} \times \sqrt{\frac{1,132 - 204}{1,132 - 1}} = 5.2\%$$

In 2024, this calculation was performed for all participant surveys.

## Adjustment Ratio Margins of Error – Stratified Sample

Below is a description of the steps followed to calculate the margins of error for adjustment ratios applied to electrical energy and peak demand savings based on the energy savings example from the 2024 Custom Retrofit evaluation.

### Calculation of the Weighted Average of Adjustment Ratios

In 2024, different types of projects were reviewed for Custom Retrofit; the example herein is for regular retrofit projects. For these projects, the Evaluator used a stratified sample. Therefore, the weighted average adjustment ratio was calculated by using the following formula.

$$\text{Weighted Average AR} = \frac{\sum_{i=1}^n (\text{Stratum Weight}_i \times \text{Tracked Energy Savings}_i)}{\sum_{i=1}^n (\text{Stratum Weight}_i \times \text{Revised Energy Savings}_i)} = 1.021$$

In this calculation,  $n$  is the number of reviewed measures (18) and  $i$  represents each individual evaluated project; the Evaluator established a weighted average adjustment ratio of 1.021. The stratum weight corresponds to the total population number of projects in the stratum in which each project is found divided by the number of projects in that stratum in the sample.

### Calculation of the Standard Error

Since the overall adjustment ratio is based on a stratified weighted average, the Evaluator also calculated a stratified weighted standard error of the adjustment ratio instead of a simple standard error. The following formula is taken from the Uniform Methods Project (UMP) Chapter 11<sup>1</sup> and is applicable to a ratio that is obtained from a stratified sample. First, we calculate the standard error on evaluated savings.

$$\text{Standard Error Evaluated Savings} = \sqrt{\sum_{h=1}^H \left( \frac{(N_h)^2}{n_h} \times \left( 1 - \frac{n_h}{N_h} \right) \times (S_h)^2 \times \frac{\mu_{all}}{\bar{x}_{all}} \right)} = 369,784$$

Where:

- ›  $H$  is the number of strata (4) and  $h$  represents each stratum.
- ›  $N_h$  is the number of projects in the population for a stratum.
- ›  $n_h$  is the number of projects in the sample for a stratum.

<sup>1</sup> Khawaja, M.S., Rushton, J. and Keeling, J., Chapter 11: Sample Design Cross-Cutting Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68567, 2017.

- ›  $S_h$  is an estimator for stratum weights calculated with the equation below.

$$(S_h)^2 = \sum_{i=1}^{n_h} \frac{(\text{Revised Energy Savings}_i - \text{Weighted Average AR} \times \text{Tracked Energy Savings}_i)^2}{n_h - 1}$$

- ›  $\mu_{all}$  is the average savings per project for the population.
- ›  $\bar{x}_{all}$  is the average savings per project for the sample while accounting for weights, as presented in the equation below.

$$\bar{x}_{all} = \frac{\sum_{i=1}^{n_h} (\text{Stratum Weight}_i \times \text{Tracked Energy Savings}_i)}{\sum_{i=1}^{n_h} (\text{Stratum Weight}_i)}$$

The weighted standard error for the adjustment ratio of energy savings for Custom Retrofit projects was established at 369,784.

### Calculation of the Margins of Error

The margin of error on the adjustment ratio of Custom Retrofit energy savings was established by using the following formula, which compares the error in evaluated savings divided by the evaluated savings to obtain a margin of error in percentage; this percentage represents the error on the adjustment ratio.

$$\text{Margin of Error AR} = \frac{\text{Standard Error Evaluated Savings} \times t}{\text{Tracked Energy Savings}_{all} \times \text{Weighted Average AR}} = \frac{369,784 \times 1.740}{12,762,154 \times 1.021} = 4.9\%$$

In this calculation, the coefficient  $t$  was calculated for a sample size of 18 at a level of confidence of 90%, which yields 1.740. By using the above formula, the margin of error for the adjustment ratio applied to the electrical energy savings generated by Custom Retrofit projects was established at 4.9%.

In 2024, this calculation was only performed for the adjustment ratios of Custom and BNI DR. Sometimes, such as for smaller measure categories or small programs (like Strategic Energy Management [SEM]), a census approach was used, meaning that all projects were reviewed and that calculating a margin of error on the adjustment ratio was unnecessary.

### Free-ridership Level Margin of Error

The Evaluator used the margin of error calculation of the free-ridership level for EPI LED lighting in 2024 as an example. Below are the steps followed to calculate this margin of error. The same calculation is used for installation rates and adjustment ratios for non-stratified samples, with the only difference being the use of installation rates or adjustment ratios instead of free-ridership levels in the equations.

### Calculation of the Weighted Average of Free-ridership Levels

The weighted average was calculated by using the following formula.

$$\text{Weighted Average FR} = \frac{\sum_{i=1}^n \text{Free-ridership Level}_i \times \text{Revised Gross Energy Savings}_i}{\text{Total Revised Gross Energy Savings}} = 16\%$$

In this calculation,  $n$  is the number of surveyed participants who installed LED lighting in 2024, and  $i$  represents each individual participant surveyed. The Evaluator established the weighted average free-ridership level at 16%.

## Calculation of the Standard Error

Since the free-ridership level is based on a weighted average, the Evaluator also calculated a weighted standard error of the free-ridership level instead of a simple standard error. The same formula as for the adjustment ratio standard error was applied, as follows.

$$\text{Standard Error FR} = \frac{1}{\sqrt{n}} \sqrt{\sum_{i=1}^n \left( \frac{(FR \text{ Savings}_i - \text{Weighted Average FR} \times \text{Revised Gross Savings}_i)^2}{(\text{Average Revised Gross Savings per Participant})^2 \times (n-1)} \right)} = 0.0193$$

In this calculation,  $n$  is the sample size (the number of surveyed participants) and  $FR \text{ Savings}_i$  is the free-ridership percentage measured for a given participant  $i$  multiplied by the gross savings of that participant. The average revised gross savings per participant is calculated for all participants who installed LED lighting in 2024 at the time of the survey.

## Calculation of the Margin of Error

The margin of error on the adjustment ratio of the EPI LED lighting free-ridership level was established by using the following formula that is the general equation linking the standard error to the margin of error.

$$\begin{aligned} \text{Margin of Error FR} &= \text{Standard Error FR} \times t \times \text{Finite Population Correction Factor} \\ &= \text{Standard Error} \times t \times \sqrt{\frac{N-n}{N-1}} = 0.0193 \times 1.667 \times \sqrt{\frac{5,342-70}{5,342-1}} = 3.2\% \end{aligned}$$

In this calculation,  $N$  represents the total number of participants at the time of the survey and who installed LED lighting in 2024, which was 5,342. The coefficient  $t$  was calculated for a sample size of 90 at a level of confidence of 90%, which yields 1.667. By using the above formula, the margin of error for the free-ridership level for EPI LED lighting was established at 3.2%.

In 2024, this calculation was performed for the free-ridership ratios of EPI, Instant Savings, BER Instant Rebates, and Custom. This calculation was also performed for EPI installation rates and AMH adjustment ratios.



## APPENDIX III

### NTGR Calculations

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This appendix provides an example of net-to-gross ratio (NTGR) calculations. The example details the calculations of participant free-ridership levels and resulting NTGR for EPI LED Bulbs. The Evaluator used a similar approach in assessing the NTGR of other program components. More details can be found in the evaluation reports of individual program components.

## NTGR Calculations

| Free-ridership algorithm                                                                                                                                                                                                |                                                                                                 |        | Low Free-ridership Participant                              |       | High Free-ridership Participant                           |       | Medium Free-ridership Participant                         |       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------|-------------------------------------------------------------|-------|-----------------------------------------------------------|-------|-----------------------------------------------------------|-------|
| Questions                                                                                                                                                                                                               | Calculation Algorithm                                                                           |        | Answer                                                      | Calc. | Answer                                                    | Calc. | Answer                                                    | Calc. |
| E1. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install LED bulbs in your home?                                                                           | 1) Yes                                                                                          | Use E2 | Yes                                                         | 100%  | Yes                                                       | 100%  | Yes                                                       | 100%  |
|                                                                                                                                                                                                                         | 2) No                                                                                           | 0%     |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                       |        |                                                             |       |                                                           |       |                                                           |       |
| E2. [IF E1=YES] Just to confirm: Have I understood correctly that you had already made the decision to purchase and install LED bulbs in your home before you learned about the Efficient Product Installation Service? | 1) Yes, correct (already made decision)                                                         | 100%   | No                                                          | 0%    | Yes, correct (already made decision)                      | 100%  | Yes, correct (already made decision)                      | 100%  |
|                                                                                                                                                                                                                         | 2) No, incorrect (not already made decision)                                                    | 0%     |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                       |        |                                                             |       |                                                           |       |                                                           |       |
| Planning Score (PS):                                                                                                                                                                                                    | E1 Adjusted with E2                                                                             |        | 0%                                                          |       | 100%                                                      |       | 100%                                                      |       |
| E3. Without the Efficient Product Installation Service, what is the likelihood you would have paid for the LED bulbs, knowing that the cost is about \$2 to \$4 per bulb?                                               | 1) Definitely would have                                                                        | 100%   | 4) Definitely would not have                                | 0%    | 2) Probably would have                                    | 75%   | 2) Probably would have                                    | 75%   |
|                                                                                                                                                                                                                         | 2) Probably would have                                                                          | 75%    |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 3) Probably would not have                                                                      | 25%    |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 4) Definitely would not have                                                                    | 0%     |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                       | EMPTY  |                                                             |       |                                                           |       |                                                           |       |
| Cost Score (CS):                                                                                                                                                                                                        | E3                                                                                              |        | 0%                                                          |       | 75%                                                       |       | 75%                                                       |       |
| E4. Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them in your home?                                           | 1) Definitely would have                                                                        | 100%   | 3) Probably would not have                                  | 25%   | 2) Probably would have                                    | 75%   | 2) Probably would have                                    | 75%   |
|                                                                                                                                                                                                                         | 2) Probably would have                                                                          | 75%    |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 3) Probably would not have                                                                      | 25%    |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 4) Definitely would not have                                                                    | 0%     |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                       | EMPTY  |                                                             |       |                                                           |       |                                                           |       |
| Effort Score (ES)                                                                                                                                                                                                       | E4                                                                                              |        | 25%                                                         |       | 75%                                                       |       |                                                           |       |
| E5. [IF CODES 1,2,3,4 AT E4] Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your bulbs with LEDs by at least one year?                                   | 1) Definitely would have                                                                        | 0%     | 2) Probably would have                                      | 25%   | 2) Probably would have                                    | 25%   | 1) Definitely would have                                  | 0%    |
|                                                                                                                                                                                                                         | 2) Probably would have                                                                          | 25%    |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 3) Probably would not have                                                                      | 75%    |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 4) Definitely would not have                                                                    | 100%   |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                       | EMPTY  |                                                             |       |                                                           |       |                                                           |       |
| Timing Score (TS)                                                                                                                                                                                                       | E5                                                                                              |        | 25%                                                         |       | 25%                                                       |       | 0%                                                        |       |
| E6. [ASK IF LED BULBS QUANTITY>1 AND IF CODES 1, 2, 3 AT E4] Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred?                                      | 1) You would have purchased and installed exactly the same number of LED bulbs                  | 100%   | 3) You would not have purchased nor installed any LED bulbs | 0%    | 2) You would have purchased and installed fewer LED bulbs | 50%   | 2) You would have purchased and installed fewer LED bulbs | 50%   |
|                                                                                                                                                                                                                         | 2) You would have purchased and installed fewer LED bulbs                                       | 50%    |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 3) You would not have purchased nor installed any LED bulbs                                     | 0%     |                                                             |       |                                                           |       |                                                           |       |
|                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                       | EMPTY  |                                                             |       |                                                           |       |                                                           |       |
| Quantity Score (QS)                                                                                                                                                                                                     | E6                                                                                              |        | 0%                                                          |       | 50%                                                       |       | 50%                                                       |       |
| Inconsistency Test (adjusted E1)                                                                                                                                                                                        | IF E1=100% AND<br>IF E3<75% OR E4<75%<br>E1= EMPTY                                              |        |                                                             |       | 100%                                                      |       | 100%                                                      |       |
| Inconsistency Test (adjusted E4)                                                                                                                                                                                        | IF E4 <> EMPTY AND<br>ABS (E4-E19a) > 50%<br>E4 = EMPTY                                         |        | 25%                                                         |       | 75%                                                       |       |                                                           |       |
| Intention Score                                                                                                                                                                                                         | INTENTION Score: MIN [MEAN (PS; CS; ES); MEAN (PS; CS; ES; TS); MEAN (PS; CS; ES; TS; QS); MEAN |        | 6%                                                          |       | 65%                                                       |       | 56%                                                       |       |

|                                                                                                                                                                                                                                                                                                    |                                                      |                                                                                                       |                                                           |                                |                                                                   |                                 |                                                               |                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|--------------------------------|-------------------------------------------------------------------|---------------------------------|---------------------------------------------------------------|-----------------------------------|
| E19. How influential were the following two factors in your decision to have energy efficient products installed in your home? (RANDOMIZE)<br>a) The free installation of energy efficient products offered through the service<br>b) The information or advice provided by the service staff      | 1) Very influential                                  | 0%                                                                                                    | MIN(E19a: 1) Very influential; E19b: 1) Very influential] | 0%                             | MIN(E19a: 3) Not very influential; E19b: 3) Not very influential] | 75%                             | MIN(E19a: 1) Very influential; E19b: 2) Somewhat influential] | 0%                                |
|                                                                                                                                                                                                                                                                                                    | 2) Somewhat influential                              | 25%                                                                                                   |                                                           |                                |                                                                   |                                 |                                                               |                                   |
|                                                                                                                                                                                                                                                                                                    | 3) Not very influential                              | 75%                                                                                                   |                                                           |                                |                                                                   |                                 |                                                               |                                   |
|                                                                                                                                                                                                                                                                                                    | 4) Not at all influential                            | 100%                                                                                                  |                                                           |                                |                                                                   |                                 |                                                               |                                   |
|                                                                                                                                                                                                                                                                                                    | 98/99) Don't know/Refused                            | EMPTY                                                                                                 |                                                           |                                |                                                                   |                                 |                                                               |                                   |
| MIN (E19a Answer; E19b Answer)                                                                                                                                                                                                                                                                     |                                                      | E19                                                                                                   |                                                           | 0%                             |                                                                   | 75%                             |                                                               | 0%                                |
| Influence Score (IS)                                                                                                                                                                                                                                                                               |                                                      |                                                                                                       |                                                           |                                |                                                                   |                                 |                                                               |                                   |
| Free-Ridership (FR): MEAN (PA1; PA2; PA3; PA4; PA5)                                                                                                                                                                                                                                                |                                                      | Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                        |                                                           | 3%                             |                                                                   | 70%                             |                                                               | 28%                               |
| Cross-influence algorithm                                                                                                                                                                                                                                                                          |                                                      |                                                                                                       |                                                           | Low Free-ridership Participant |                                                                   | High Free-ridership Participant |                                                               | Medium Free-ridership Participant |
| Questions                                                                                                                                                                                                                                                                                          | Calculation Algorithm                                |                                                                                                       | Answer                                                    | Calc. Result                   | Answer                                                            | Calc. Result                    | Answer                                                        | Calc. Result                      |
| F1. Before participating in the efficient product installation service in <MONTH/YEAR>, had you at any time in the past participated in any Efficiency Nova Scotia program or service?                                                                                                             | 1) Yes<br>2) No<br>98/99) Don't know/Refused         | 1<br>0<br>EMPTY                                                                                       | No                                                        | 0                              | No                                                                | 0                               | No                                                            | 0                                 |
| F2. [IF F1=1] Do you agree or disagree that your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home?                                                                              | 1) Agree<br>2) Disagree<br>98/99) Don't know/Refused | 1<br>EMPTY<br>EMPTY                                                                                   |                                                           |                                |                                                                   |                                 |                                                               |                                   |
| F4. [IF F1=1] Do you agree or disagree that because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home? | 1) Agree<br>2) Disagree<br>98/99) Don't know/Refused | 1<br>EMPTY<br>EMPTY                                                                                   |                                                           |                                |                                                                   |                                 |                                                               |                                   |
| F5. Before participating in the Efficient Product Installation Service in <MONTH/YEAR>, had you at any time in the past seen Efficiency Nova Scotia advertisements or information discussing the benefits of energy efficiency?                                                                    | 1) Yes<br>2) No<br>98/99) Don't know/Refused         | 1<br>0<br>EMPTY                                                                                       | Yes                                                       | 1                              | No                                                                | 0                               | No                                                            | 0                                 |
| F7. [IF F5=1] Do you agree or disagree that the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home?                                                                                            | 1) Agree<br>2) Disagree<br>98/99) Don't know/Refused | 1<br>EMPTY<br>EMPTY                                                                                   | Agree                                                     | 1                              |                                                                   |                                 |                                                               |                                   |
| F8. [IF F5=1] Do you agree or disagree that you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia?                                                           | 1) Agree<br>2) Disagree<br>98/99) Don't know/Refused | 1<br>EMPTY<br>EMPTY                                                                                   | Agree                                                     | 1                              |                                                                   |                                 |                                                               |                                   |
| Cross-influence (CI)                                                                                                                                                                                                                                                                               |                                                      | Cross-influence (CI): IF(F2= Agree; 1) + IF(F7= Agree; 1) + IF(F4 OR F8= Agree; 1)                    |                                                           | 2                              |                                                                   | 0                               |                                                               | 0                                 |
| Revised Free-ridership                                                                                                                                                                                                                                                                             |                                                      | IF CI = 0; Revised FR = FR<br>IF CI = 1; Revised FR = FR*0.75<br>IF CI = 2 OR 3; Revised FR = FR*0.50 |                                                           | 2%                             |                                                                   | 70%                             |                                                               | 28%                               |

Overall free-ridership level (%)  
for LEDs

$$FR_{total} = \frac{\sum_{i=1}^n (FR_i \times Gross\_Savings_i)}{\sum_{i=1}^n Gross\_Savings_i}$$

FR = 16%

SO = 8%

NTGR for LEDs

$$NTGR = 1 - FR_{total} + SO$$

NTGR = 0.92



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EfficiencyOne

# RESIDENTIAL EFFICIENT PRODUCT REBATES PROGRAM

Final Report

2024 DSM EVALUATION

March 25, 2025

In collaboration with:







## ABBREVIATIONS

|                 |                                         |
|-----------------|-----------------------------------------|
| <b>ARCA</b>     | ARCA Canada Inc.                        |
| <b>ARet</b>     | Appliance Retirement                    |
| <b>ASFH</b>     | Affordable Single-family Homes          |
| <b>BNI</b>      | Business, non-profit, and institutional |
| <b>DA</b>       | Delivery agent                          |
| <b>DR</b>       | Demand response                         |
| <b>DSM</b>      | Demand-side management                  |
| <b>E1</b>       | EfficiencyOne                           |
| <b>EER</b>      | Energy efficiency ratio                 |
| <b>ENS</b>      | Efficiency Nova Scotia                  |
| <b>EUL</b>      | Effective useful life                   |
| <b>GHG</b>      | Greenhouse gas                          |
| <b>LED</b>      | Light-emitting diode                    |
| <b>MA</b>       | Measure Assessment                      |
| <b>MHEEP</b>    | Mi'kmaw Home Energy Efficiency Project  |
| <b>NS Power</b> | Nova Scotia Power                       |
| <b>NSUARB</b>   | Nova Scotia Utility and Review Board    |
| <b>NTGR</b>     | Net-to-gross ratio                      |
| <b>RUL</b>      | Remaining useful life                   |
| <b>SKU</b>      | Stock keeping unit                      |
| <b>UMP</b>      | Uniform Methods Project                 |

## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life values.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Available Demand Response Capacity</b> | The capacity that is available to Nova Scotia Power (NS Power) to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure available demand response (DR) capacity. Available DR capacity is evaluated on a per-participant basis based on the average demand reduction observed for each event in which the participant was scheduled to participate. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established, providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                                                      |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or a load reduction in response to events called by the electric utility (NS Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.                                                                                                                                                                                                                                                                                             |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and that of the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                                                                 |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both electrical energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Equipment life</b>                     | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



|                                         |                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global warming potential is estimated over a timescale of 100 years.                                                                           |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual electrical energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net electrical energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                                    |
| <b>First-year savings</b>               | The first full year of electrical energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                                    |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an energy efficiency program regardless of why they participated.                                                                                                                                        |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                                 |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems (such as heating and cooling) in a building due to the installation of an energy efficiency measure.                                                                                                                                                                         |
| <b>In-service rate</b>                  | The proportion of incentivized products installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as light-emitting diode (LED) lamps.                                                |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.                        |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                                         |
| <b>Line loss factor</b>                 | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                                 |
| <b>Margin of error</b>                  | The amount of random sampling error.                                                                                                                                                                                                                                                                                            |
| <b>Market effects</b>                   | The impact of a program on the market (in terms of product availability, practices, and prices) and that extends beyond changing program participant behaviours. Market effects include spillover among non-participants.                                                                                                       |



|                                 |                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Net savings</b>              | Electrical energy or peak demand savings that can be reliably attributed to a program. These include effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                               |
| <b>Net-to-gross ratio</b>       | The ratio of net electrical energy savings to gross electrical energy savings.                                                                                                                                                                                                                                                                              |
| <b>Non-sampling error</b>       | Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                 |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                                |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when NS Power's 10-minute reserve is low.                                        |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                                           |
| <b>Random sampling error</b>    | An error in measurement due to the fact that measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                          |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                                          |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                                  |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                                          |
| <b>Spillover</b>                | Savings attributable to participants who implement additional energy efficiency measure(s) introduced by a program after participating in it once and without participating in the program a second time.                                                                                                                                                   |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, with the exception of the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Electrical energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                          |



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## EXECUTIVE SUMMARY

This report presents the 2024 demand-side management (DSM) evaluation results of the Residential Efficient Product Rebates program administered by EfficiencyOne (E1). This program is comprised of two components: (1) Appliance Retirement (ARet) and (2) Instant Savings.

### Evaluation Approach

The 2024 evaluation was aimed at calculating program component gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided greenhouse gas (GHG) emissions. Table 1 summarizes the types of evaluation conducted for each program component and the corresponding methodology.

**Table 1: Summary of 2024 Residential Efficient Product Rebates Program Evaluation**

| Program Component    | Evaluation Type |         |        | Methodology                                                                                                                                                                                                                                                                                                                                |
|----------------------|-----------------|---------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | Impact          | Process | Market |                                                                                                                                                                                                                                                                                                                                            |
| Appliance Retirement | Condensed       |         |        | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Unitary savings review</li><li>› Calculations using evaluation results</li><li>› Use of 2022 net-to-gross ratio (NTGR) results</li><li>› GHG emission reduction calculations</li></ul>                                                                              |
| Instant Savings      | Comprehensive   |         |        | <ul style="list-style-type: none"><li>› Participant survey</li><li>› Tracking sheet audit</li><li>› Unitary savings review</li><li>› Effective useful life (EUL) update</li><li>› Calculations using evaluation results</li><li>› Use of 2023 market effects results for spillover</li><li>› GHG emission reduction calculations</li></ul> |

### Program Performance

Table 2 below presents the participation levels, NTGRs, evaluated gross and net savings at the generator, annual GHG emission reductions, as well as EUL values for each program component and for Residential Efficient Product Rebates as a whole.



**Table 2: Overall 2024 Residential Efficient Product Rebates Participation and Evaluated Savings**

|                                | Participation Level |               | Gross Savings |                  | NTGR  | Net Savings |                  |
|--------------------------------|---------------------|---------------|---------------|------------------|-------|-------------|------------------|
|                                | Value               | Unit          | Value         | Unit             | Value | Value       | Unit             |
| ARet                           |                     |               |               |                  |       |             |                  |
| Energy Savings                 | 5,941               | Appliances    | 4.195         | GWh              | 0.56  | 2.365       | GWh              |
| Lifetime Energy Savings        |                     |               | 16.729        | GWh              | 0.56  | 9.433       | GWh              |
| Peak Demand Savings            |                     |               | 0.598         | MW               | 0.56  | 0.337       | MW               |
| Annual GHG Emission Reductions |                     |               | 1,981         | Tonnes of CO2 eq | 0.56  | 1,117       | Tonnes of CO2 eq |
| EUL                            |                     |               | 4.0           | Years            |       | 4.0         | Years            |
| Instant Savings                |                     |               |               |                  |       |             |                  |
| Energy Savings                 | 395,472             | Products sold | 26.884        | GWh              | 0.83  | 22.252      | GWh              |
| Lifetime Energy Savings        |                     |               | 102.688       | GWh              | 0.95  | 97.841      | GWh              |
| Peak Demand Savings            |                     |               | 2.956         | MW               | 0.82  | 2.428       | MW               |
| Annual GHG Emission Reductions |                     |               | 12,695        | Tonnes of CO2 eq | 0.83  | 10,508      | Tonnes of CO2 eq |
| EUL                            |                     |               | 3.8           | Years            |       | 4.4         | Years            |
| Total                          |                     |               |               |                  |       |             |                  |
| Energy Savings                 |                     |               | 31.079        | GWh              | 0.79  | 24.617      | GWh              |
| Lifetime Energy Savings        |                     |               | 119.417       | GWh              | 0.90  | 107.274     | GWh              |
| Peak Demand Savings            |                     |               | 3.554         | MW               | 0.78  | 2.765       | MW               |
| Annual GHG Emission Reductions |                     |               | 14,676        | Tonnes of CO2 eq | 0.79  | 11,625      | Tonnes of CO2 eq |
| EUL                            |                     |               | 3.8           | Years            |       | 4.4         | Years            |

Residential Efficient Product Rebates was aimed at achieving 14.481 GWh in net electrical energy savings and 1.967 MW in net peak demand savings at the generator for 2024. The program exceeded the net electrical energy savings target by 70% and peak demand savings target by 41%, mostly driven by Instant Savings which remains the largest contributor to both total program net electrical energy and peak demand savings.

The following subsections present findings and recommendations at the program component level.

## ARet Findings and Recommendations

This subsection presents the key findings from the 2024 ARet evaluation. The Evaluator has no specific recommendation for ARet.

**2024 ARet-Finding:** ARet achieved both its net electrical energy savings and peak demand savings targets by 22% and 18% respectively.

**2024 ARet-Finding:** The evaluated net electrical energy savings and peak demand savings determined by the Evaluator were equal to and slightly lower than the net savings and peak demand savings tracked by E1 respectively.

**2024 ARet-Finding:** Program participation levels in 2024 increased by 39% compared to 2023, with refrigerator and freezer retirements remaining the largest drivers of participation and savings.

## Instant Savings Findings and Recommendations

This subsection presents the key findings from 2024 Instant Savings evaluation. The Evaluator has no specific recommendation for Instant Savings.

**2024 Instant Savings-Finding:** Instant Savings surpassed both its net electrical energy savings and peak demand savings targets by 77% and 45% respectively.

**2024 Instant Savings-Finding:** Program participation levels in 2024 increased by 82% compared to 2023 levels, likely driven by E1's Lights Out campaign, with ENERGY STAR® certified LED fixtures and ENERGY STAR certified non-A-type LED lamps being the largest drivers of participation.

**2024 Instant Savings-Finding:** Savings from products other than lighting increased in 2024 compared to 2023 levels, while most savings continued to come from LED lighting products.

**2024 Instant Savings-Finding:** The free-ridership level for both LED lamps and LED fixtures decreased in 2024 compared to 2023 levels.

**2024 Instant Savings-Finding:** The evaluated net electrical energy savings and net peak demand savings determined by the Evaluator were higher than the net savings tracked by E1.

## Program Tracked and Evaluated Savings

Table 3 below compares E1 tracked energy and peak demand savings to Evaluated savings at the generator. The realization rate and NTGR are also presented and correspond to the rounded averages obtained by dividing net savings by gross savings, which explains why the NTGR values are different from those presented in the other sections.

**Table 3: Comparison of 2024 Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                 |                       | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                 |                       | Value         | Unit |       | Value       | Unit |                  |
| ARet                                                                                                                                                            | Energy Savings        |               |      |       |             |      |                  |
|                                                                                                                                                                 | Tracked Savings by E1 | 4.212         | GWh  | 0.56  | 2.374       | GWh  | 100%             |
|                                                                                                                                                                 | Evaluation Results    | 4.195         | GWh  | 0.56  | 2.365       | GWh  |                  |
|                                                                                                                                                                 | Peak Demand Savings   |               |      |       |             |      |                  |
|                                                                                                                                                                 | Tracked Savings by E1 | 0.602         | MW   | 0.56  | 0.339       | MW   | 99%              |
|                                                                                                                                                                 | Evaluation Results    | 0.598         | MW   | 0.56  | 0.337       | MW   |                  |
| Instant Savings                                                                                                                                                 | Energy Savings        |               |      |       |             |      |                  |
|                                                                                                                                                                 | Tracked Savings by E1 | 29.151        | GWh  | 0.66  | 19.129      | GWh  | 116%             |
|                                                                                                                                                                 | Evaluation Results    | 26.884        | GWh  | 0.83  | 22.252      | GWh  |                  |
|                                                                                                                                                                 | Peak Demand Savings   |               |      |       |             |      |                  |
|                                                                                                                                                                 | Tracked Savings by E1 | 3.585         | MW   | 0.62  | 2.206       | MW   | 110%             |
|                                                                                                                                                                 | Evaluation Results    | 2.956         | MW   | 0.82  | 2.428       | MW   |                  |
| *NTGRs vary for each type of appliance. The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings. |                       |               |      |       |             |      |                  |



## INTRODUCTION

EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response, and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight of its DSM activities is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electricity demand-side management (DSM) activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs, three business, non-profit, and institutional (BNI) programs, and one demand response (DR) program that are marketed to Nova Scotians through the Efficiency Nova Scotia (ENS) franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2024 DSM program portfolio.

This evaluation report relates to the Residential Efficient Product Rebates program comprised of two components: Appliance Retirement (ARet) and Instant Savings. Table 4 below lists the Residential Efficient Product Rebates program components and the types of evaluations conducted for 2024. A comprehensive impact evaluation involves reviewing the following four key elements: (1) The baseline definition; (2) the savings calculation methodology; (3) the values of the parameters used to calculate savings; and (4) net-to-gross ratios (NTGRs). A condensed impact evaluation involves using some or all of the previous year's impact evaluation parameters such as unitary savings values, adjustment ratios, installation rates, and NTGRs to provide evaluated results.

**Table 4: Types of Evaluation Conducted for Each Program Component, 2024**

| Program                               | Program Component | 2024    |        |               |
|---------------------------------------|-------------------|---------|--------|---------------|
|                                       |                   | Process | Market | Impact        |
| Residential Efficient Product Rebates | ARet              |         |        | Condensed     |
|                                       | Instant Savings   |         |        | Comprehensive |

For each program, the Evaluator prepared a DSM evaluation report presenting key findings, electrical first-year and lifetime electrical energy savings, peak demand savings, and avoided greenhouse gas (GHG) emissions.<sup>1</sup>

<sup>1</sup> Unless specified otherwise, electrical energy savings refer to first-year savings rather than lifetime savings throughout this report.

# 1 ARet Overview

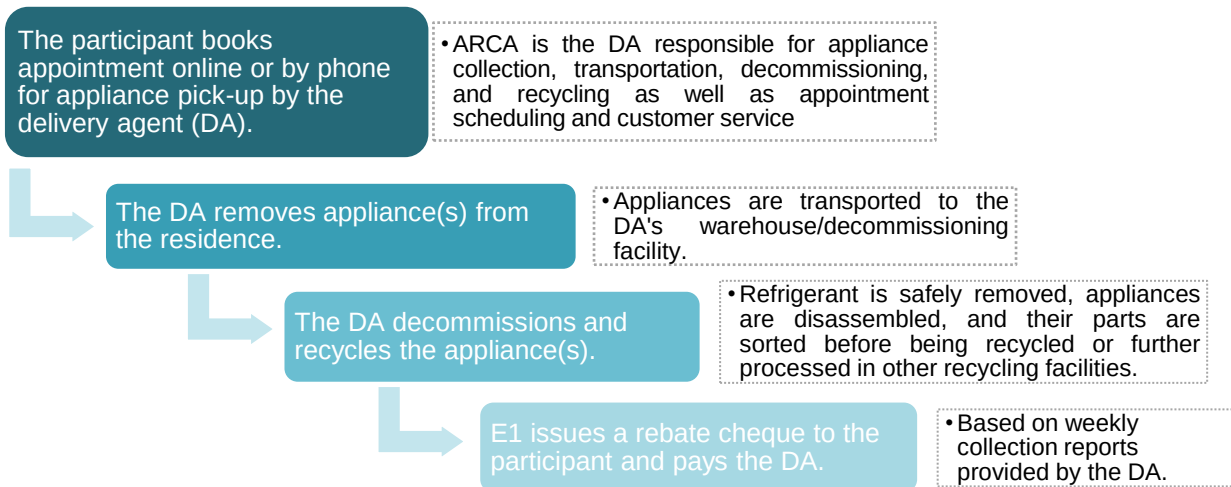
This section describes the Appliance Retirement (ARet) program component, follows up on past evaluation recommendations, and provides an overview of participation history.

## 1.1 ARet Description

Through ARet, E1 promotes the retirement of old, inefficient household appliances such as refrigerators, freezers, room air conditioners, and dehumidifiers. ARet educates Nova Scotians about the cost of maintaining old and inefficient appliances, provides free appliance pick-ups from homes, and offers financial incentives for appliance retirements.

In addition to removing old appliances from participants' homes, ARet transports them to a local recycling depot where over 95% of components are decommissioned and responsibly recycled. ARCA Canada Inc. (ARCA) is the delivery agent (DA) responsible for appliance collection, transportation, decommissioning, and recycling. To have appliances picked up, participants must call a toll-free number or register online using the booking portal available on the E1 website, both of which are managed by the DA. All website bookings, scheduling, and maintenance activities are the responsibility of the DA. Figure 1 outlines the main steps of the ARet participation process.

**Figure 1: ARet Participation Process Summary**



Eligible appliances must be in working condition and be 10 years of age or older. In 2024, this meant that eligible appliances had to be manufactured before 2014. In addition, full-sized refrigerators must have a standard size between 10 and 25 cubic feet, while full-sized freezers must be between seven and 25 cubic feet. For cost effectiveness, room air conditioners as well as small refrigerators and freezers are only picked up when a participant retires a full-sized refrigerator or full-sized freezer at the same time. To participate in ARet, participants must own the appliance(s) to be retired.



The following rebates are offered through ARet:

- › \$50 for each retired full-sized refrigerator<sup>2</sup>
- › \$50 for each retired full-sized freezer<sup>3</sup>
- › \$10 for each retired room air conditioner
- › \$10 for each retired small refrigerator or freezer

ARet was aimed at achieving 1.937 GWh in net electrical energy savings and 0.287 MW in net peak demand savings at the generator in 2024.

## 1.2 Follow-up on Past Evaluation Report Recommendations

No recommendations were made for ARet in the 2023 evaluation.

## 1.3 Participation History

Since 2012, ARet has retired or replaced a total of 77,696 old and inefficient appliances from homes and schools. These were recycled so that they could not be refurbished, sold second hand, or left plugged in.

In 2024, 5,941 appliances were retired through ARet as outlined in Figure 2 below. Specifically, a total of 3,763 refrigerators, 1,756 freezers, 257 air-conditioning units, and 165 small refrigerators or freezers were retired. No dehumidifiers were retired in 2024.

In 2024, 39% more appliance retirements were recorded compared to 2023 results. This increase was due to higher participation following two consecutive years of decreases. The increase was observed across all categories.

Figure 3 further below provides an overview of the evolution of ARet gross energy and peak demand savings from 2012 to 2024. The 2024 results represent increases of 39% in both gross energy and peak demand savings compared to 2023 levels.

---

<sup>2</sup> Incentives for full-sized refrigerators and freezers were increased from \$30 to \$50 in July 2021 to increase participation.

<sup>3</sup> Ibid.

**Figure 2: Overview of ARet Participation, 2012-2024**

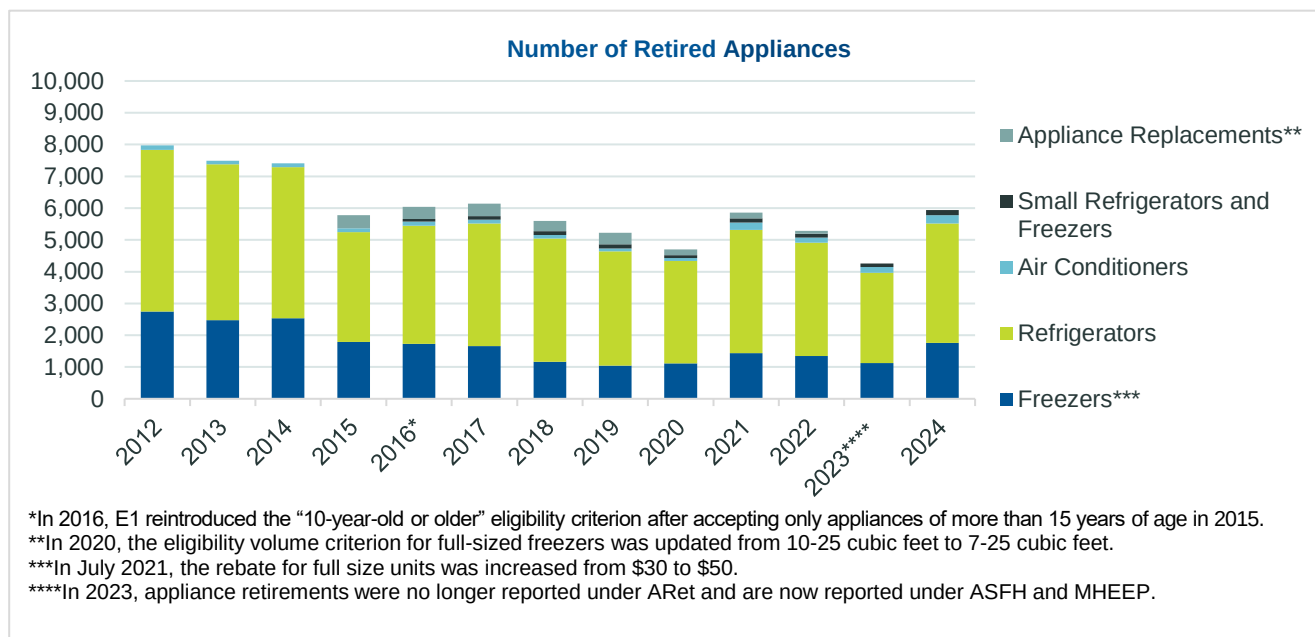
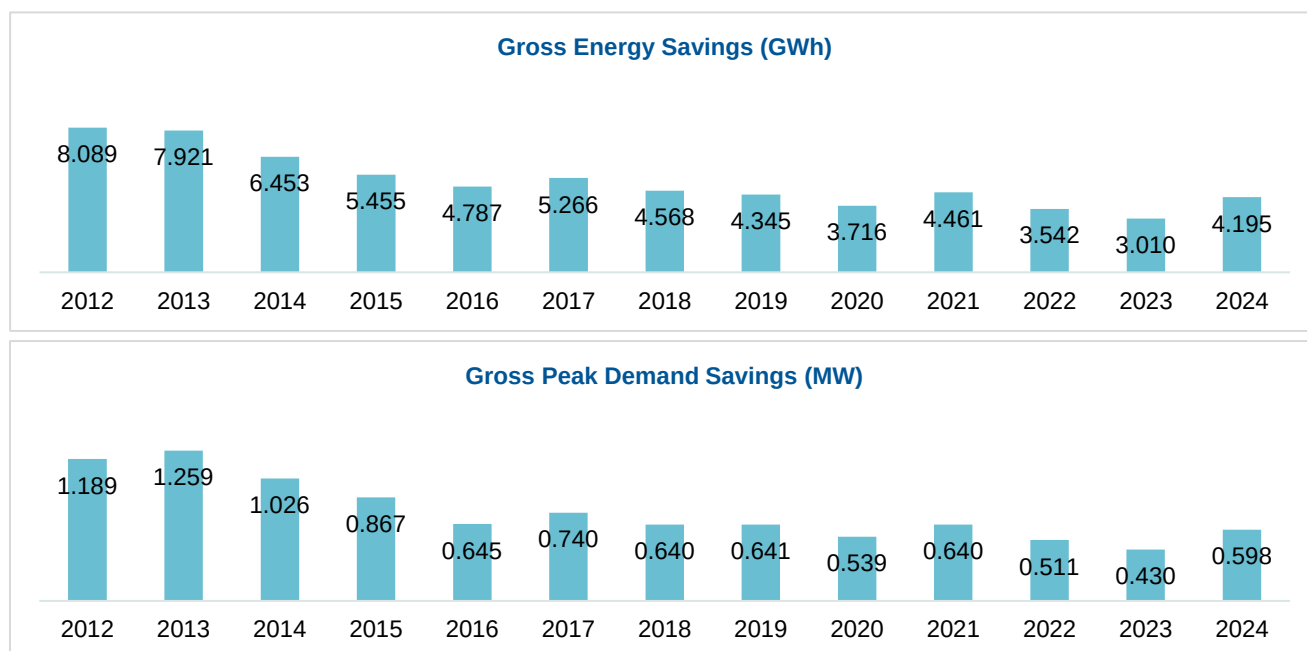


**Figure 3: Evolution of ARet Gross Savings, 2012-2024**



## 2 ARet Evaluation Approach

The 2024 ARet evaluation involved a condensed impact evaluation. The main objectives were as follows:

- › Calculate gross and net results, namely electrical first-year and lifetime electrical energy savings, peak demand savings, as well as avoided GHG emissions

The Evaluator identified key research questions aimed at achieving the above objectives. Table 5 outlines the evaluation objectives and maps them to the research questions and methods established by the Evaluator. Each method is described further below.

**Table 5: 2024 ARet Evaluation Approach**

| Evaluation Objectives   | Research Questions                                                                                                                                                                                                                 | Methodology                                                                                                                                                              |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Unitary savings review</li><li>› Calculations using evaluation results</li></ul>                  |
| Calculate net results   | <ul style="list-style-type: none"><li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li><li>› What are the net greenhouse gas (GHG) emission reductions in CO2 eq?</li></ul>     | <ul style="list-style-type: none"><li>› Use of 2022 NTGR results</li><li>› Calculations using evaluation results</li><li>› GHG emission reduction calculations</li></ul> |

### Tracking Sheet Audit

Prior to performing a unitary savings review, the Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The detailed protocol used for the tracking sheet audit and the results obtained are presented in Appendix I.

### Unitary Savings Review

As part of a major update to the 2024-2025 Demand-side Management Measure Assessment (DSM MA),<sup>4</sup> a unitary savings review was conducted for all measures. The unitary savings review entailed a literature review of technical reference manuals, metering studies, and program evaluations to determine if there were more appropriate methodologies or parameters to be applied to calculate energy and peak demand unitary savings. The Evaluator also reviewed the unitary savings values of refrigerators and freezers to account for the evolving mix of manufacture year-class and average unit size.

### Calculations Using Evaluation Results

The Evaluator calculated the first-year and lifetime energy and peak demand savings as per the calculation methodology presented in Section 3 below.

<sup>4</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the evaluations conducted during the last two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.



## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for ARet, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.



## 3 ARet Impact Evaluation

This section presents the findings of the 2024 condensed impact evaluation aimed at determining gross and net electrical energy and peak demand savings.

### 3.1 Tracking Sheet Audit

To ensure program results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1 as well as correcting the tracked savings as needed. The results are provided in Appendix I. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 3.2 Gross Savings

For ARet, gross savings correspond to the change in energy consumption resulting from the retirement of energy inefficient appliances in participants' homes regardless of both why they participated and what they would have done if the program had not been available.<sup>5</sup>

As part of the 2024-2025 DSM MA update, the Evaluator revised the unitary savings values for freezer and refrigerator retirements based on both updated annual consumption and the proportion of units per manufacture-year class and average unit size found in the 2024 ARet tracking sheet. The unitary savings value for air conditioners was also updated with an updated energy efficiency ratio (EER), while values from the 2022 evaluation were used for dehumidifiers.

Detailed descriptions of the unitary savings calculations are presented in the 2024-2025 DSM MA.

#### 3.2.1 Unitary Energy Savings

Table 6 below presents the tracked and evaluated energy savings for each type of appliance retired through ARet for which a change in unitary savings was made in 2024 compared to 2023.

For full-sized and small refrigerator as well as full-sized and small freezer retirements, the variations in unitary savings values are due to changes in characteristics, namely age and size, of the appliances retired in 2024.

**Table 6: 2024 ARet Tracked and Evaluated Unitary Energy Savings**

| Appliance           | Tracked Unitary Energy Savings<br>[kWh/year] | Evaluated Unitary Energy Savings<br>[kWh/year] | Difference<br>(%) |
|---------------------|----------------------------------------------|------------------------------------------------|-------------------|
| <b>ARet</b>         |                                              |                                                |                   |
| Refrigerators       | 654                                          | 660                                            | 1%                |
| Freezers            | 752                                          | 726                                            | -3%               |
| Air Conditioners    | 164                                          | 184                                            | 12%               |
| Small Refrigerators | 164                                          | 164                                            | 0%                |
| Small Freezers      | 176                                          | 230                                            | 31%               |

<sup>5</sup> Definition adapted from: National Renewable Energy Laboratory, The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices, September 2014, p. 3.

### 3.2.2 Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity peak demand period in Nova Scotia is between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays. The detailed unitary peak demand savings calculations are presented in the 2024-2025 DSM MA.

Table 7 below lists the tracked and evaluated unitary peak demand savings for each category of appliance retired through ARet for which a change in unitary savings was made in 2024 compared to 2023. Although the Evaluator used the same peak demand-to-energy ratio as in previous years, there are variations in unitary peak demand savings because the Evaluator made changes to the unitary energy savings values as presented in Subsection 3.2.1 above.

**Table 7: 2024 ARet Tracked and Evaluated Unitary Peak Demand Savings**

| Appliance           | Tracked Unitary Peak Demand Savings [W] | Evaluated Unitary Peak Demand Savings [W] | Difference (%) |
|---------------------|-----------------------------------------|-------------------------------------------|----------------|
| <b>ARet</b>         |                                         |                                           |                |
| Refrigerators       | 90.3                                    | 91.1                                      | 1%             |
| Freezers            | 103.8                                   | 100.0                                     | -4%            |
| Small Refrigerators | 22.6                                    | 22.6                                      | 0%             |
| Small Freezers      | 24.3                                    | 31.7                                      | 30%            |

### 3.2.3 Interactive Effects

Interactive effects occur when an implemented energy efficiency measure has an impact on the energy consumption of other elements such as heating and cooling equipment. For ARet, retiring old appliances causes an increase in the heating load in winter and a decrease in the cooling load in summer since the compressor of the old appliance releases significantly more waste heat than a newer and more efficient model. If an inefficient appliance is retired without being replaced, interactive effects are greater.

The heating period in Nova Scotia lasts about eight months, while the cooling period is short and lasts approximately two months. Total annual interactive effects due to the retirement of old appliances are therefore expected to be negative, pushing the savings generated by such retirements downward.

Other factors can also affect the interactive effects caused through the program component, including:

- › The focus of the 2024 ARet evaluation was on electricity savings. In Nova Scotia, 53% of households use electricity as their primary heating source.<sup>6</sup> Therefore, the negative interactive effects on the heating load only affect approximately one-half of participating households.
- › Many appliances retired through ARet, such as refrigerators and freezers, are built into or leaned against an exterior wall. Rather than contributing to building heating loads, this results in more heat loss through the building envelope and through the appliance back side, thereby reducing interactive effects.
- › In Nova Scotia, slightly more than one-third of households (43%)<sup>7</sup> use air conditioning. For those households, positive interactive effects occur during the cooling period, which cancel a portion of the negative interactive effects.

<sup>6</sup> Statistics Canada, Residential Sector, Nova Scotia, Table 14: Total Households by Building Type and Energy Source, <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&year=2020&rn=14&page=0> (last accessed December 11, 2024).

<sup>7</sup> Statistics Canada, Table 38-10-0019-01 – Air conditioners, <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3810001901> (last accessed December 12, 2024).

After carefully considering all these factors and noting that most jurisdictions that offer refrigerator and freezer retirement or replacement programs do not consider interactive effects for those appliance types,<sup>8</sup> the Evaluator concluded that ARet interactive effects were negligible and therefore established the interactive effects factor at 0%.

### 3.2.4 Effective Useful Life

Effective useful life (EUL) values are used in the calculations of electrical energy savings that are expected to persist over time. For ARet, the lifetime energy savings and equivalent EUL values are highly influenced by the remaining useful life (RUL) of old units; the latter corresponds to the remaining time that the old appliance would still have been used if it had not been retired.

For the 2024 evaluation, the Evaluator relied on the EUL values presented in the 2024-2025 DSM MA. Table 8 below summarizes the equivalent EUL values for each type of appliance. The equivalent EUL values were applied to the gross and net first-year energy savings of each appliance to obtain gross and net lifetime energy savings (see Subsections 3.2.5 and 3.3.4 below). The weighted average EUL value is 4.0 years.

**Table 8: 2024 ARet Equivalent EUL and Gross Lifetime Unitary Savings Values**

| Appliance           | Tracked Equivalent EUL [years] | Evaluated Equivalent EUL [years] | Evaluated Gross Lifetime Unitary Savings [kWh] |
|---------------------|--------------------------------|----------------------------------|------------------------------------------------|
| <b>ARet</b>         |                                |                                  |                                                |
| Refrigerators       | 4                              | No change                        | 2,640                                          |
| Freezers            | 4                              | No change                        | 2,904                                          |
| Air Conditioners    | 3                              | No change                        | 552                                            |
| Small Refrigerators | 4                              | No change                        | 656                                            |
| Small Freezers      | 4                              | No change                        | 920                                            |

### 3.2.5 Evaluated Gross Savings

The gross energy and peak demand savings resulting from the retirement of appliances through ARet are listed in Table 9 below.

Line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>9</sup> The proportions of residential participants versus that of commercial participants were calculated using 2024 ARet tracking sheet data. For appliances retired through ARet, gross energy savings at the generator were estimated by using a line loss factor of 0.0947 kW, while peak demand savings were estimated using a line loss factor of 0.1439 kW.<sup>10</sup>

<sup>8</sup> The technical reference manuals (TRMs) for California municipal utilities, Connecticut, Illinois, Maine, Massachusetts, Minnesota, Mid-Atlantic, New York, Northwest Power and Conservation Council, Ohio, Pennsylvania, Vermont, and Wisconsin were consulted. Only Northwest Power and Conservation Council and New York apply interactive effect factors for freezers and refrigerators (although only for new rebated appliances and not for recycled appliances).

<sup>9</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

<sup>10</sup> For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed.

**Table 9: Evaluated 2024 ARet Gross Energy and Peak Demand Savings**

| Measure Category                                              | Appliance Retirement |              |                       |                     |                |               |
|---------------------------------------------------------------|----------------------|--------------|-----------------------|---------------------|----------------|---------------|
|                                                               | Refrigerators        | Freezers     | Room Air Conditioners | Small Refrigerators | Small Freezers | Total         |
| <b>Number of Units Retired or Replaced</b>                    | <b>3,763</b>         | <b>1,756</b> | <b>257</b>            | <b>118</b>          | <b>47</b>      | <b>5,941</b>  |
| <b>Energy Savings</b>                                         |                      |              |                       |                     |                |               |
| Unitary Energy Savings (kWh)                                  | 660                  | 726          | 184                   | 164                 | 230            | -             |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>2.484</b>         | <b>1.275</b> | <b>0.047</b>          | <b>0.019</b>        | <b>0.011</b>   | <b>3.836</b>  |
| Line Loss Factor                                              | 1.0947               | 1.0947       | 1.0947                | 1.0947              | 1.0947         | -             |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>2.716</b>         | <b>1.394</b> | <b>0.052</b>          | <b>0.021</b>        | <b>0.012</b>   | <b>4.195</b>  |
| Equivalent Effective Useful Life (years)                      | 4.0                  | 4.0          | 3.0                   | 4.0                 | 4.0            | -             |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>10.865</b>        | <b>5.577</b> | <b>0.155</b>          | <b>0.085</b>        | <b>0.047</b>   | <b>16.729</b> |
| <b>Peak Demand Savings</b>                                    |                      |              |                       |                     |                |               |
| Unitary Peak Demand Savings (W)                               | 91.1                 | 100          | 0.00                  | 22.6                | 31.7           | -             |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.343</b>         | <b>0.176</b> | <b>0.000</b>          | <b>0.003</b>        | <b>0.001</b>   | <b>0.523</b>  |
| Line Loss Factor                                              | 1.1439               | 1.1439       | 1.1439                | 1.1439              | 1.1439         | -             |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.392</b>         | <b>0.201</b> | <b>0.000</b>          | <b>0.003</b>        | <b>0.002</b>   | <b>0.598</b>  |

Figure 4 below compares the tracked and evaluated gross electrical energy savings, while Figure 5 further below compares the tracked and evaluated gross peak demand energy savings. The two measures generating the majority of first-year electrical energy savings were refrigerator retirements (65%) and freezer retirements (33%).

**Figure 4: 2024 Tracked and Evaluated Gross Electrical Energy Savings at the Generator**

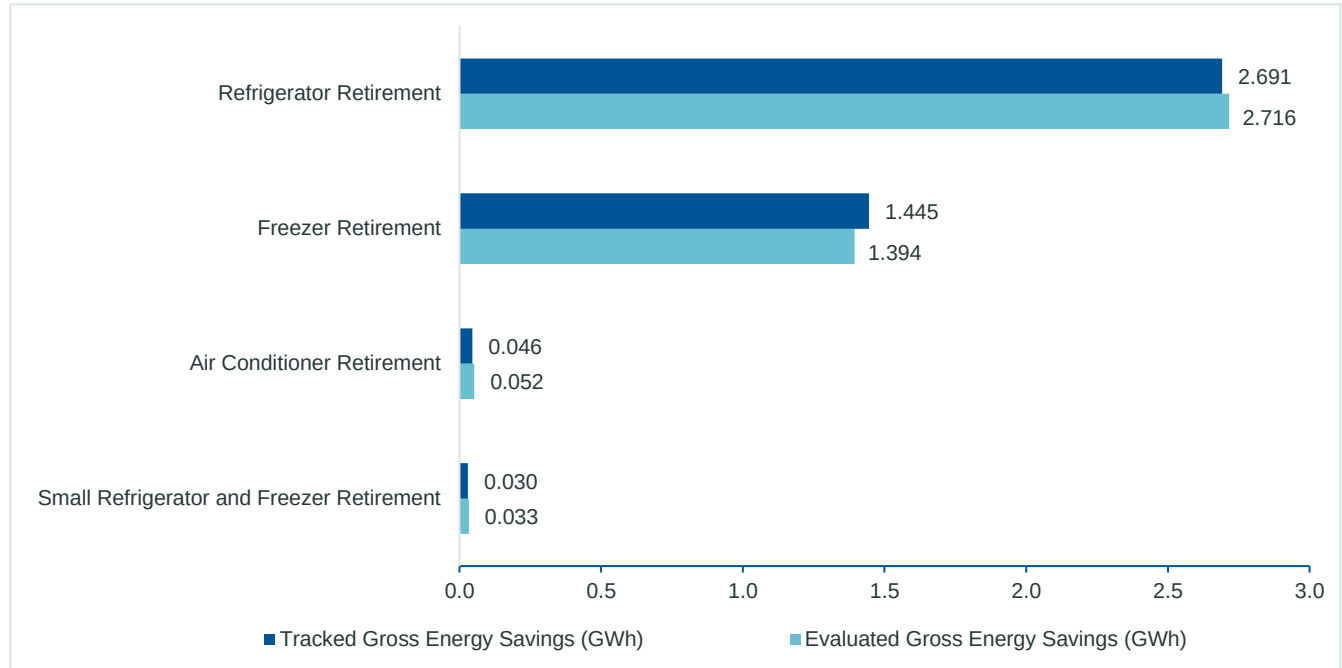
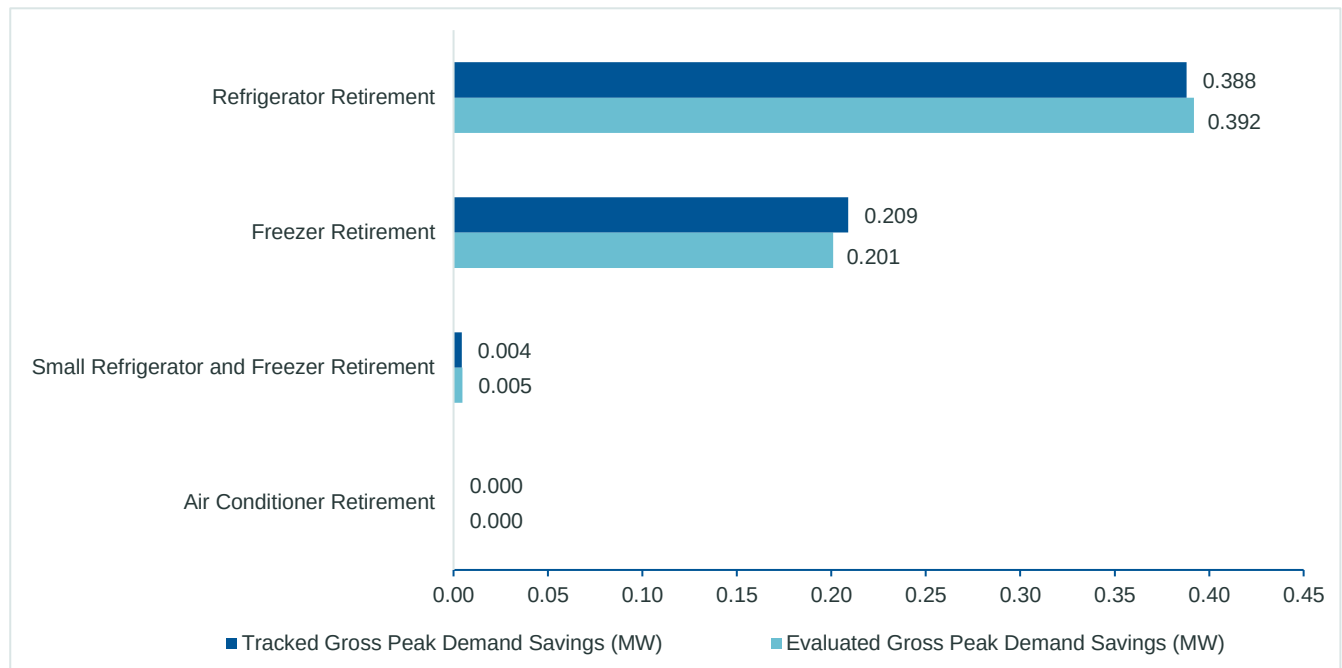


**Figure 5: 2024 Tracked and Evaluated Gross Peak Demand Savings at the Generator**



As presented in Table 10, gross GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>11</sup> for GHG emissions generated by electricity production to ARet gross savings.

**Table 10: Evaluated 2024 ARet Gross GHG Emission Reductions**

|                                                                                            | Total        |
|--------------------------------------------------------------------------------------------|--------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                       | <b>4.195</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonne of CO2 eq/GWh) | 472.2        |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                             | <b>1,981</b> |

### 3.3 Net Savings

The Evaluator determined the net energy and peak demand savings, that is the electrical energy and peak demand savings that can be reliably attributed to the program component, by establishing a NTGR for each appliance type. For ARet, the NTGRs were established by considering the free-ridership and secondary market impacts that negatively affect energy savings as well as spillover that positively affects energy savings.

For appliance retirements, the NTGR assessment was based on a methodology that complies with the general guidelines of the Uniform Methods Project (UMP) for refrigerator recycling evaluations.<sup>12</sup> This methodology involves considering the full energy consumption of retired appliances as gross unitary energy savings; then, net savings (without spillover) are obtained by deducting the energy impacts from free-ridership and secondary market scenarios. From these results, average free-ridership levels (including secondary market impacts) are calculated, while spillover is determined by calculating the energy impacts of all appliance retirements influenced by the program component but not achieved through the latter as a percentage of ARet gross energy savings.

#### 3.3.1 Free-ridership and Secondary Market Impacts

For appliance retirements, free-ridership corresponds to the energy consumption of appliances that would have been disposed of in the absence of the program, and secondary market impacts correspond to the consumption of those appliances that would have been transferred to other owners.

Since no data collection was conducted in 2024, the 2022 free-ridership and secondary market impact levels were used for full-sized refrigerators and freezers. These levels were assessed during the 2022 evaluation using a self-reporting approach consisting of a participant telephone survey. Participants were asked questions to assess the likelihood that their appliance would have been kept, transferred, or destroyed in the absence of ARet.<sup>13</sup> The participation levels for the retirement of other appliance types were too low to reliably assess free-ridership using the 2022 survey; thus, for air conditioners and small appliances, the free-ridership levels from the 2018 evaluation were used.

<sup>11</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

<sup>12</sup> NREL, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 7: Refrigerator Recycling Evaluation Protocol, prepared by the Cadmus Group, September 2017.

<sup>13</sup> Data for the discard scenario proportions for freezer retirements were not collected in 2022; therefore 2018 data were used. For further details on how the discard scenario proportions are incorporated into the free-ridership calculation, please refer to Appendix VI.

The average free-ridership levels and secondary market impacts are presented in Table 11 for each appliance type.

**Table 11: 2024 ARet Free-ridership Levels**

| Appliance Type      | Free-ridership<br>(with Secondary Market Impacts) |                 |
|---------------------|---------------------------------------------------|-----------------|
|                     | Level                                             | Margin of Error |
| Refrigerators       | 43%                                               | 6.3%            |
| Freezers            | 45%                                               | 5.5%            |
| Air Conditioners    | 47%                                               | 13.0%           |
| Small Refrigerators | 32%                                               | 10.3%           |
| Small Freezers      | 32%                                               | 10.3%           |
| Dehumidifiers       | 0%                                                | N/A             |

### 3.3.2 Participant Spillover

Appliance retirements may have occurred due to the influence of ARet even if no application was submitted. This influence can be due to a number of factors such as better awareness about the energy impacts from keeping the appliances. These retirements should be attributed to the program component as a form of spillover.

The methodology used to calculate spillover consists of estimating the energy impacts as a percentage of ARet gross energy savings for all appliance retirements influenced by the program component but not made through it.

There was no change in spillover since the last evaluation for ARet; hence, the spillover level was still considered to be nil.

### 3.3.3 Net-to-gross Ratio Calculation

NTGR values were calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Spillover})$$

Using the average free-ridership levels established for each appliance type, the Evaluator calculated corresponding NTGR values, the results of which are presented in Table 12.

**Table 12: 2024 ARet Effects and NTGR**

| Appliance Type      | Average Free-ridership<br>(with Secondary Market Impacts) | Spillover | NTGR        |
|---------------------|-----------------------------------------------------------|-----------|-------------|
| Refrigerators       | 43%                                                       | 0%        | <b>0.57</b> |
| Freezers            | 45%                                                       |           | <b>0.55</b> |
| Air Conditioners    | 47%                                                       |           | <b>0.53</b> |
| Small Refrigerators | 32%                                                       |           | <b>0.68</b> |
| Small Freezers      | 32%                                                       |           | <b>0.68</b> |
| Dehumidifiers       | 0%                                                        |           | <b>1.00</b> |



### 3.3.4 Evaluated Net Savings

Net savings represent the savings that can be reliably attributed to a program component. For ARet, net savings are calculated by applying the NTGR values to gross savings as illustrated in the following equation:

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR}$$

The detailed savings results are outlined in Table 13 below. The net energy savings resulted in 1,117 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions.

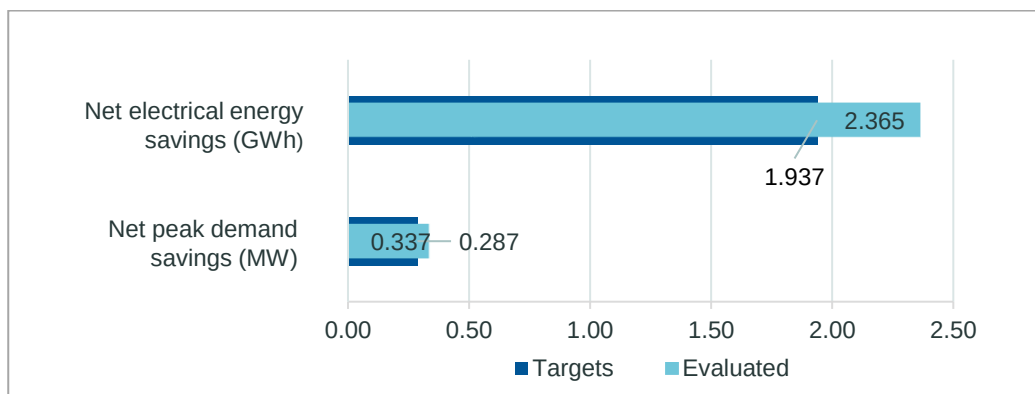


**Table 13: Evaluated 2024 ARet Net Energy and Peak Demand Savings**

| Measure Category                                            | Appliance Retirement |              |                       |                     |                |              |
|-------------------------------------------------------------|----------------------|--------------|-----------------------|---------------------|----------------|--------------|
|                                                             | Refrigerators        | Freezers     | Room Air Conditioners | Small Refrigerators | Small Freezers | Total        |
| <b>Energy Savings</b>                                       |                      |              |                       |                     |                |              |
| Gross Energy Savings – at the Meter (GWh)                   | 2.484                | 1.275        | 0.047                 | 0.019               | 0.011          | 3.836        |
| NTGR                                                        | 0.57                 | 0.55         | 0.53                  | 0.68                | 0.68           | -            |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>1.416</b>         | <b>0.701</b> | <b>0.025</b>          | <b>0.013</b>        | <b>0.007</b>   | <b>2.162</b> |
| Line Loss Factor                                            | 1.0937               | 1.0937       | 1.0937                | 1.0937              | 1.0937         | -            |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>1.548</b>         | <b>0.767</b> | <b>0.027</b>          | <b>0.014</b>        | <b>0.008</b>   | <b>2.365</b> |
| Equivalent Effective Useful Life (years)                    | 4.0                  | 4.0          | 3.0                   | 4.0                 | 4.0            | -            |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>6.193</b>         | <b>3.067</b> | <b>0.082</b>          | <b>0.058</b>        | <b>0.032</b>   | <b>9.433</b> |
| <b>Peak Demand Savings</b>                                  |                      |              |                       |                     |                |              |
| Gross Peak Demand Savings – at the Meter (MW)               | 0.343                | 0.176        | 0.000                 | 0.003               | 0.001          | 0.523        |
| NTGR                                                        | 0.57                 | 0.55         | 0.53                  | 0.68                | 0.68           | -            |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>0.195</b>         | <b>0.097</b> | <b>0.000</b>          | <b>0.002</b>        | <b>0.001</b>   | <b>0.295</b> |
| Line Loss Factor                                            | 1.1439               | 1.1439       | 1.1439                | 1.1439              | 1.1439         | -            |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>0.224</b>         | <b>0.110</b> | <b>0.000</b>          | <b>0.002</b>        | <b>0.001</b>   | <b>0.337</b> |

As outlined in Figure 6, ARet exceeded both its electrical energy and peak demand savings targets by 22% and 18% respectively.

**Figure 6: 2024 ARet Targets and Evaluated Savings**



### 3.4 Realization Rate

Table 14 below compares ARet total tracked and evaluated savings. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 14: Comparison of 2024 ARet Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                 | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                 | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings                                                                                                                                                  |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                           | 4.212         | GWh  | 0.56  | 2.374       | GWh  | 100%             |
| Evaluation Results                                                                                                                                              | 4.195         | GWh  | 0.56  | 2.365       | GWh  |                  |
| Peak Demand Savings                                                                                                                                             |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                           | 0.602         | MW   | 0.56  | 0.339       | MW   | 99%              |
| Evaluation Results                                                                                                                                              | 0.598         | MW   | 0.56  | 0.337       | MW   |                  |
| *NTGRs vary for each type of appliance. The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings. |               |      |       |             |      |                  |

Although unitary savings values were updated for all measures, the evaluated net energy and peak demand savings were both less than 1% below the values tracked by E1.



## 4 ARet Key Findings and Recommendations

The 2024 ARet evaluation included a condensed impact evaluation, and its main objectives were as follows:

- › Calculate gross and net ARet results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

This section provides the Evaluator's key findings in relation to the above objectives. The Evaluator has no specific recommendation for ARet.

**2024 ARet-Finding: ARet achieved both its net electrical energy savings and peak demand savings targets by 22% and 18% respectively.**

ARet achieved 2.365 GWh in net electrical energy savings and 0.337 MW in net peak demand savings at the generator in 2024, thus surpassing the planned net electrical energy savings and net peak demand savings of 1.937 GWh and 0.287 MW respectively.

**2024 ARet-Finding: The evaluated net electrical energy savings and peak demand savings determined by the Evaluator were equal to and slightly lower than the net savings tracked by E1 respectively.**

Although unitary savings values were updated for all measures, the evaluated net energy and peak demand savings were both less than 1% below the values tracked by E1.

**2024 ARet-Finding: Program participation levels in 2024 increased by 39% compared to 2023 levels, with refrigerator and freezer retirements remaining the largest drivers of participation and savings.**

Full-sized refrigerators and freezers continue to be the largest contributors to participation and savings for the program component, generating 98% of 2024 savings. After two consecutive decreases in 2022 and 2023, participation levels increased by 39% in 2024.

## 5 Instant Savings Overview

This section describes Instant Savings, follows up on past evaluation recommendations, and provides an overview of participation history.

### 5.1 Instant Savings Description

Instant Savings offers instant cash rebates to consumers who purchase eligible energy efficient products. Instant Savings is delivered with the help of one Delivery Agent (DA), Summerhill Group Inc., as well as national and independent retailers that offer instant rebates on energy efficient products at over 150 locations across Nova Scotia. To respond to online shopping trends, E1 introduced online retailers to their list of participating retailers in 2019 and online purchasing of select products directly from manufacturers in 2020.

Rebates on eligible products were offered during the following periods:

- › Spring campaign from March 22 to May 19, 2024
- › Fall campaign from September 23 to November 17, 2024
- › Year-round on selected products from January 1 to December 31, 2024

Table 15 below summarizes the energy efficient products offered through Instant Savings and their respective rebate amount. For each product category, a list of eligible stock keeping units (SKUs) for each retail partner is maintained and approved by E1.

**Table 15: List of 2024 Rebates by Product**

| Products Offered During Campaigns                                                                                                                                                                                            | Rebate During Spring Campaign                 | Rebate During Fall Campaign               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------------------------------------------|
| ENERGY STAR® Certified LED Lights Non-A-series (single & multipacks)                                                                                                                                                         | Up to 70% off package price*                  | Up to 80% off package price*              |
| ENERGY STAR Certified LED Recessed Downlight Fixtures (single & multipacks)                                                                                                                                                  | Up to 70% off package price*                  | Up to 80% off package price*              |
| ENERGY STAR Certified LED Fixtures Without Motion Sensors                                                                                                                                                                    | Up to 70% off package price (up to \$25 off)* | Up to 80% off package price (up to \$30)* |
| ENERGY STAR Certified LED Fixtures with Motion Sensors (+ solar option if available)                                                                                                                                         | Up to 70% off package price (up to \$25 off)* | Up to 80% off package price (up to \$30)* |
| Dimmer Switches or Wi-Fi Enabled Switches (single pack and multipack)                                                                                                                                                        | \$3/unit or up to 65% off package price       | \$3/unit or up to 65% off package price   |
| Indoor Motion Sensors                                                                                                                                                                                                        | \$5                                           | \$5                                       |
| Outdoor Motion Sensors                                                                                                                                                                                                       | \$8                                           | \$8                                       |
| Power Bars with Integrated Timers <sup>14</sup>                                                                                                                                                                              | \$5                                           | \$5                                       |
| Smart Power Strips (load sensing power strips only)                                                                                                                                                                          | \$10                                          | \$10                                      |
| Heavy-duty Outdoor Timers                                                                                                                                                                                                    | \$10/unit or up to 65% off package price      | \$10/unit or up to 65% off package price  |
| Programmable or Wi-Fi Enabled Thermostats for Electric Baseboard Heaters (single & multipacks)                                                                                                                               | \$25/unit or up to 65% off package price      | \$25/unit or up to 65% off package price  |
| Products Offered Year-Round                                                                                                                                                                                                  |                                               |                                           |
| ENERGY STAR Certified LED Fixtures Without Motion Sensors                                                                                                                                                                    | \$15/unit or up to 65% off package price      |                                           |
| ENERGY STAR Certified LED Fixtures with Motion Sensors (+ solar option if available)                                                                                                                                         | \$20/unit or up to 65% off package price      |                                           |
| ENERGY STAR Certified LED Recessed Downlight Fixtures (single & multipacks)                                                                                                                                                  | \$10/unit or up to 65% off package price      |                                           |
| Outdoor Clothesline Kits and Outdoor Drying Racks                                                                                                                                                                            | \$5                                           |                                           |
| Select Smart Thermostats (with occupancy sensors) for Electric Heating: Electric Baseboards, Mini-split Heat Pumps, and In-floor Radiant Heat                                                                                | \$45/unit                                     |                                           |
| ENERGY STAR Certified Dehumidifiers                                                                                                                                                                                          | \$30                                          |                                           |
| ENERGY STAR Certified Room Air Purifiers                                                                                                                                                                                     | Up to \$75                                    |                                           |
| Clothes Washers (qualifying models are on the ENERGY STAR Most Efficient list)                                                                                                                                               | \$75                                          |                                           |
| Clothes Dryers (qualifying models must be ENERGY STAR certified and use less than 100 kWh per cubic foot of drum capacity)                                                                                                   | \$75                                          |                                           |
| Energy Efficient Combined Washer/Dryer (qualifying models must meet the efficiency requirements for washer and dryer components separately. Models must be pre-approved by Efficiency Nova Scotia prior to offering rebates) | \$150 per combination unit                    |                                           |
| ENERGY STAR Certified Variable Speed Pool Pumps                                                                                                                                                                              | \$200                                         |                                           |
| ENERGY STAR Certified Air-source Heat Pump Hot Water Heaters                                                                                                                                                                 | \$400                                         |                                           |
| Dishwashers (qualifying models must be ENERGY STAR certified and use less than or equal 250 kWh per year)                                                                                                                    | \$75                                          |                                           |
| Bathroom and Utility Room Fans (no light) (qualifying models must be on the ENERGY STAR Most Efficient list)                                                                                                                 | Up to \$25                                    |                                           |
| *Represents changed incentives that were introduced during the 2024 spring and fall campaigns.                                                                                                                               |                                               |                                           |

<sup>14</sup> No power bars with integrated timers were rebated in 2024.

Instant Savings is typically advertised through point-of-purchase materials and signage, the Efficiency Nova Scotia (ENS) website, and other media including television commercials, social media, as well as print, online, and outdoor advertising. Consumer engagement events were held in participating retail stores during both campaign periods to provide information about Instant Savings and cross-promote other E1 programs, components, and services. In 2024, E1 ran a “Lights Out” campaign to make customers (and retailers) aware that 2024 would be the final year to take advantage of rebates on LED lamps and fixtures.

Instant Savings was aimed at achieving 12.544 GWh in net electrical energy savings and 1.680 MW in net peak demand savings at the generator in 2024.

## 5.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated Instant Savings in previous years and issued improvement recommendations. Table 16 provides a summary on the implementation status of a past recommendation that has been carried forward.

**Table 16: Implementation Status of Past Recommendations for Instant Savings**

| #          | Past Recommendations                                                                                                                                                                                                                              | Status   | Comments                                                                                                                                                                                                                                                                                       |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2023-IS-R1 | Review the incented models in the LED non-A-type lamp category (R, BR, Decorative) and phase out in 2024 any models that are no longer pertinent for the program component given regulations and the market availability of non-LED replacements. | Complete | E1 agrees with this recommendation and has reviewed LED measures and phased out LED Non-A-Type bulbs, LED Fixtures, and LED Recessed Downlights measures starting in January 2025. Retailers have been sufficiently informed that 2024 was the final year for LED measures in Instant Savings. |

## 5.3 Participation History

In 2024, a total of 395,472 eligible products were sold in participating stores across Nova Scotia, which represents an increase of 82% compared to 2023.

As presented in Table 17 below, sales of ENERGY STAR certified non-A-type LED lamps remained stable with an increase of 0.1% compared to 2023, maintaining the levels after a decrease observed in 2022. LED fixture sales increased the most with a 204% difference compared to 2023. All products in this category increased significantly, especially solar fixtures with a 3,988% increase and LED recessed downlight fixtures with a 305% increase. Overall sales of control products in 2024 remained stable, smart thermostat sales increased by 191%, while sales for dimmer switches, indoor and outdoor motion sensors, heavy duty outdoor timers, and programmable thermostats decreased.

Sales in the appliance product category decreased by 11% driven by a decrease in units sold for room air purifiers (-34%), ENERGY STAR dehumidifiers (-23%), as well as ENERGY STAR certified clothes washers (-12%) and dryers (-4%).

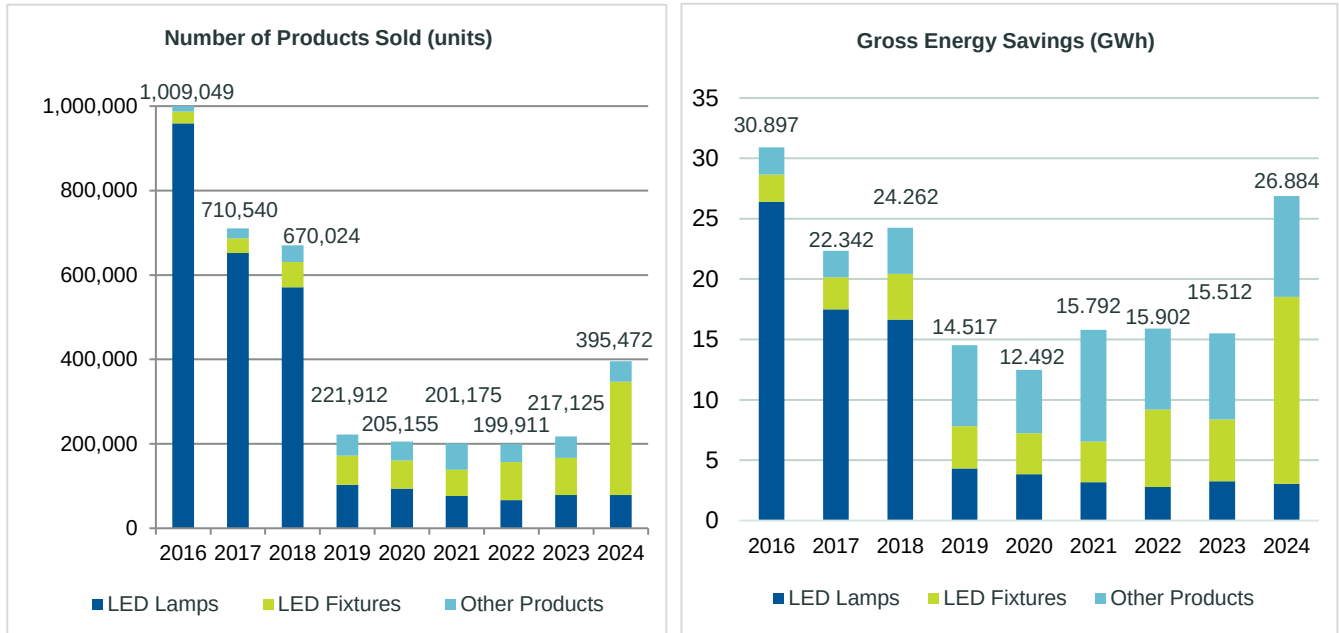
**Table 17: Number of Rebated Products Sold Through Instant Savings, 2023–2024**

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2023           | 2024           | Variation |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|-----------|------------|
| ENERGY STAR Certified Non-A-type LED Lamps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 78,438         | 78,539         | ↑         | 0.1%       |
| ENERGY STAR Certified LED Fixtures <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 88,337         | 268,740        | ↑         | 204%       |
| Controls <sup>b</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 19,299         | 19,545         | ↑         | 1%         |
| Clothesline Kits and Outdoor Drying Racks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2,463          | 3,115          | ↑         | 26%        |
| Appliances <sup>c</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 28,406         | 25,327         | ↓         | -11%       |
| Energy STAR Certified Air-source Heat Pump Hot Water Heaters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 141            | 163            | ↑         | 16%        |
| ENERGY STAR Certified Variable Speed Pool Pumps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 41             | 43             | ↑         | 5%         |
| <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>217,125</b> | <b>395,472</b> | <b>↑</b>  | <b>82%</b> |
| <sup>a</sup> Including ENERGY STAR certified LED fixtures with and without motion sensors, ENERGY STAR certified LED recessed downlight fixtures, and solar fixtures.<br><sup>b</sup> Including dimmer switches, indoor and outdoor motion sensors, heavy-duty outdoor timers, programmable thermostats, smart thermostats for electrical heat and in-floor heating, and smart power bars.<br><sup>c</sup> ENERGY STAR certified clothes washers and dryers, ENERGY STAR certified combination washer and dryer units, ENERGY STAR certified dishwashers, ENERGY STAR certified dehumidifiers, ENERGY STAR certified room air purifiers and ENERGY STAR certified bathroom & utility fans. |                |                |           |            |

As illustrated in Figure 7 below, LED fixtures surpassed lamps in the number of products sold with 68% of sales, while LED recessed downlight fixtures represented 68% and LED fixtures without motion sensors represented 28% of total LED fixtures sales. LED lamps followed fixtures with 20% of total sales.

Instant Savings gross energy savings significantly increased by 73% compared to 2023 levels. Gross savings from lighting products increased by 121% driven in large part by increased sales in LED fixtures. LED lamps and fixtures comprised 69% of gross savings. Savings from non-lighting products increased by 17% compared to 2023. Products other than LED lamps and fixtures constituted 31% of gross energy savings, with ENERGY STAR certified room air purifiers (11%) and smart thermostats for electrical baseboards (10%) being top drivers of gross energy savings.

Figure 7: Overview of Participation in Instant Savings, 2016-2024





## 6 Instant Savings Evaluation Approach

The 2024 Instant Savings evaluation included a comprehensive impact evaluation whereby NTGRs, namely free-ridership, as well as unitary savings were reviewed and updated. The main objectives of the 2024 Instant Savings evaluation were as follows:

- › Calculate gross and net Instant Savings results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions.

The Evaluator identified key research questions aimed at achieving these objectives. Table 18 outlines the evaluation objectives and maps them to the Evaluator's research questions, methods, and sample sizes (n). Each method is described further below.

**Table 18: 2024 Instant Savings Evaluation Approach**

| Evaluation Objective    | Research Question                                                                                                                                                                                                                                                                                    | Methodology                                                                                                                                                                                                                   |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› What are the unitary savings and EUL values by product?</li><li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Unitary savings review</li><li>› EUL update</li><li>› Calculations using evaluation results</li></ul>                                                  |
| Calculate net results   | <ul style="list-style-type: none"><li>› What is the free-ridership level for 2024?</li><li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li><li>› What are the net GHG emission reductions in CO<sub>2</sub> eq?</li></ul>                        | <ul style="list-style-type: none"><li>› Participant survey</li><li>› Use of 2023 market effects results for spillover</li><li>› Calculations using evaluation results</li><li>› GHG emission reduction calculations</li></ul> |

### Participant Online Survey

Narrative Research staff conducted an online participant survey with 41 consumers who purchased qualifying non-A-type LED lamps, 98 who purchased recessed downlight fixtures, and 61 who purchased other LED fixtures during the fall campaign, for a total of 200 survey participants.

The online survey was conducted throughout the 2024 fall campaign via the use of cards with a survey link distributed to consumers at participating retail locations. Completed surveys were collected through samples from Costco, Kent, and Home Depot store locations.

The average length of the survey was 10 minutes. The questionnaire used is presented in Appendix III, and complete participant survey results are outlined in Appendix IV. The online survey sample of 200 participants yields a maximum margin of error of  $\pm 5.7\%$  at a 90% confidence level.

### Tracking Sheet Audit

The Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The results obtained are presented in Appendix V.



## Unitary Savings Review

A unitary savings review was conducted for all measures as part of a major update to the 2024-2025 DSM Measure Assessment (DSM MA).<sup>15</sup> The unitary savings review consisted of a literature review of technical reference manuals, metering studies, and program evaluation documents to determine if there were more appropriate<sup>16</sup> methodologies or parameters to be applied to calculate energy and peak demand unitary savings, including elements such as baseline assumptions, operation hours, efficiency levels, peak demand-to-energy ratios, and interactive effects factors.

## EUL Update

For 2024, the Evaluator conducted a review of all EUL values as part of the 2024-2025 DSM MA update to determine if there were more appropriate EUL estimates.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated first-year and lifetime energy and peak demand savings as per the calculation methodology presented in Section 7 below.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for Instant Savings, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was provided by NS Power data.

## Note on Margin of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within ten percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>17</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>18</sup>

As part of the Instant Savings evaluation, the Evaluator calculated the margins of error for free-ridership levels. The margins of error are listed alongside results in the applicable sections below. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary.

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<sup>15</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the remainder of the evaluations to be conducted during the 2023-2025 DSM cycle, the Evaluator will refer to the values presented in the 2024-2025 DSM MA.

<sup>16</sup> The Evaluator will judge whether new studies are more appropriate based on various factors, including but not limited by the following: The similarities between the measures implemented in the given study and E1's measures, the similarities in terms of climate or market conditions, the size of the sample studied, whether a study is recent, the quality of the study methodology, etc.

<sup>17</sup> Precision refers to how reproducible a set of measurements is. It does not consider how close the measured values are to the true values since this would refer to accuracy.

<sup>18</sup> As part of this evaluation, the confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.



## 7 Instant Savings Impact Evaluation

The objectives of the 2024 Instant Savings impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as effective useful life (EUL) values and associated lifetime energy savings.

### 7.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in Appendix V. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 7.2 Gross Savings

For Instant Savings, gross savings correspond to the change in energy consumption resulting from eligible energy efficient products being purchased by participants regardless of why they participated.<sup>19</sup>

#### 7.2.1 Installation Rates

The installation rates of products sold under Instant Savings are assumed to be 100% except for smart power controllers for audiovisual equipment (smart power strips) for which the installation rate was updated to 86% as part of the 2024-2025 DSM MA Update. Please refer to the 2024-2025 DSM MA for more details.

#### 7.2.2 Unitary Energy Savings

Table 19 below summarizes the tracked and evaluated energy savings values for the product categories rebated through Instant Savings, which were revised as part of the 2024-2025 DSM MA update. Detailed descriptions of inputs, references, and unitary savings for all products are provided in the 2024-2025 DSM MA. The unitary savings for all other measures remain unchanged.

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<sup>19</sup> Definition adapted from: National Renewable Energy Laboratory, The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices, September 2014, p. 3.

**Table 19: 2024 Instant Savings Tracked and Evaluated Unitary Energy Savings**

| Product                                                                        | Tracked Savings [kWh/year] | Evaluated Savings [kWh/year] |
|--------------------------------------------------------------------------------|----------------------------|------------------------------|
| ENERGY STAR Certified LED Non-A-type Lamps (R, BR, and Decorative)             | 49.2                       | 43.2                         |
| ENERGY STAR Certified LED Non-A-type Lamps (excluding R, BR, and Decorative)   | 42.2                       | 41.3                         |
| ENERGY STAR Certified LED Recessed Downlight Fixtures                          | 51.0                       | 52.8                         |
| ENERGY STAR Certified LED Fixtures                                             | 73.5                       | 83.8                         |
| ENERGY STAR Certified LED Fixtures with Motion Sensors                         | 204.6                      | 201                          |
| Dimmer Switches                                                                | 17.0                       | 8.20                         |
| Indoor Motion Sensors                                                          | 45.8                       | 22.1                         |
| Indoor Motion Sensors with Dimmer Switches*                                    | 53.6                       | 25.9                         |
| Outdoor Motion Sensors                                                         | 159                        | 54.1                         |
| Solar Fixtures                                                                 | 478                        | 81.0                         |
| Power Bars with Integrated Timers*                                             | 53.7                       | 47.9                         |
| Smart Power Controllers for Audiovisual Equipment (smart power strips)         | 53.8                       | 105                          |
| Programmable Thermostats                                                       | 221                        | 164                          |
| Smart Thermostats for Electric Baseboards                                      | 348                        | 312                          |
| Smart Thermostats for Mini-split Heat Pumps                                    | 514                        | 564                          |
| Smart Thermostats for Electric In-floor Heating                                | 348                        | 312                          |
| Efficient Clothes Washers                                                      | 125                        | 138                          |
| ENERGY STAR Certified Clothes Dryers                                           | 113                        | 25.0                         |
| Efficient Combined Clothes Washers and Dryers                                  | 236                        | 144                          |
| ENERGY STAR Certified Heat Pump Water Heaters                                  | 922                        | 1,007                        |
| ENERGY STAR Certified Dishwashers                                              | 14.2                       | 15.2                         |
| ENERGY STAR Certified Bathroom and Utility Fans**                              | 7.85                       | 143                          |
| *No products rebated in 2024.                                                  |                            |                              |
| **Referred to as "Humidity sensors for bathroom fans" in the 2024-2025 DSM MA. |                            |                              |

## 7.2.3 Unitary Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity peak demand period in Nova Scotia is defined as the coldest days (with an on-peak temperature estimated at -15 °C) between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays. The Evaluator developed unitary peak demand savings for each measure for all products, and the differences between tracked and evaluated peak demand savings reflect updates made to the unitary energy savings of those products. The peak demand-to-energy ratios used are presented in the 2024-2025 DSM MA.

Table 20 below summarizes the tracked and evaluated unitary peak demand savings for the product categories rebated through Instant Savings, which were revised as part of the 2024-2025 DSM MA update. The unitary peak demand savings for all other measures remain unchanged.

**Table 20: 2024 Instant Savings Tracked and Evaluated Unitary Peak Demand Savings**

| Product                                                                      | Tracked Savings [W/year] | Evaluated Savings [W/year] |
|------------------------------------------------------------------------------|--------------------------|----------------------------|
| ENERGY STAR Certified LED Non-A-type Lamps (R, BR, and Decorative)           | 7.97                     | 7.00                       |
| ENERGY STAR Certified LED Non-A-type Lamps (excluding R, BR, and Decorative) | 6.84                     | 6.69                       |
| ENERGY STAR Certified LED Recessed Downlight Fixtures                        | 8.26                     | 8.55                       |
| ENERGY STAR Certified LED Fixtures                                           | 11.9                     | 13.6                       |
| ENERGY STAR Certified LED Fixtures with Motion Sensors                       | 33.15                    | 32.6                       |
| Dimmer Switches                                                              | 2.75                     | 1.33                       |
| Solar Fixtures                                                               | 77.4                     | 13.1                       |
| Efficient Clothes Washers                                                    | 17.3                     | 19.0                       |
| ENERGY STAR Certified Clothes Dryers                                         | 15.6                     | 3.45                       |
| Efficient Combined Clothes Washers and Dryers                                | 32.6                     | 19.9                       |
| ENERGY STAR Certified Heat Pump Water Heaters                                | 149                      | 163                        |
| ENERGY STAR Certified Dishwashers                                            | 1.30                     | 1.39                       |
| ENERGY STAR Certified Bathroom and Utility Fans                              | 0.70                     | 14.3                       |

#### 7.2.4 Interactive Effects

In a home, interactive effects occur when implementing energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling. Interactive effects occur only when products are installed inside homes. In the case of Instant Savings, replacing incandescent lighting products with LED lamps results in an increase in the heating load during winter and a decrease in the cooling load during summer.

#### Lighting Products and Controls

The weighted interactive effects factors for lighting products were established as part of the 2024-2025 DSM MA update and included the various types of space heating and cooling found in Nova Scotia homes. Table 21 presents the interactive effects factors for LED products.

**Table 21: 2024 Instant Savings Interactive Effects Factors for Lighting Products**

| Product Category - LED Lamps, Fixtures, and Other Indoor Devices             | Weighted Energy Interactive Effects Factor | Weighted Peak Demand Interactive Effects Factor | Indoor % | Outdoor % | Energy Interactive Effects Factor | Peak Demand Interactive Effects Factor |
|------------------------------------------------------------------------------|--------------------------------------------|-------------------------------------------------|----------|-----------|-----------------------------------|----------------------------------------|
| ENERGY STAR Certified LED Non-A-type Lamps (R, BR, and Decorative)           | -17.7%                                     | -46.8%                                          | 92%      | 8%        | -16.3%                            | -43.1%                                 |
| ENERGY STAR Certified LED Non-A-type Lamps (excluding R, BR, and Decorative) | -17.7%                                     | -46.8%                                          | 92%      | 8%        | -16.3%                            | -43.1%                                 |
| ENERGY STAR Certified LED Recessed Downlight Fixtures                        | -17.7%                                     | -46.8%                                          | 100%     | 0%        | -17.7%                            | -46.8%                                 |
| ENERGY STAR Certified LED Fixtures                                           | -17.7%                                     | -46.8%                                          | 100%     | 0%        | -17.7%                            | -46.8%                                 |
| ENERGY STAR Certified LED Fixtures with Motion Sensors                       | -17.7%                                     | -46.8%                                          | 3%       | 97%       | -0.5%                             | -1.4%                                  |
| Indoor Motion Sensors                                                        | -17.7%                                     | -46.8%                                          | 100%     | 0%        | -17.7%                            | -46.8%                                 |
| Dimmer Switches                                                              | -17.7%                                     | -46.8%                                          | 100%     | 0%        | -17.7%                            | -46.8%                                 |
| Solar Fixtures                                                               | 0%                                         | 0%                                              | 0%       | 100%      | 0%                                | 0%                                     |

## Other Products

No interactive effects factors were calculated for power bars, outdoor devices, and thermostats sold through Instant Savings. For clotheslines and outdoor drying racks as well as large appliances, interactive effects were considered negligible.

### 7.2.5 Effective Useful Life

The Evaluator validated the EUL values based on the 2024-2025 DSM MA. The EUL values are used in the calculation of electrical energy savings that are expected to persist over time. The baseline for LED lamps reflects the changes made as part of the 2022 evaluation that included the assumption that LED lamps will become the baseline starting in 2025 given indications that the market is rapidly moving away from compact fluorescent lamps. This is discussed in further detail in Appendix II of the 2024-2025 DSM MA.

Table 22 below summarizes the tracked and evaluated equivalent EUL values for product categories rebated through Instant Savings, which were revised as part of the 2024-2025 DSM MA update. The EUL values for all other measures remain unchanged.

The evaluated equivalent EUL values were applied to the gross and net first-year electrical energy savings of each product to obtain gross and net lifetime energy savings (see Subsections 7.2.6 and 7.3.4 below). The weighted average gross EUL value is 3.8 years, and the weighted average net EUL value is 4.4 years.

**Table 22: 2024 Instant Savings Equivalent EUL and Gross Lifetime Unitary Savings Values**

| Product                                                                      | Tracked Equivalent EUL [years] | Evaluated Equivalent EUL [years] | Evaluated Gross Lifetime Unitary Savings [kWh] |
|------------------------------------------------------------------------------|--------------------------------|----------------------------------|------------------------------------------------|
| ENERGY STAR Certified LED Non-A-type Lamps (R, BR, and Decorative)           | 2.0                            | 1.0                              | 43.2                                           |
| ENERGY STAR Certified LED Non-A-type Lamps (Excluding R, BR, and Decorative) | 2.0                            | 1.0                              | 41.3                                           |
| ENERGY STAR Certified LED Recessed Downlight Fixtures                        | 2.0                            | 1.0                              | 52.8                                           |
| ENERGY STAR Certified LED Fixtures Without Motion Sensors                    | 2.0                            | 1.0                              | 83.8                                           |
| ENERGY STAR Certified LED Fixtures with Motion Sensors                       | 2.9                            | 1.6                              | 322                                            |
| Solar Fixtures                                                               | 3.2                            | 1.9                              | 154                                            |
| ENERGY STAR Certified Heat Pump Water Heaters                                | 10.0                           | 15.0                             | 15,105                                         |

## 7.2.6 Evaluated Gross Savings

Annual gross savings are based on the evaluated unitary savings values established for each product sold in 2024. The results are presented in Table 23 below.

The gross savings at the generator were estimated by using a line loss factor of 1.0947 and 1.1466 for energy and peak demand savings respectively.<sup>20</sup> The line loss factors were updated in 2019 and correspond to the values submitted to the Nova Scotia Utility and Review Board as part of the 2014 Cost of Service Study Progress Update.<sup>21</sup>

<sup>20</sup> For municipal utility participants, the line loss factor for the most similar NS Power rate code was assumed. If a municipal utility participant did not have a specific rate code, the average of participants for which the line loss was known was used.

<sup>21</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

**Table 23: Evaluated 2024 Instant Savings Gross Electrical Energy and Peak Demand Savings**

| Product Category                                       | LED Non-A-type Lamps  |        | LED Recessed Downlight Fixtures | ENERGY STAR LED Fixtures |                     |                | Dimmer Switches | Indoor Motion Sensors | Outdoor Motion Sensors |
|--------------------------------------------------------|-----------------------|--------|---------------------------------|--------------------------|---------------------|----------------|-----------------|-----------------------|------------------------|
|                                                        | R, BR, and Decorative | Others |                                 | Without Motion Sensors   | With Motion Sensors | Solar Fixtures |                 |                       |                        |
| Number of Units                                        |                       |        |                                 |                          |                     |                |                 |                       |                        |
| Number of Units – Spring                               | 11,413                | 3      | 3,175                           | 22,968                   | 25                  | 43             | 1               | -                     | 1                      |
| Number of Units – Fall                                 | 35                    | 35     | 2,555                           | 1,651                    | 127                 | 465            | 3               | 1                     | 3                      |
| Number of Units – Year-round                           | 37,503                | 29,550 | 177,245                         | 51,765                   | 1,175               | 7,546          | 6,012           | 283                   | 2,112                  |
| Total Number of Units                                  | 48,951                | 29,588 | 182,975                         | 76,384                   | 1,327               | 8,054          | 6,016           | 284                   | 2,116                  |
| Energy Savings                                         |                       |        |                                 |                          |                     |                |                 |                       |                        |
| Unitary Energy Savings Value (kWh)                     | 43.2                  | 41.3   | 52.8                            | 83.8                     | 201                 | 81.0           | 8.20            | 22.1                  | 54.1                   |
| Installation Rate (%)                                  | 100%                  | 100%   | 100%                            | 100%                     | 100%                | 100%           | 100%            | 100%                  | 100%                   |
| Energy Interactive Effects Factor (%)                  | -16.3%                | -16.3% | -17.7%                          | -17.7%                   | -0.5%               | 0.0%           | -17.7%          | -17.7%                | 0.0%                   |
| Gross Energy Savings – at the Meter (GWh)              | 1.770                 | 1.023  | 7.951                           | 5.268                    | 0.265               | 0.652          | 0.041           | 0.005                 | 0.114                  |
| Line Loss Factor                                       | 1.0947                | 1.0947 | 1.0947                          | 1.0947                   | 1.0947              | 1.0947         | 1.0947          | 1.0947                | 1.0947                 |
| Gross Energy Savings – at the Generator (GWh)          | 1.938                 | 1.120  | 8.704                           | 5.767                    | 0.290               | 0.714          | 0.044           | 0.006                 | 0.125                  |
| Effective Useful Life (years)                          | 1.0                   | 1.0    | 1.0                             | 1.0                      | 1.6                 | 1.9            | 10.0            | 10.0                  | 10.0                   |
| Gross Lifetime Energy Savings – at the Generator (GWh) | 1.938                 | 1.120  | 8.704                           | 5.767                    | 0.465               | 1.357          | 0.444           | 0.057                 | 1.253                  |
| Peak Demand Savings                                    |                       |        |                                 |                          |                     |                |                 |                       |                        |
| Unitary Peak Demand Savings (W)                        | 7.00                  | 6.69   | 8.55                            | 13.6                     | 32.6                | 13.1           | 1.33            | 0.00                  | 0.00                   |
| Installation Rate (%)                                  | 100%                  | 100%   | 100%                            | 100%                     | 100%                | 100%           | 100%            | 100%                  | 100%                   |
| Peak Demand Interactive Effects Factor (%)             | -43.1%                | -43.1% | -46.8%                          | -46.8%                   | -1.4%               | 0.0%           | -46.8%          | -46.8%                | 0.0%                   |
| Gross Peak Demand Savings – at the Meter (MW)          | 0.195                 | 0.113  | 0.832                           | 0.553                    | 0.043               | 0.106          | 0.004           | 0.000                 | 0.000                  |
| Line Loss Factor                                       | 1.1466                | 1.1466 | 1.1466                          | 1.1466                   | 1.1466              | 1.1466         | 1.1466          | 1.1466                | 1.1466                 |
| Gross Peak Demand Savings – at the Generator (MW)      | 0.224                 | 0.129  | 0.954                           | 0.634                    | 0.049               | 0.121          | 0.005           | 0.000                 | 0.000                  |



Evaluated 2024 Instant Savings Gross Electrical Energy and Peak Demand Savings (Continued)

| Product Category                                       | Smart Power Bars | Heavy-duty Outdoor Timers | Programmable Thermostats | Smart Thermostats   |        |                  | Clotheslines | Efficient Clothes Washers | Efficient Clothes Dryers |
|--------------------------------------------------------|------------------|---------------------------|--------------------------|---------------------|--------|------------------|--------------|---------------------------|--------------------------|
|                                                        |                  |                           |                          | Electric Baseboards | MSHPs  | In-floor Heating |              |                           |                          |
| Number of Units                                        |                  |                           |                          |                     |        |                  |              |                           |                          |
| Number of Units – Spring                               | -                | -                         | -                        | 193                 | 54     | 4                | 137          | 467                       | 750                      |
| Number of Units – Fall                                 | -                | 1                         | 1                        | 296                 | 111    | 3                | 159          | 540                       | 677                      |
| Number of Units – Year-round                           | 111              | 1,564                     | 661                      | 7,284               | 791    | 55               | 2,819        | 1,840                     | 2,572                    |
| Total Number of Units                                  | 111              | 1,565                     | 662                      | 7,773               | 956    | 62               | 3,115        | 2,847                     | 3,999                    |
| Energy Savings                                         |                  |                           |                          |                     |        |                  |              |                           |                          |
| Unitary Energy Savings Value (kWh)                     | 105              | 122                       | 164                      | 312                 | 564    | 312              | 70.6         | 138                       | 25.0                     |
| Installation Rate (%)                                  | 86%              | 100%                      | 100%                     | 100%                | 100%   | 100%             | 100%         | 100%                      | 100%                     |
| Energy Interactive Effects Factor (%)                  | 0.0%             | 0.0%                      | 0.0%                     | 0.0%                | 0.0%   | 0.0%             | 0.0%         | 0.0%                      | 0.0%                     |
| Gross Energy Savings – at the Meter (GWh)              | 0.010            | 0.191                     | 0.109                    | 2.425               | 0.539  | 0.019            | 0.220        | 0.393                     | 0.100                    |
| Line Loss Factor                                       | 1.0947           | 1.0947                    | 1.0947                   | 1.0947              | 1.0947 | 1.0947           | 1.0947       | 1.0947                    | 1.0947                   |
| Gross Energy Savings – at the Generator (GWh)          | 0.011            | 0.209                     | 0.119                    | 2.655               | 0.590  | 0.021            | 0.241        | 0.430                     | 0.109                    |
| Effective Useful Life (years)                          | 4.0              | 10.0                      | 10.0                     | 10.0                | 10.0   | 10.0             | 10.0         | 11.0                      | 12.0                     |
| Gross Lifetime Energy Savings – at the Generator (GWh) | 0.044            | 2.090                     | 1.188                    | 26.548              | 5.902  | 0.212            | 2.407        | 4.731                     | 1.313                    |
| Peak Demand Savings                                    |                  |                           |                          |                     |        |                  |              |                           |                          |
| Unitary Peak Demand Savings (W)                        | 0.00             | 0.00                      | 0.00                     | 0.00                | 0.00   | 0.00             | 0.00         | 19.0                      | 3.45                     |
| Installation Rate (%)                                  | 86%              | 100%                      | 100%                     | 100%                | 100%   | 100%             | 100%         | 100%                      | 100%                     |
| Peak Demand Interactive Effects Factor (%)             | 0.0%             | 0.0%                      | 0.0%                     | 0.0%                | 0.0%   | 0.0%             | 0.0%         | 0.0%                      | 0.0%                     |
| Gross Peak Demand Savings – at the Meter (MW)          | 0.000            | 0.000                     | 0.000                    | 0.000               | 0.000  | 0.000            | 0.000        | 0.054                     | 0.014                    |
| Line Loss Factor                                       | 1.1466           | 1.1466                    | 1.1466                   | 1.1466              | 1.1466 | 1.1466           | 1.1466       | 1.1466                    | 1.1466                   |
| Gross Peak Demand Savings – at the Generator (MW)      | 0.000            | 0.000                     | 0.000                    | 0.000               | 0.000  | 0.000            | 0.000        | 0.062                     | 0.016                    |



**Evaluated 2024 Instant Savings Gross Electrical Energy and Peak Demand Savings (Continued)**

| Product Category                                              | Efficient Combined Washers/Dryers | Room Air Purifiers | Dehumidifiers | Pool Pumps   | Heat Pump Water Heaters | High-efficiency Dishwashers | Bathroom and Utility Fans | Total for All Products |
|---------------------------------------------------------------|-----------------------------------|--------------------|---------------|--------------|-------------------------|-----------------------------|---------------------------|------------------------|
| <b>Number of Units</b>                                        |                                   |                    |               |              |                         |                             |                           |                        |
| Number of Units – Spring                                      | 32                                | 723                | 590           | -            | 21                      | 743                         | -                         | 41,343                 |
| Number of Units – Fall                                        | 61                                | 29                 | 805           | -            | 18                      | 544                         | 1                         | 8,121                  |
| Number of Units – Year-round                                  | 236                               | 2,709              | 10,101        | 43           | 124                     | 1,898                       | 9                         | 346,008                |
| <b>Total Number of Units</b>                                  | <b>329</b>                        | <b>3,461</b>       | <b>11,496</b> | <b>43</b>    | <b>163</b>              | <b>3,185</b>                | <b>10</b>                 | <b>395,472</b>         |
| <b>Energy savings</b>                                         |                                   |                    |               |              |                         |                             |                           |                        |
| Unitary Energy Savings Value (kWh)                            | 144                               | 768                | 45.2          | 530          | 1,007                   | 15.2                        | 143                       | -                      |
| Installation Rate (%)                                         | 100%                              | 100%               | 100%          | 100%         | 100%                    | 100%                        | 100%                      | -                      |
| Energy Interactive Effects Factor (%)                         | 0.0%                              | 0.0%               | 0.0%          | 0.0%         | 0.0%                    | 0.0%                        | 0.0%                      | -                      |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>0.047</b>                      | <b>2.658</b>       | <b>0.520</b>  | <b>0.023</b> | <b>0.164</b>            | <b>0.048</b>                | <b>0.001</b>              | <b>24.558</b>          |
| Line Loss Factor                                              | 1.0947                            | 1.0947             | 1.0947        | 1.0947       | 1.0947                  | 1.0947                      | 1.0947                    | -                      |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>0.052</b>                      | <b>2.910</b>       | <b>0.569</b>  | <b>0.025</b> | <b>0.180</b>            | <b>0.053</b>                | <b>0.002</b>              | <b>26.884</b>          |
| Effective Useful Life (years)                                 | 11.0                              | 9.0                | 12.0          | 10.0         | 15.0                    | 11.0                        | 9.5                       | -                      |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.570</b>                      | <b>26.188</b>      | <b>6.826</b>  | <b>0.249</b> | <b>2.695</b>            | <b>0.583</b>                | <b>0.015</b>              | <b>102.668</b>         |
| <b>Peak Demand savings</b>                                    |                                   |                    |               |              |                         |                             |                           |                        |
| Unitary Peak Demand Savings (W)                               | 19.9                              | 131                | 15.1          | 0.00         | 163                     | 1.39                        | 14.3                      | -                      |
| Installation Rate (%)                                         | 100%                              | 100%               | 100%          | 100%         | 100%                    | 100%                        | 100%                      | -                      |
| Peak Demand Interactive Effects Factor (%)                    | 0.0%                              | 0.0%               | 0.0%          | 0.0%         | 0.0%                    | 0.0%                        | 0.0%                      | -                      |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.007</b>                      | <b>0.453</b>       | <b>0.174</b>  | <b>0.000</b> | <b>0.027</b>            | <b>0.004</b>                | <b>0.000</b>              | <b>2.578</b>           |
| Line Loss Factor                                              | 1.1466                            | 1.1466             | 1.1466        | 1.1466       | 1.1466                  | 1.1466                      | 1.1466                    | -                      |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.008</b>                      | <b>0.520</b>       | <b>0.199</b>  | <b>0.000</b> | <b>0.030</b>            | <b>0.005</b>                | <b>0.000</b>              | <b>2.956</b>           |

Figure 8 and Figure 9 below compare tracked unitary electrical energy and peak demand savings to evaluated gross savings. Both sets of savings values include adjustments to account for interactive effects. As outlined in the figures, the most significant difference in gross energy and peak demand savings came from the revision of the unitary energy savings and unitary peak demand savings value for LED fixtures, notably solar fixtures, and room air purifiers.

**Figure 8: 2024 Instant Savings Tracked and Evaluated Gross Energy Savings**

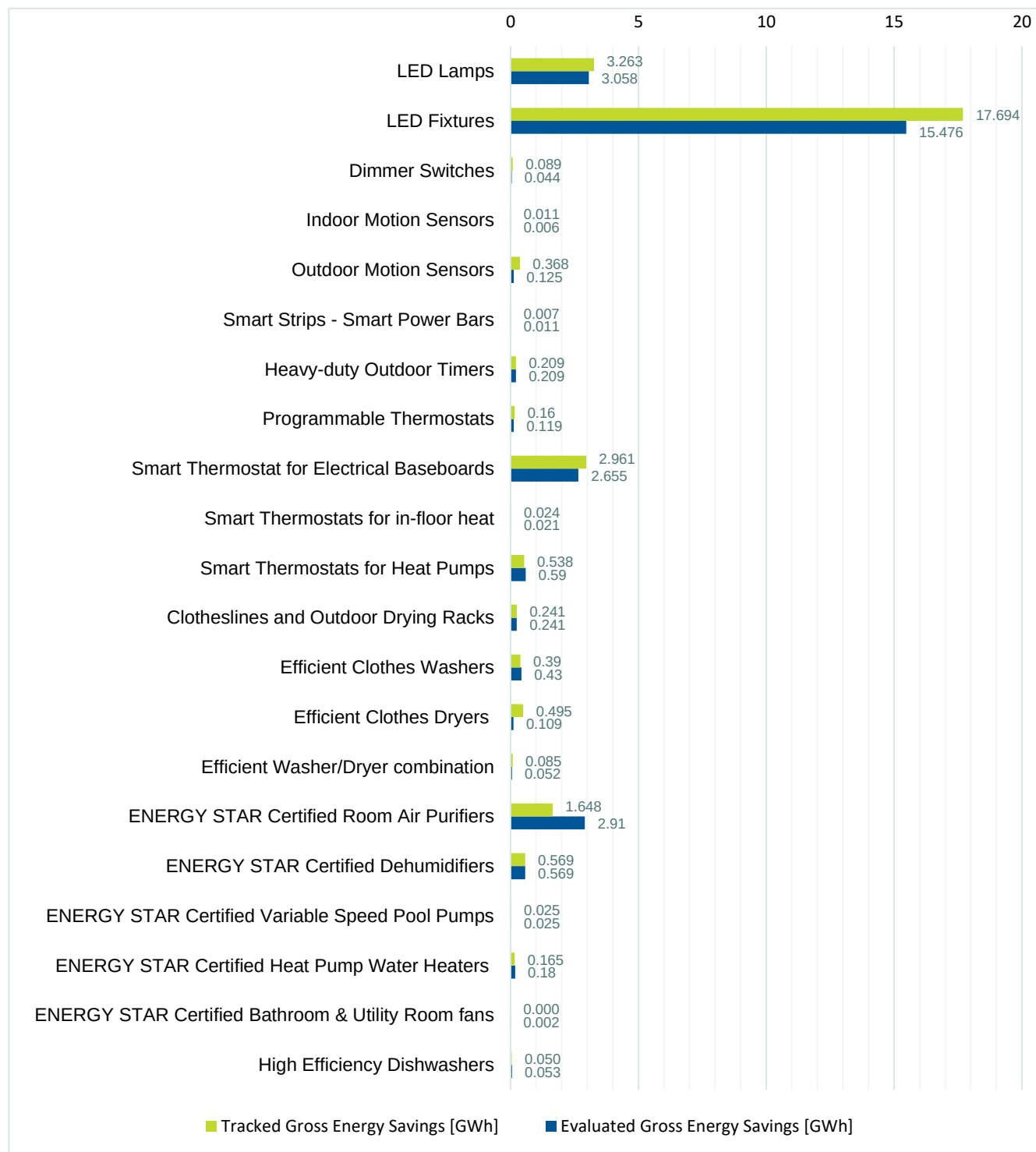
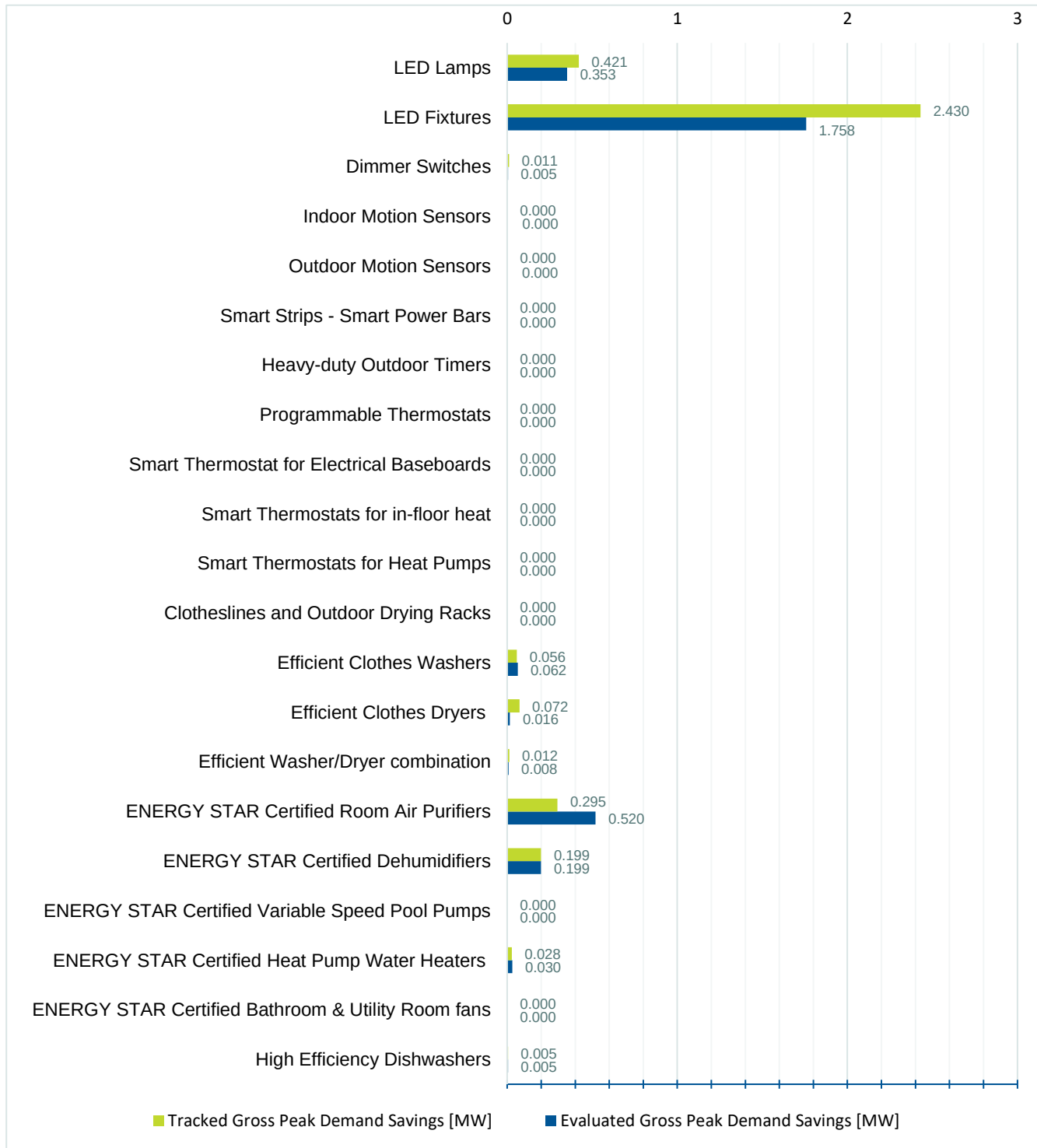


Figure 9: 2024 Instant Savings Tracked and Evaluated Gross Peak Demand Savings



As presented in Table 24, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>22</sup> for GHG emissions generated by electricity production to Instant Savings gross savings.

**Table 24: Evaluated 2024 Instant Savings Gross GHG Emission Reductions**

|                                                                                             | Total         |
|---------------------------------------------------------------------------------------------|---------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>26.884</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2         |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>12,695</b> |

## 7.3 Net Savings

The Evaluator determined the net energy and peak demand savings, that is the electrical energy and peak demand savings that can be reliably attributed to a program component, by estimating the NTGR. In the case of Instant Savings, free-ridership and spillover are considered for three specific products, namely LED lamps, LED recessed downlight fixtures (simplified as recessed fixtures), and other LED fixtures. Those products were selected since they remain the best-selling product categories of the program component, accounting for 69% of total gross savings.

### 7.3.1 Free-ridership

Free-ridership levels are calculated using algorithms that assess the likelihood of participants purchasing LED lamps or fixtures without the discount offered through Instant Savings. The algorithms consider all applicable variables in the decision-making process, including awareness about the given discount, cost, timing, and quantity. The algorithms underlying the free-ridership calculations are presented in Appendix VI.

The free-ridership levels were assessed using a self-reporting approach that involved asking a series of questions through an online intercept survey to participants who had purchased LED lamps, recessed fixtures, or other LED fixtures.

Program sales are split between Costco and non-Costco stores. For Instant Savings, Costco accounts for 63% of lighting product sales and non-Costco stores account for the remaining 37%. Given the relatively large portion of lighting sales from Costco stores and indications based on 2019 data that Costco consumers may have different behaviours than consumers at other retailers, the Evaluator established free-ridership levels associated with Costco and non-Costco consumers of LED lamps and LED fixtures.

The Evaluator calculated a free-ridership level associated with Costco participants as well as non-Costco participants who purchased LED lamps. However, the 2024 online survey did not serve to collect sufficient responses from participants that purchased LED fixtures at non-Costco stores. Therefore, the Evaluator used 2023 results to establish a free-ridership level associated with non-Costco purchasers of LED fixtures. Similar methodologies were used in the 2022 evaluation. The following subsections present the results.

<sup>22</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024), and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

## Measurement of Free-ridership for Costco Participants

The free-ridership results for Costco participants are presented in Table 25 below.

**Table 25: 2024 Instant Savings Free-ridership for Costco Participants**

| Product Category  | Free-ridership |                 |
|-------------------|----------------|-----------------|
|                   | Level          | Margin of Error |
| LED Lamps         | 16%            | 7.1%            |
| LED Fixtures      | 19%            | 9.1%            |
| Recessed Fixtures | 18%            | 4.7%            |

For Costco participants, the intercept survey revealed a free-ridership level of 16% for LED lamps sold through Instant Savings in 2024. This level is lower than the 36% obtained for Costco participants during the 2022 evaluation, which was the last time data were collected for Costco participants. This decrease is mostly due to the lower proportion of Costco participants who were unaware of the discount before paying in 2024 (0% for LED lamps and 16% for fixtures) compared to 2022 (33% for lamps and 57% for fixtures). In addition, both the proportion of people that would have bought products at full price or the same number of products without the discount decreased compared to 2022.

Free-ridership for recessed fixtures could not be established for 2024. Combined, the free-ridership established for all LED fixtures is 18%, lower than the 50% obtained in 2022. Reasons for this free-ridership decrease for LED fixtures is similar to that for LED lamps.

As for all other types of products rebated through Instant Savings, the Evaluator considered the free-ridership values to be nil.

## Measurement of Free-ridership for Non-Costco Participants – LED Lamps

The free-ridership results for LED lamps for non-Costco participants are presented in Table 26 below.

**Table 26: 2024 Instant Savings Free-ridership for Non-Costco Participants**

| Product Category | Free-ridership |                 |
|------------------|----------------|-----------------|
|                  | Level          | Margin of Error |
| LED Lamps        | 51%            | 14.7%           |

For non-Costco participants, the intercept survey revealed a free-ridership level of 51% for LED lamps, which is lower than the 70% established in 2023. While the margin of error is higher than 10%, the Evaluator elected to use this result as Costco results also indicated a similar reduction in free-ridership between 2023 and 2024.

## Treatment of Free-ridership for Non-Costco Participants – LED Fixtures

The 2023 results for non-Costco participants that purchased LED fixtures were based on an online survey that generally used the same questions and algorithms for LED lamps and fixtures as in 2024. The results are presented in Table 27.

**Table 27: 2024 Instant Savings Free-ridership Levels for Non-Costco Participants**

| Product Category | Free-Ridership |                 |
|------------------|----------------|-----------------|
|                  | Level          | Margin of Error |
| All LED Fixtures | 48%            | 10.3%           |

## 2024 Overall Free-ridership Levels

The overall free-ridership levels for LED lamps and fixtures correspond to the average of the 2024 Costco free-ridership levels, the 2024 non-Costco free-ridership levels for LED lamps, and the free-ridership of non-Costco consumers for LED fixtures obtained in 2023 weighted by the number of units sold in 2024 for each product category.

Table 28 outlines the free-ridership levels for LED lamps and LED fixtures.

**Table 28: 2024 Instant Savings Free-Ridership for LED Lamps and Fixtures**

| Product Category | Retailer   | Evaluation Period | Free-ridership |                 | Number of Units Sold in 2024 | Weighted Average Free-ridership |                 |
|------------------|------------|-------------------|----------------|-----------------|------------------------------|---------------------------------|-----------------|
|                  |            |                   | Level          | Margin of Error |                              | Level                           | Margin of Error |
| LED Lamps        | Costco     | 2024              | 16%            | 7.1%            | 26,620                       | 39%                             | 6.8%            |
|                  | Non-Costco | 2024              | 51%            | 14.7%           | 51,919                       |                                 |                 |
| LED Fixtures     | Costco     | 2024              | 18%            | 6.6%            | 193,579                      | 26%                             | 7.6%            |
|                  | Non-Costco | 2023              | 48%            | 10.3%           | 75,161                       |                                 |                 |

As for all other types of products rebated through Instant Savings, the Evaluator considered the free-ridership values to be nil. Table 29 outlines the free-ridership levels for products sold through Instant Savings in 2024.

**Table 29: 2024 Instant Savings Free-ridership**

| Product Category   | Free-ridership |                 |
|--------------------|----------------|-----------------|
|                    | Level          | Margin of Error |
| LED Lamps          | 39%            | 6.8%            |
| LED Fixtures       | 26%            | 7.6%            |
| All Other Products | 0              | 0               |

## 7.3.2 Spillover

Throughout the year, sales of eligible products may have occurred due to the influence of Instant Savings even if no discount was offered. This influence is due to better knowledge and awareness about energy efficient products and changes in retailer offerings. These sales should be attributable to the program component as a form of market effects.

For the 2024 evaluation, the Evaluator used the spillover levels from the 2023 evaluation. Table 30 below outlines the spillover level by product category. The Evaluator considered the spillover values for all other products rebated through Instant Savings to be nil.

**Table 30: 2024 Instant Savings Spillover Levels**

| Product Category   | Spillover Level |
|--------------------|-----------------|
| LED Lamps          | 9%              |
| LED Fixtures       | 2%              |
| All Other Products | -               |

### 7.3.3 Net-to-gross Ratio Calculations

The NTGR is calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Spillover})$$

Using this equation, the NTGRs for LED lamps and LED fixtures were estimated at 0.70 and 0.76 respectively, as presented in Table 31 below. For all other products, a NTGR of 1.00 was used.

The free-ridership and spillover levels for non-LED products were not assessed through this evaluation. Units such as dimmer switches, occupancy sensors, and power bars are specialized products grouped into broader retail categories, which makes it difficult for retailers to estimate program component influence on product sales. Moreover, the population segments for these products are smaller, which make it more difficult to reach those consumers through an online survey or general population survey. A margin of error is not presented for spillover since it was established by census. Table 31 summarizes the NTGR of each product category based on the respective free-ridership and spillover levels.

**Table 31: 2024 Instant Savings Net-to-gross Ratios**

| Product Category   | Weighted Average Free-ridership |                 | Spillover | Net-to-gross Ratio |
|--------------------|---------------------------------|-----------------|-----------|--------------------|
|                    | Level                           | Margin of Error |           |                    |
| LED Lamps          | 39%                             | 6.8%            | 9%        | 0.70               |
| All LED Fixtures   | 26%                             | 7.6%            | 2%        | 0.76               |
| All Other Products | 0                               | 0               | 0         | 1.00               |

### 7.3.4 Evaluated Net Savings

Net savings are defined as the changes in energy use that are attributable specifically to Instant Savings. Net program component impacts were estimated by applying the overall NTGR to gross savings, as exemplified in the following equation.

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR}$$

This equation was used to calculate both net electrical energy savings and net peak demand savings.

The detailed results are presented in Table 32 below. The net energy savings resulted in 10,508 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions.



**Table 32: Evaluated 2024 Instant Savings Net Energy and Peak Demand Savings**

| Product Category                                     | LED Non-A-type Lamps  |        | LED Recessed Downlight Fixtures | LED ENERGY STAR Fixtures |                     |                | Dimmer Switches | Indoor Motion Sensors | Outdoor Motion Sensors |
|------------------------------------------------------|-----------------------|--------|---------------------------------|--------------------------|---------------------|----------------|-----------------|-----------------------|------------------------|
|                                                      | R, BR, and Decorative | Others |                                 | Without Motion Sensors   | With Motion Sensors | Solar Fixtures |                 |                       |                        |
| Energy Savings                                       |                       |        |                                 |                          |                     |                |                 |                       |                        |
| Gross Energy Savings – at the Meter (GWh)            | 1.770                 | 1.023  | 7.951                           | 5.268                    | 0.265               | 0.652          | 0.041           | 0.005                 | 0.114                  |
| NTGR                                                 | 0.70                  | 0.70   | 0.76                            | 0.76                     | 0.76                | 0.76           | 1.0             | 1.0                   | 1.0                    |
| Net Energy Savings – at the Meter (GWh)              | 1.239                 | 0.716  | 6.043                           | 4.004                    | 0.202               | 0.496          | 0.041           | 0.005                 | 0.114                  |
| Line Loss Factor                                     | 1.0947                | 1.0947 | 1.0947                          | 1.0947                   | 1.0947              | 1.0947         | 1.0947          | 1.0947                | 1.0947                 |
| Net Energy Savings – at the Generator (GWh)          | 1.357                 | 0.784  | 6.615                           | 4.383                    | 0.221               | 0.543          | 0.044           | 0.006                 | 0.125                  |
| Effective Useful Life (years)                        | 1.0                   | 1.0    | 1.0                             | 1.0                      | 1.6                 | 1.9            | 10.0            | 10.0                  | 10.0                   |
| Net Lifetime Energy Savings – at the Generator (GWh) | 1.357                 | 0.784  | 6.615                           | 4.383                    | 0.353               | 1.031          | 0.444           | 0.057                 | 1.253                  |
| Peak Demand Savings                                  |                       |        |                                 |                          |                     |                |                 |                       |                        |
| Gross Peak Demand Savings – at the Meter (MW)        | 0.195                 | 0.113  | 0.832                           | 0.553                    | 0.043               | 0.106          | 0.004           | 0.000                 | 0.000                  |
| NTGR                                                 | 0.70                  | 0.70   | 0.76                            | 0.76                     | 0.76                | 0.76           | 1.0             | 1.0                   | 1.0                    |
| Net Peak Demand Savings – at the Meter (MW)          | 0.137                 | 0.079  | 0.633                           | 0.420                    | 0.032               | 0.080          | 0.004           | 0.000                 | 0.000                  |
| Line Loss Factor                                     | 1.1466                | 1.1466 | 1.1466                          | 1.1466                   | 1.1466              | 1.1466         | 1.1466          | 1.1466                | 1.1466                 |
| Net Peak Demand Savings – at the Generator (MW)      | 0.157                 | 0.090  | 0.725                           | 0.482                    | 0.037               | 0.092          | 0.005           | 0.000                 | 0.000                  |



**Evaluated 2024 Instant Savings Net Energy and Peak Demand Savings (Continued)**

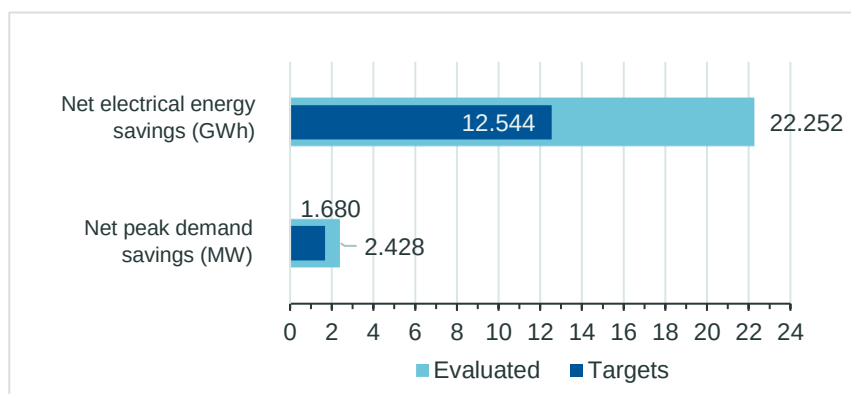
| Product Category                                     | Smart Power Bars | Heavy-duty Outdoor Timers | Programmable Thermostats | Smart Thermostats |        |                  | Clotheslines | Efficient Clothes Washers | Efficient Clothes Dryers |
|------------------------------------------------------|------------------|---------------------------|--------------------------|-------------------|--------|------------------|--------------|---------------------------|--------------------------|
|                                                      |                  |                           |                          | EBB               | MSHPs  | In-floor Heating |              |                           |                          |
| Energy Savings                                       |                  |                           |                          |                   |        |                  |              |                           |                          |
| Gross Energy Savings – at the Meter (GWh)            | 0.010            | 0.191                     | 0.109                    | 2.425             | 0.539  | 0.019            | 0.220        | 0.393                     | 0.100                    |
| NTGR                                                 | 1.0              | 1.0                       | 1.0                      | 1.0               | 1.0    | 1.0              | 1.0          | 1.0                       | 1.0                      |
| Net Energy Savings – at the Meter (GWh)              | 0.010            | 0.191                     | 0.109                    | 2.425             | 0.539  | 0.019            | 0.220        | 0.393                     | 0.100                    |
| Line Loss Factor                                     | 1.0947           | 1.0947                    | 1.0947                   | 1.0947            | 1.0947 | 1.0947           | 1.0947       | 1.0947                    | 1.0947                   |
| Net Energy Savings – at the Generator (GWh)          | 0.011            | 0.209                     | 0.119                    | 2.655             | 0.590  | 0.021            | 0.241        | 0.430                     | 0.109                    |
| Effective Useful Life (years)                        | 4.0              | 10.0                      | 10.0                     | 10.0              | 10.0   | 10.0             | 10.0         | 11.0                      | 12.0                     |
| Net Lifetime Energy Savings – at the Generator (GWh) | 0.044            | 2.090                     | 1.188                    | 26.548            | 5.902  | 0.212            | 2.407        | 4.731                     | 1.313                    |
| Peak Demand Savings                                  |                  |                           |                          |                   |        |                  |              |                           |                          |
| Gross Peak Demand Savings – at the Meter (MW)        | 0.000            | 0.000                     | 0.000                    | 0.000             | 0.000  | 0.000            | 0.000        | 0.054                     | 0.014                    |
| NTGR                                                 | 1.0              | 1.0                       | 1.0                      | 1.0               | 1.0    | 1.0              | 1.0          | 1.0                       | 1.0                      |
| Net Peak Demand Savings – at the Meter (MW)          | 0.000            | 0.000                     | 0.000                    | 0.000             | 0.000  | 0.000            | 0.000        | 0.054                     | 0.014                    |
| Line Loss Factor                                     | 1.1466           | 1.1466                    | 1.1466                   | 1.1466            | 1.1466 | 1.1466           | 1.1466       | 1.1466                    | 1.1466                   |
| Net Peak Demand Savings – at the Generator (MW)      | 0.000            | 0.000                     | 0.000                    | 0.000             | 0.000  | 0.000            | 0.000        | 0.062                     | 0.016                    |

**Evaluated 2024 Instant Savings Net Energy and Peak Demand Savings (Continued)**

| Product Category                                            | Efficient Combined Washers/Dryers | Room Air Purifiers | Dehumidifiers | Pool Pumps   | Heat Pump Water Heaters | High Efficiency Dishwashers | Bathroom & Utility fans | Total for All Products |
|-------------------------------------------------------------|-----------------------------------|--------------------|---------------|--------------|-------------------------|-----------------------------|-------------------------|------------------------|
| <b>Energy Savings</b>                                       |                                   |                    |               |              |                         |                             |                         |                        |
| <b>Gross Energy Savings – at the Meter (GWh)</b>            | <b>0.047</b>                      | <b>2.658</b>       | <b>0.520</b>  | <b>0.023</b> | <b>0.164</b>            | <b>0.048</b>                | <b>0.001</b>            | <b>24.558</b>          |
| NTGR                                                        | 1.0                               | 1.0                | 1.0           | 1.0          | 1.0                     | 1.0                         | 1.0                     | -                      |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>0.047</b>                      | <b>2.658</b>       | <b>0.520</b>  | <b>0.023</b> | <b>0.164</b>            | <b>0.048</b>                | <b>0.001</b>            | <b>20.327</b>          |
| Line Loss Factor                                            | 1.0947                            | 1.0947             | 1.0947        | 1.0947       | 1.0947                  | 1.0947                      | 1.0947                  | -                      |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>0.052</b>                      | <b>2.910</b>       | <b>0.569</b>  | <b>0.025</b> | <b>0.180</b>            | <b>0.053</b>                | <b>0.002</b>            | <b>22.252</b>          |
| Effective Useful Life (years)                               | 11.0                              | 9.0                | 12.0          | 10.0         | 15.0                    | 11.0                        | 9.5                     | -                      |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.570</b>                      | <b>26.188</b>      | <b>6.826</b>  | <b>0.249</b> | <b>2.695</b>            | <b>0.583</b>                | <b>0.015</b>            | <b>97.841</b>          |
| <b>Peak Demand Savings</b>                                  |                                   |                    |               |              |                         |                             |                         |                        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>        | <b>0.007</b>                      | <b>0.453</b>       | <b>0.174</b>  | <b>0.000</b> | <b>0.027</b>            | <b>0.004</b>                | <b>0.000</b>            | <b>2.578</b>           |
| NTGR                                                        | 1.0                               | 1.0                | 1.0           | 1.0          | 1.0                     | 1.0                         | 1.0                     | -                      |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>0.007</b>                      | <b>0.453</b>       | <b>0.174</b>  | <b>0.000</b> | <b>0.027</b>            | <b>0.004</b>                | <b>0.000</b>            | <b>2.117</b>           |
| Line Loss Factor                                            | 1.1466                            | 1.1466             | 1.1466        | 1.1466       | 1.1466                  | 1.1466                      | 1.1466                  |                        |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>0.008</b>                      | <b>0.520</b>       | <b>0.199</b>  | <b>0.000</b> | <b>0.030</b>            | <b>0.005</b>                | <b>0.000</b>            | <b>2.428</b>           |

As outlined in Figure 10 below, Instant Savings exceeded both its electrical energy and peak demand savings targets by 77% and 45% respectively.

**Figure 10: 2024 Instant Savings Targets and Evaluated Results**



## 7.4 Realization Rate

Table 33 below compares the energy and peak demand savings established through this evaluation to those tracked by E1. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 33: Comparison of 2024 Instant Savings Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                  | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                  | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings                                                                                                                                                   |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                            | 29.151        | GWh  | 0.66  | 19.129      | GWh  | 116%             |
| Evaluation Results                                                                                                                                               | 26.884        | GWh  | 0.83  | 22.252      | GWh  |                  |
| Peak Demand Savings                                                                                                                                              |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                            | 3.585         | MW   | 0.62  | 2.206       | MW   | 110%             |
| Evaluation Results                                                                                                                                               | 2.956         | MW   | 0.82  | 2.428       | MW   |                  |
| *NTGRs varied for each product category. The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings. |               |      |       |             |      |                  |

The evaluated net energy savings were higher than the value tracked by E1 (16%). The evaluated gross savings were lower than those tracked by E1 (-8%) mainly due to updates in the unitary savings values for several products, notably LED fixtures. This was counterbalanced by an increase in the NTGR due to a decrease in free-ridership for LED lamps and fixtures.

The evaluated net peak demand savings were also 10% higher than those tracked by E1 for the same reasons.



## 8 Instant Savings Key Findings and Recommendations

The 2024 Instant Savings evaluation included a comprehensive impact evaluation whereby NTGRs, notably for free-ridership, as well as unitary savings were reviewed and updated. The main objectives of the 2024 Instant Savings evaluation were as follows:

- › Calculate gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions.

This section provides the Evaluator's key findings in relation to the above objectives. The Evaluator has no specific recommendation for Instant Savings.

**2024 Instant Savings-Finding: Instant Savings surpassed both its net electrical energy savings and peak demand savings targets by 77% and 45% respectively.**

Instant Savings achieved 22.252 GWh in net electrical energy savings and 2.428 MW in net peak demand savings at the generator in 2024, thus surpassing the planned net electrical energy savings and net peak demand savings of 12.544 GWh and 1.680 MW respectively.

**2024 Instant Savings-Finding: Program participation levels in 2024 increased by 82% compared to 2023 levels, likely driven by E1's Lights Out campaign, with ENERGY STAR certified LED fixtures and ENERGY STAR certified non-A-type LED lamps being the largest drivers of participation.**

E1 ran a campaign in 2024 to make customers and retailers aware that 2024 would be the final year to take advantage of rebates on LED lamps and fixtures. In 2025, the new baseline for certain residential lighting measures will be LED, making 2024 the last year of savings for these products in Instant Savings. The ENERGY STAR certified LED fixture products saw an increase of 204%, representing 68% of total units sold.

**2024 Instant Savings-Finding: Savings from products other than lighting increased in 2024, while most savings continued to come from LED lighting products.**

ENERGY STAR certified LED fixture products and ENERGY STAR certified non-A-type LED lamps continued to be the largest contributors to participation and savings for the program component, generating 69% of 2024 savings. E1 will stop rebating LED lamps and fixtures in 2025. Non-lighting products saw a 17% increase in savings in 2024 compared to 2023 levels.

**2024 Instant Savings-Finding: The free-ridership level for both LED lamps and LED fixtures decreased in 2024.**

In 2024, the free-ridership level for LED lamps was established at 39% compared to 59% in the 2023 evaluation. The free-ridership level for LED fixtures for Costco participants was 18% compared to 50% established in 2022. Combining these results with 2023 results for non-Costco participants resulted in an overall free-ridership of 26% for LED fixtures.

**2024 Instant Savings-Finding: The evaluated net electrical energy savings and net peak demand savings determined by the Evaluator were higher than the net savings tracked by E1.**

The evaluated net energy and peak demand savings were 16% and 10% higher than the values tracked by E1, respectively. This was due to the higher NTGR established for LED lamps and LED fixtures in 2024.

## CONCLUSION

Table 34 presents the participation levels, NTGRs, evaluated gross and net savings at the generator, annual GHG emission reductions, as well as EUL values for each Residential Efficient Product Rebates program component and for the program as a whole.

**Table 34: Overall 2024 Residential Efficient Product Rebates Participation and Evaluated Savings**

|                                | Participation Level |               | Gross Savings |                  | NTGR  | Net Savings |                  |
|--------------------------------|---------------------|---------------|---------------|------------------|-------|-------------|------------------|
|                                | Value               | Unit          | Value         | Unit             | Value | Value       | Unit             |
| ARet                           |                     |               |               |                  |       |             |                  |
| Energy Savings                 | 5,941               | Appliances    | 4.195         | GWh              | 0.56  | 2.365       | GWh              |
| Lifetime Energy Savings        |                     |               | 16.729        | GWh              | 0.56  | 9.433       | GWh              |
| Peak Demand Savings            |                     |               | 0.598         | MW               | 0.56  | 0.337       | MW               |
| Annual GHG Emission Reductions |                     |               | 1,981         | Tonnes of CO2 eq | 0.56  | 1,117       | Tonnes of CO2 eq |
| EUL                            |                     |               | 4.0           | Years            |       | 4.0         | Years            |
| Instant Savings                |                     |               |               |                  |       |             |                  |
| Energy Savings                 | 395,472             | Products sold | 26.884        | GWh              | 0.83  | 22.252      | GWh              |
| Lifetime Energy Savings        |                     |               | 102.688       | GWh              | 0.95  | 97.841      | GWh              |
| Peak Demand Savings            |                     |               | 2.956         | MW               | 0.82  | 2.428       | MW               |
| Annual GHG Emission Reductions |                     |               | 12,695        | Tonnes of CO2 eq | 0.83  | 10,508      | Tonnes of CO2 eq |
| EUL                            |                     |               | 3.8           | Years            |       | 4.4         | Years            |
| Total                          |                     |               |               |                  |       |             |                  |
| Energy Savings                 |                     |               | 31.079        | GWh              | 0.79  | 24.617      | GWh              |
| Lifetime Energy Savings        |                     |               | 119.417       | GWh              | 0.90  | 107.274     | GWh              |
| Peak Demand Savings            |                     |               | 3.554         | MW               | 0.78  | 2.765       | MW               |
| Annual GHG Emission Reductions |                     |               | 14,676        | Tonnes of CO2 eq | 0.79  | 11,625      | Tonnes of CO2 eq |
| EUL                            |                     |               | 3.8           | GWh              |       | 4.4         | Years            |

Figure 11 and Figure 12 below illustrate the net electrical energy and peak demand savings targets respectively for each program component and for Residential Efficient Product Rebates as a whole. Residential Efficiency Product Rebates achieved its targets in 2024. Residential Efficient Product Rebates was aimed at achieving 14.481 GWh in net electrical energy savings and 1.967 MW in net peak demand savings at the generator for 2024. The program exceeded the net electrical energy savings target by 70% and peak demand savings target by 41%, mostly driven by Instant Savings which remains the largest contributor to total program net electrical energy and peak demand savings.

**Figure 11: 2024 Residential Efficient Product Rebates Program Targeted and Evaluated Net Electrical Energy Savings**

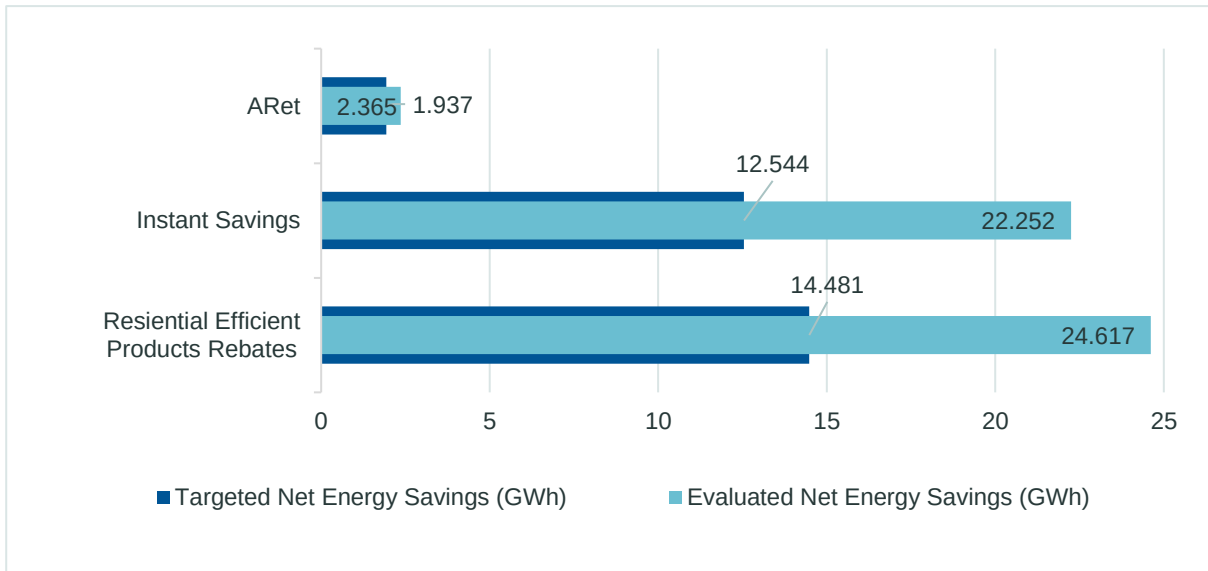
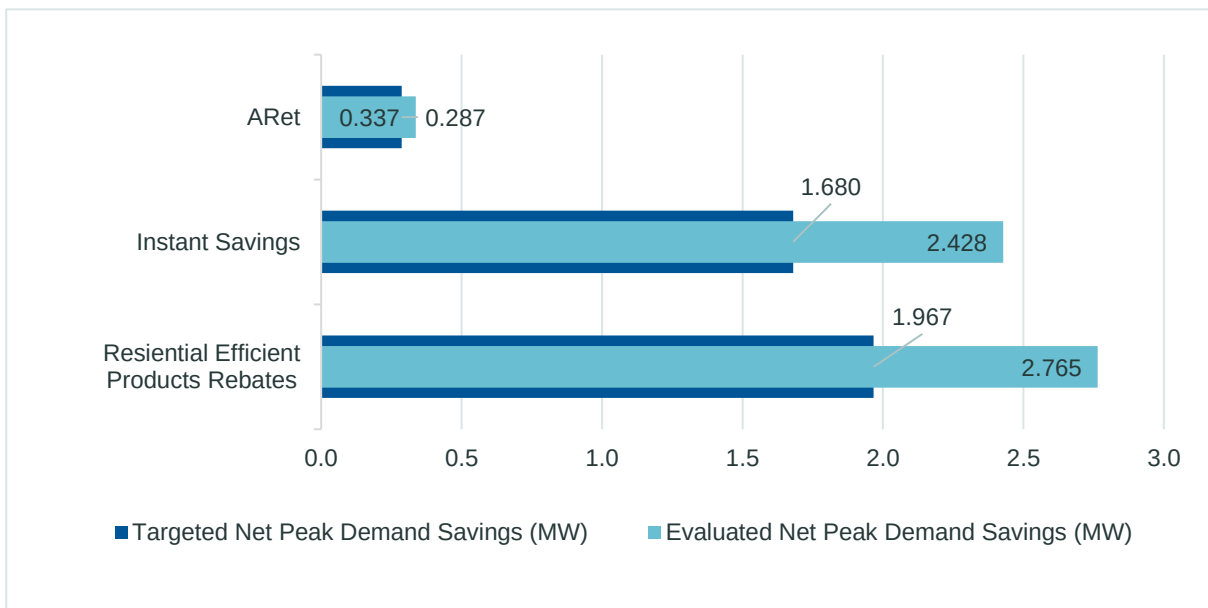


**Figure 12: 2024 Residential Efficient Product Rebates Program Targeted and Evaluated Net Peak Demand Savings**





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The following are presented in the Residential Efficient Product Rebates Program – Appendices document.

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Appendix I ARet: Tracking Sheet Audit

Appendix II ARet: 2024 Recommendations

### Instant Savings

Appendix III Instant Savings: Participant Online Survey Questionnaire

Appendix IV Instant Savings: Participant Survey Results

Appendix V Instant Savings: Tracking Sheet Audit

Appendix VI Instant Savings: Algorithms for Free-ridership Calculations

Appendix VII Instant Savings: 2024 Recommendations





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EfficiencyOne

# RESIDENTIAL EFFICIENT PRODUCT REBATES PROGRAM

Final Appendix Report

2024 DSM EVALUATION

March 4, 2025

In collaboration with:



**ECONOLUX**



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## APPENDIX I

### ARet Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by EfficiencyOne (E1)
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 ARet Corrected Tracked Savings**

| Program Component Results                  | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>ARet</b>                                |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 4.211               | GWh  | 4.212                   | GWh  | 0.02%               |
| Gross Peak Demand Savings at the Generator | 0.602               | MW   | 0.602                   | MW   | -0.03%              |
| Net Energy Savings at the Generator        | 2.373               | GWh  | 2.374                   | GWh  | 0.02%               |
| Net Peak Demand Savings at the Generator   | 0.339               | MW   | 0.339                   | MW   | -0.03%              |

Overall, the difference between tracked and corrected values is minor. The difference in gross electrical energy and peak demand savings is mainly due to the different rounding method used by the Evaluator for peak demand-to-energy ratios and line loss factors. The impact is negligible.



## APPENDIX II

### ARet 2024 Recommendations

The Evaluator made no specific recommendation as part of the 2024 evaluation of ARet.

## APPENDIX III

### Instant Savings Participant Online Survey Questionnaire

**Table 1: Overview of Data Collection Activity**

| Descriptor                      | This Instrument                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Instrument Type                 | Participant Intercept Survey with Online Option                                                                     |
| Estimated Time to Complete      | 5 min                                                                                                               |
| Target Audience                 | Instant Savings participants who have purchased LED non-A type bulbs, OR LED fixtures during the fall 2024 campaign |
| Expected Number of Completions  | n = 180: 60 for LED non-A type lamps, 60 for LED fixtures and 60 for recessed downlight fixtures                    |
| Fielding Firm                   | Narrative Research                                                                                                  |
| Estimated Timeline for Fielding | September – November                                                                                                |

**Table 2: Research Objectives and Associated Questions**

| Research Objectives                                                | Section |
|--------------------------------------------------------------------|---------|
| Introduction and Screening Respondent                              | A       |
| Number of LED lamps / LED fixtures purchased and who is using them | B and E |
| Free-Ridership for non-A type LED lamps                            | C       |
| Free-Ridership for LED fixtures                                    | D       |
| Cross-Influence                                                    | H       |
| Participant perspectives on Instant Savings awareness              | C and F |
| Demographics                                                       | I       |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**

## A. Identification and Screening of Respondent

Thank you for taking the time to answer the following short survey about energy efficiency. We are gathering information from customers who purchased certain energy-efficient LED bulbs or LED fixtures between September 23rd and November 17th. This survey should take about 5 minutes to complete.

A1. Where did you purchase your LED bulbs or LED fixtures?

1. Costco
2. The Home Depot
3. Kent

A2. Please enter the SKU number for the LED bulbs or LED fixtures you recently purchased.

- › If you purchased both LED fixtures as well as LED bulbs, please enter the SKU number for a fixture.

A3. If you purchased more than one package of LED bulbs, please enter the SKU number for a package of non-pear-shaped LED bulbs, such as those illustrated below.

- › If you purchased more than one LED fixture, please enter the SKU number for any one fixture.

: \_\_\_\_\_

| Pear-Shaped LED Bulbs                                                               |                                                                                     | Non-Pear-Shaped LED Bulbs                                                           |                                                                                      |                                                                                       |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|  |  |  |  |  |
| Pear-shaped bulb                                                                    | Smart LED bulb                                                                      | Reflector bulb                                                                      | Chandelier bulb                                                                      | Globe bulb                                                                            |

[IF SKU = BULB, GO TO B SERIES,

IF SKU = FIXTURE, GO TO E SERIES,

IF SKU IS NOT ON LIST, THANK AND TERMINATE]



## LED BULB SURVEY [ASK IF SKU = NON-A-TYPE LED BULB]

### B. Purchase – LED Bulbs

- B1. How many non-pear-shaped LED bulbs did you purchase? Please enter the number of bulbs, not packages.
1. Enter number of LED bulbs bought: \_\_\_\_ **[NUMBER OF BULBS MUST BE ≥ 1].**
  98. Don't know **[ASK RESPONDENT TO PROVIDE ESTIMATE TO CONTINUE SURVEY. IF UNABLE, THANK AND TERMINATE]**
- B2. **[IN B1 IF NUMBER OF BULBS IS > 50 BULBS]** You just entered that you purchased **[ANSWER FROM B1]** LED bulbs. Is that quantity correct?
1. Yes
  2. No **[CORRECT THE NUMBER OF BULBS FROM B1 \_\_\_\_ CAN'T EXCEED 100 BULBS]**
  98. Don't know **[ASK RESPONDENT TO PROVIDE ESTIMATE TO CONTINUE SURVEY. IF UNABLE, THANK AND TERMINATE]**
- B3. Did you purchase these bulbs for your own use (for example, for your home or cottage) **[ALLOW ONE RESPONSE ONLY]**
1. I purchased them for my own use
  96. Other, please specify [\_\_\_\_\_]
- B4. Are there any non-pear-shaped LED bulbs currently installed in your home (other than those you just bought)? **[CODE ONE ONLY]**
1. Yes
  2. No
  98. Don't know
- B5. **[ASK IF B1 OR B2.2 = 1 BULB]** You bought one LED bulb. Do you plan on installing it... **[CODE ONLY ONE]**
1. To replace another LED bulb
  2. To replace a bulb that was not LED
  3. Into a new lamp or light fixture
  96. Other **[SPECIFY\_\_\_\_\_]**



B6. **[ASK IF B5=1]** Do you plan on installing this LED bulb... **[ALLOW ONLY ONE CODE]**

1. To replace an LED bulb once it burns out
2. To replace an LED bulb that is still working
96. Other [SPECIFY\_\_\_\_\_]

B7. **[ASK IF B5=2]** Do you plan on installing this LED bulb ... **[ALLOW ONLY ONE CODE ]**

1. To replace a bulb once it burns out
2. To replace a bulb that is still working
96. Other [SPECIFY\_\_\_\_\_]

B8. **[ASK IF B1 (IF CORRECT) OR B2.2 > 1 (MORE THAN 1 BULB)]** You bought **[INSERT NUMBER OF LEDS FROM B1 (IF CORRECT) OR B2.2]** LED bulbs. How many, if any, of these **[INSERT NUMBER OF LEDS FROM B1 (IF CORRECT) OR B2.2]** LED bulbs will be installed... **[TOTAL NUMBER OF BULBS RECORDED CAN'T BE HIGHER THAN COUNT IN B1 (IF CORRECT) OR B2.2] [ALL CATEGORIES (EXCEPT 'OTHER') NEED A NUMBER, ADD IN ZEROS FOR ANY THAT WERE NOT SELECTED ]**

1. To replace another LED bulb: \_\_\_\_\_
2. To replace a bulb that was not LED: \_\_\_\_\_
3. Into a new lamp or light fixture: \_\_\_\_\_
96. Other [SPECIFY\_\_\_\_\_]

B9. **[ASK IF B8.1 >0]** Concerning the LED bulbs that you will use to replace existing LED bulbs: do you plan on installing these bulbs mostly ... **[ALLOW ONLY ONE CODE ]**

1. To replace LED bulbs once they burn out
2. To replace LED bulbs that are still working
96. Other [SPECIFY\_\_\_\_\_]
98. Don't know

B10. **[ASK IF B8.2 >0]** Concerning the bulbs that you will use to replace existing non-LED bulbs: do you plan on installing these LED bulbs mostly ... **[ALLOW ONLY ONE CODE ]**

1. To replace bulbs once they burn out
2. To replace bulbs that are still working
96. Other [SPECIFY\_\_\_\_\_]
98. Don't know

B11. **[ASK IF B6=2 OR B9=2]** Why do you plan on replacing LED bulbs that are still working?

**ALLOW VERBATIM RESPONSE**\_\_\_\_\_



## C. Awareness of Program and Efficiency Nova Scotia – LED Bulbs

- C1. Have you ever heard of the Efficiency Nova Scotia program that offers instant savings at the cash register for the purchase of energy-efficient lighting, controls or appliances? **[ALLOW ONLY ONE CODE]**
1. Yes
  2. No
- C2. **[ASK IF C1=1]** How did you find out about this program? **[ALLOW MULTIPLE RESPONSES; MAKE DON'T KNOW EXCLUSIVE]**
1. TV ads
  2. Print ads
  3. Radio ads
  4. In-store promotions
  5. Store flyer
  6. Store personnel
  7. Efficiency Nova Scotia website
  8. Social Media (e.g., Facebook, Twitter/X, Instagram, Snapchat, TikTok, YouTube, etc.)
  9. Online advertisement on smart phone, computer or tablet
  10. YouTube video
  11. Word of mouth
  12. Through an Efficiency Nova Scotia representative during an in-store engagement event
  13. Through another Efficiency Nova Scotia program
  96. Other [SPECIFY \_\_\_\_\_]
  98. Don't know
- C3. The day you recently bought the LED bulb(s), did you see signs or posters in the light bulb section of the store promoting the discount offered on LED bulbs? **[ALLOW ONLY ONE CODE]**
1. Yes
  2. No
  98. Don't know

## D. Free-Ridership - LED Bulbs

- D1. Efficiency Nova Scotia offered a discount on non-pear-shaped LED bulbs. Before paying at the cash register, were you aware that a discount was offered on the purchase of LEDs? **[ALLOW ONLY ONE CODE]**
1. Yes **[GO TO D3]**
  2. No **[GO TO D2]**
  98. Don't know **[GO TO D2]**
- D2. **[ASK IF NOT AWARE OF THE DISCOUNT (D1=2, DK)]** To confirm, you did not know about the discount on specific LED bulbs before paying at the register? **[CODE ONE ONLY]**
1. Yes, I knew about the discount
  2. No, I did not know about the discount **[GO TO SECTION H]**
- [ASK THE FOLLOWING QUESTIONS IF AWARE OF THE DISCOUNT (D1=1) OR (D2=1), OTHERWISE SKIP TO SECTION H]**
- D3. Before the beginning of the rebate campaign on September 23rd, were you aware that discounts on LED bulbs would be offered this fall?
1. Yes
  2. No **[SKIP TO D6]**
- D4. Were you aware that this would be the last year to take advantage of Efficiency Nova Scotia discounts on LED bulbs?
1. Yes
  2. No
- D5. **[ASK IF YES IN D3]** Did you delay your purchase of LEDs to the beginning of the rebate campaign to take advantage of the discount?
1. Yes
  2. No
- D6. If the discount on LEDs had NOT been offered, what would you have bought? Would you have... **[ALLOW ONLY ONE CODE]**
1. Bought LEDs anyway
  2. Bought another type of bulb
  3. Not bought any bulbs

D7. **[ASK IF D6=2]** Which type(s) of bulb would you have purchased instead? **[ALLOW MULTIPLE RESPONSES]**

1. Incandescent
2. Halogen
3. CFLs
96. Other, SPECIFY: \_\_\_\_\_



D8. How likely would you have been to buy the LED bulbs that you purchased if you had to pay the full price? That is, how likely would have you have been to buy the LED bulbs that you purchased if you did not receive the [\$REBATE AMOUNT] discount? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely Would Not Have Bought these LEDs” and a 10 indicating that you “Definitely Would Have Bought these LEDs.” **[DO NOT ACCEPT A RANGE]**

|                                             |   |   |   |   |   |   |   |   |   |                                         |
|---------------------------------------------|---|---|---|---|---|---|---|---|---|-----------------------------------------|
| Definitely Would Not Have Bought these LEDs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Definitely Would Have Bought these LEDs |
| 0                                           |   |   |   |   |   |   |   |   |   | 10                                      |

D9. If the discount had NOT been offered, when would you have purchased the LED bulbs that you did? **[ALLOW ONLY ONE CODE]**

1. **[INCLUDE IF D5=1]** Earlier
2. Definitely on the same day
3. Probably on the same day
4. Probably at a later date
5. Definitely at a later date
6. Would not have purchased them at all **[SKIP TO H SECTION]**

D10. **[ASK IF B1 (IF CORRECT) OR B2.2 >1 (MORE THAN 1 BULB)]** Without the **[\$REBATE AMOUNT]** discount, would you have definitely purchased the same number of LED bulbs, probably purchased the same number, probably purchased fewer or definitely purchased fewer? **[ALLOW ONLY ONE CODE]**

1. Definitely the same number
2. Probably the same number
3. Probably fewer
4. Definitely fewer

D11. **[ASK D4 = 1 (YES) AND IF D10 = 3 OR 4]** You bought **[INSERT NUMBER OF LEDS FROM B1 (IF CORRECT) OR B2.2]** LED bulbs, what proportion of these bulbs do you expect to install in the next 12 months? **[ALLOW ONLY ONE CODE]**

1. All or nearly all
2. About half
3. Less than half
4. None

**[NOTE TO PROGRAMMER: CONTINUE TO SECTION H]**

## **LED FIXTURE SURVEY [ASK IF SKU = LED FIXTURE]**

### **E. Purchase – LED Fixtures**

E1. How many LED fixtures did you purchase? Please enter the number of fixtures, not packages.

1. Enter number of LED fixtures bought: \_\_\_\_ **[NUMBER OF FIXTURES MUST BE ≥ 1].**
98. Don't know **[ASK RESPONDENT TO PROVIDE ESTIMATE TO CONTINUE SURVEY. IF UNABLE, THANK AND TERMINATE]**

E2. **[IN E1 IF NUMBER OF FIXTURES IS > 50 FIXTURES]** You entered that you purchased **[ANSWER FROM E1]** LED fixtures. Is that quantity correct?

1. Yes
2. No **[CORRECT THE NUMBER OF FIXTURES FROM E1 \_\_\_\_ CAN'T EXCEED 100 FIXTURES]**
98. Don't know **[ASK RESPONDENT TO PROVIDE ESTIMATE TO CONTINUE SURVEY. IF UNABLE, THANK AND TERMINATE]**

- E3. Did you purchase these fixtures for your own use (for example, for your home or cottage)? **[ALLOW ONE RESPONSE ONLY]**
1. I purchased them for my own use
  96. Other, please specify [\_\_\_\_\_]
- E4. Are there any LED fixtures currently installed in your home (other than those you just bought)? **[ALLOW ONLY ONE CODE]**
1. Yes
  2. No
  98. Don't know
- E5. Will the LED fixture(s) you bought be installed indoor or outdoor? **[ALLOW ONLY ONE CODE]**
1. Indoor
  2. Outdoor
  3. **[SHOW IF E1 (IF CORRECT) OR E2.2 > 1 FIXTURE]** Both
  96. Other [SPECIFY \_\_\_\_\_]
- E6. **[IF E1 (IF CORRECT) OR E2.2=1 FIXTURE]** For which of the following reasons did you buy this LED fixture? **[ALLOW ONLY ONE CODE]**
1. To replace a fixture that was still functional
  2. To replace a fixture that was broken/burnt out bulb
  3. To install in a place that did not have a fixture before
  96. Other [SPECIFY \_\_\_\_\_]
- E7. **[ASK IF E1 (IF CORRECT) OR E2.2 > 1 (MORE THAN 1 FIXTURE)]** You bought **[INSERT NUMBER FROM E1 (IF CORRECT) OR E2.2]** LED fixtures. How many, if any, of these **[INSERT NUMBER FROM E1 (IF CORRECT) OR E2.2]** LED fixtures will be installed... **[TOTAL NUMBER OF FIXTURES RECORDED CAN'T BE HIGHER THAN COUNT IN E1 (IF CORRECT) OR E2.2]**
- [NOTE TO PROGRAMMER: ALL CATEGORIES NEED A NUMBER (EXCEPT 'OTHER'), CODE AS ZEROS FOR ANY THAT WERE NOT SELECTED].**
1. To replace a fixture that was still functional
  2. To replace a fixture that was broken/burn out bulb
  3. To install in a place that did not have a fixture before
  96. Other [SPECIFY \_\_\_\_\_]

E8. **[DO NOT ASK IF E6=3 OR E7= EXCLUSIVELY 3]** What types of bulbs were installed in the fixtures that you plan on replacing? **[CODE AS MANY AS APPLY; SHOW BULB TYPES ON SCREEN; RANDOMIZED]**

1. LED bulbs
2. CFL bulbs
3. Halogen bulbs
4. Standard incandescent bulbs (those bulbs typically have wattages of 40 W, 60 W or 100 W).
5. Efficient incandescent bulbs (those bulbs look the same as incandescent bulbs but typically have wattages of 29 W, 43 W or 72 W)
96. Other [SPECIFY \_\_\_\_\_]

| LED Bulb                                                                           | CFL Bulb                                                                          | Halogen Bulb                                                                       | Incandescent Bulb                                                                                                                         | Efficient Incandescent Bulb                                                                                                              |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
|  |  |  |  <p>Typically have wattages of 40 W, 60 W or 100 W</p> |  <p>Typically have wattages of 29 W, 43 W or 72 W</p> |

## **F. Awareness of Program and Efficiency Nova Scotia – LED Fixtures**

F1. Have you ever heard of the Efficiency Nova Scotia program that offers instant savings at the cash register for the purchase of energy-efficient lighting, controls or appliances? **[ALLOW ONLY ONE CODE]**

1. Yes
2. No

F2. **[ASK IF F1=1]** How did you find out about this program? **[ALLOW MULTIPLE RESPONSES; MAKE DON'T KNOW EXCLUSIVE]**

1. TV ads
2. Print ads
3. Radio ads
4. In-store promotions
5. Store flyer
6. Store personnel
7. Efficiency Nova Scotia website
8. Social Media (e.g., Facebook, Twitter/X, Instagram, Snapchat, TikTok, YouTube, etc.)
9. Online advertisement on smart phone, computer or tablet
10. YouTube video
11. Word of mouth
12. Through an Efficiency Nova Scotia representative during an in-store engagement event
13. Through another Efficiency Nova Scotia program
96. Other [SPECIFY \_\_\_\_\_]
98. Don't know

F3. The day you recently bought the LED light fixture(s), did you see signs or posters in the light fixture section of the store promoting the discount offered on LED fixtures? **[ALLOW ONLY ONE CODE]**

1. Yes
2. No
98. Don't know





## G. Free-Ridership – LED Fixtures

- G1. Efficiency Nova Scotia offered a discount on LED fixtures. Before paying at the cash register, were you aware that a discount was offered on the purchase of LED fixtures? **[ALLOW ONLY ONE CODE]**
1. Yes **[GO TO G3]**
  2. No **[GO TO G2]**
  98. Don't know **[GO TO G2]**
- G2. **[ASK IF NOT AWARE OF THE DISCOUNT (G1=2 OR 98)]** To confirm, you did not know about the discount on specific LED fixtures before paying at the register? **[ALLOW ONLY ONE CODE]**
1. Yes, I knew about the discount
  2. No, I did not know about the discount
- G3. Thinking about your purchase of LED fixtures, what best describes your situation?
1. You were looking to purchase lighting fixtures but not specifically LED
  2. You were looking to purchase LED fixtures before you were aware of the discount offered by Efficiency Nova Scotia
  3. **[ASK IF G1 = 1 OR G2 = 1]** You came to the store to purchase LED fixtures because of the discount offered by Efficiency Nova Scotia
  4. You were not looking to purchase lighting fixtures
  96. Other, SPECIFY: \_\_\_\_\_

**[ASK THE FOLLOWING QUESTIONS IF AWARE OF THE DISCOUNT (G1=1) OR (G2=1), OTHERWISE SKIP TO NEXT SECTION]**

- G4. Were you aware that this would be the last year to take advantage of Efficiency Nova Scotia discounts on LED bulbs?
1. Yes
  2. No
- G5. If the discount of [\$REBATE AMOUNT] on LED fixtures had NOT been offered, what would you have bought? Would you have... **[ALLOW ONLY ONE CODE]**
1. Bought LED fixtures anyway
  2. Bought another type of fixture without LEDs
  3. Not bought any fixtures

G6. **[ASK IF G5=2]** If you were going to purchase a fixture without LED lighting, what type of bulbs would you have installed? **[ALLOW MULTIPLE RESPONSES]**

1. Incandescent
2. Halogen
3. CFLs
96. Other, SPECIFY: \_\_\_\_\_



G7. How likely would you have been to buy the LED fixtures that you purchased if you had to pay the full price? That is, how likely would have you have been to buy the LED fixtures that you purchased if you did not receive the [\$REBATE AMOUNT] discount? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely Would Not Have Bought these LED fixtures” and a 10 indicating that you “Definitely Would Have Bought these LED fixtures.” **[DO NOT ACCEPT RANGE]**

|                                                                    |   |   |   |   |   |   |   |   |   |                                                                 |
|--------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|-----------------------------------------------------------------|
| Definitely Would Not<br>Have Bought these<br>LED fixtures<br><br>0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Definitely Would<br>Have Bought these<br>LED fixtures<br><br>10 |
|--------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|-----------------------------------------------------------------|

G8. If the discount had NOT been offered, when would you have purchased the LED fixtures that you did? **[ACCEPT ONLY ONE CODE]**

1. Earlier
2. Definitely on the same day
3. Probably on the same day
4. Probably at a later date
5. Definitely at a later date
6. Would not have purchased them at all **[SKIP TO H SECTION]**

- G9. **[ASK IF E1 (IF CORRECT) OR E2.2 > 1 (MORE THAN 1 FIXTURE)]** Without the discount, would you have definitely purchased the same number of LED fixtures, probably purchased the same number, probably purchased fewer or definitely purchased fewer? **[ACCEPT ONLY ONE CODE]**
1. Definitely the same number
  2. Probably the same number
  3. Probably fewer
  4. Definitely fewer
- G10. **[ASK G4 = 1 (YES) AND IF G9 = 3 OR 4]** You bought **[INSERT NUMBER OF LEDS FROM B1 (IF CORRECT) OR B2.2]** LED bulbs, what proportion of these bulbs do you expect to install in the next 12 months? **[ALLOW ONLY ONE CODE]**
1. All or nearly all
  2. About half
  3. Less than half
  4. None

**[NOTE TO PROGRAMMER: CONTINUE TO SECTION H]**



## CROSS-CUTTING QUESTIONS [ASK ALL]

### H. Cross-Influence

ROTATE (H1+ H2-H3) AND (H4 + H5-H6) SEQUENCES; SHOW H1 TO H3 ON SAME SCREEN AND H4 TO H6 ON SAME SCREEN

H1. Before your recent purchase, had you at any time in the past benefitted from a discount on energy efficient products or participated in any programs offered by Efficiency Nova Scotia? **[NON-OBLIGATORY]**

1. Yes
2. No

For the following statements, please indicate whether you agree or disagree.

H2. **[ASK IF H1=1]** Your previous experience with Efficiency Nova Scotia programs was a major factor in your decision to purchase **[LED BULBS/FIXTURES]**.

1. Agree
2. Disagree

H3. **[ASK IF H1=1]** Because of your previous experience with Efficiency Nova Scotia programs, you took into account the savings on your energy bill when choosing different lighting options for your home.

1. Agree
2. Disagree

H4. Before your recent purchase, had you at any time in the past already seen Efficiency Nova Scotia promotional materials advertising the benefits of LED lighting?

1. Yes
2. No
98. Don't know

For the following statements, please indicate whether you agree or disagree.

H5. **[ASK IF H4=1]** The Efficiency Nova Scotia promotional materials you saw were a major factor in your decision to purchase **[LED BULBS/FIXTURES]**.

1. Agree
2. Disagree

H6. **[ASK IF H4=1]** The Efficiency Nova Scotia promotional materials you saw prompted you to take into account the savings on your energy bill when choosing different lighting options for your home.

1. Agree
2. Disagree



## I. Demographics

These final questions are asked for statistical purposes only. The information collected is strictly confidential and will only be used in group results.

- I1. What type of residence do you live in? **[ACCEPT ONLY ONE CODE]**
1. Detached single-family house
  2. Semi-detached house
  3. Mobile home or house trailer
  4. Townhouse or duplex which share adjacent walls
  5. Row house (Single story apartment building)
  6. Apartment or condo building that has fewer than five stories
  7. Apartment or condo building that has five or more stories
  96. Another type [SPECIFY: \_\_\_\_\_]
  97. Prefer not to say
- I2. Do you own or rent this residence? **[ACCEPT ONLY ONE CODE]**
1. Own/buying **[GO TO I4]**
  2. Rent/lease **[GO TO I3]**
  96. Other (Describe)\_\_\_\_\_ **[GO TO I4]**
  97. Prefer not to say **[GO TO I4]**
- I3. Do you or does your landlord pay the electric bills for your residence? **[ACCEPT ONLY ONE CODE]**
1. I pay the electric bills
  2. My landlord pays the electric bills
  96. Other [Describe \_\_\_\_\_])
  97. Prefer not to say
- I4. Which of the following income categories best describes your total annual household income before taxes last year? **[ACCEPT ONLY ONE CODE]**
1. Less than \$28,000
  2. At least \$28,000 but less than \$39,000
  3. At least \$39,000 but less than \$47,000
  4. At least \$47,000 but less than \$54,000
  5. At least \$54,000 but less than \$61,000
  6. At least \$61,000 but less than \$100,000
  7. \$100,000 or more
  98. Don't know
  99. Prefer not to answer

15. How many individuals, including yourself, are part of your immediate household?

**DO NOT ACCEPT RANGE – NUMBER MUST BE AT LEAST 1**

**Record Number:** \_\_\_\_\_

99. Prefer not to say

16. What is your gender? **[ACCEPT ONLY ONE CODE]**

1. Male

2. Female

3. Non-binary

96. Other, please specify if you are comfortable doing so \_\_\_\_\_

99. Prefer not to say

## END

This concludes the survey. As a thank you for your time, we will provide you with a \$20 e-transfer. Please provide your full name and email address to receive the e-transfer. This information will be kept confidential. Incentives will be distributed before or soon after the end of the study in November.

- › Full name:
- › Email Address:
- › I don't wish to receive a e-transfer.
- › Do not have an email address (**DISPLAY THE FOLLOWING ONLY IF “Do not have an email address” RESPONSE IS SEELCTED:** Mailing address for \$20 cheque: \_\_\_\_\_)

## APPENDIX IV

### Instant Savings Participant Survey Results

The tables below present the survey results for Instant Savings from 2021 to 2024. As outlined in the results to A1, respondents in 2021 and 2023 were predominantly participants shopping at non-Costco retailers, 2022 results were from Costco alone and 2024 results were predominantly participants shopping at Costco. This context should be kept in mind when comparing results across years.

#### A. Identification and Screening of Respondent

A1. Where did you purchase your LED bulbs or LED fixtures?

|                    | 2024       | 2023       | 2022       | 2021       |
|--------------------|------------|------------|------------|------------|
| <b>Sample Size</b> | <b>200</b> | <b>122</b> | <b>177</b> | <b>120</b> |
| Costco             | 81%        | 7%         | 100%       | 3%         |
| The Home Depot     | 15%        | 36%        | -          | 55%        |
| Kent               | 5%         | 51%        | -          | 16%        |
| Canadian Tire      | -          | 5%         | -          | 25%        |
| Home Hardware      | -          | 1%         | -          | 2%         |

A2. Please enter the SKU number for the LED bulbs or LED fixtures you recently purchased.

|                    | 2024       | 2023       | 2022       | 2021       |
|--------------------|------------|------------|------------|------------|
| <b>Sample Size</b> | <b>200</b> | <b>122</b> | <b>177</b> | <b>120</b> |
| LED fixture(s)     | 80%        | 34%        | 72%        | 44%        |
| LED bulb(s)        | 21%        | 66%        | 28%        | 56%        |

#### B. Purchase – LED Bulbs

B1. How many non-pear-shaped LED bulbs did you purchase?

|                    | 2024      | 2023      | 2022      | 2021      |
|--------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b> | <b>41</b> | <b>81</b> | <b>49</b> | <b>67</b> |
| 1-2                | 15%       | 21%       | 10%       | 39%       |
| 3-4                | 15%       | 48%       | 0%        | 24%       |
| 5-7                | 17%       | 15%       | 16%       | 25%       |
| 8-10               | 34%       | 10%       | 43%       | 7%        |
| 11 or more         | 20%       | 6%        | 31%       | 4%        |
| MEAN               | 6.9       | 4.5       | 9.1       | 4.3       |

Base: Respondents who purchased non-A-type LED bulbs only.  
Don't know/Refused excluded from average calculations

B3. Did you purchase these bulbs for your own use (for example, for your home or cottage)?

|                                                            | 2024      | 2023      | 2022      | 2021      |
|------------------------------------------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>                                         | <b>41</b> | <b>81</b> | <b>49</b> | <b>67</b> |
| I purchased them for my own use                            | 98%       | 96%       | 98%       | 100%      |
| Others                                                     | 2%        | 4%        | 2%        | 0%        |
| Base: Respondents who purchased non-A-type LED bulbs only. |           |           |           |           |

B4. Are there any non-pear-shaped LED bulbs currently installed in your home (other than those you just bought)?

|                                                            | 2024      | 2023      | 2022      | 2021      |
|------------------------------------------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>                                         | <b>41</b> | <b>81</b> | <b>49</b> | <b>67</b> |
| Yes                                                        | 71%       | 79%       | 73%       | 79%       |
| No                                                         | 27%       | 16%       | 16%       | 19%       |
| Don't know                                                 | 2%        | 5%        | 10%       | 1%        |
| Base: Respondents who purchased non-A-type LED bulbs only. |           |           |           |           |

B5. You bought one LED bulb. Do you plan on installing it...

B8. [ASK IF B1 (MORE THAN 1 BULB)] You bought [INSERT NUMBER OF LEDS FROM B1] LED bulbs? How many, if any, of these [INSERT NUMBER OF LEDS FROM B1] LED bulbs will be installed...

|                                                | 2024      | 2023      | 2022      | 2021      |
|------------------------------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>                             | <b>41</b> | <b>81</b> | <b>49</b> | <b>67</b> |
| To replace another LED bulb                    | 22%       | 28%       | 30%       | 20%       |
| To replace a bulb that was not LED             | 59%       | 25%       | 49%       | 59%       |
| Into a new lamp or light fixture               | 16%       | 40%       | 20%       | 22%       |
| Base: Respondents who purchased LED bulbs only |           |           |           |           |



B6 / B9 Concerning the LED bulbs that you will use to replace existing LED bulbs: Do you plan on installing this LED bulb...

|                                              | 2024      | 2023      | 2022      | 2021          |
|----------------------------------------------|-----------|-----------|-----------|---------------|
| <b>Sample Size</b>                           | <b>21</b> | <b>34</b> | <b>28</b> | <b>19 (#)</b> |
| To replace an LED bulb once it burns out     | 81%       | 76%       | 71%       | 11            |
| To replace an LED bulb that is still working | 14%       | 18%       | 21%       | 8             |
| Others                                       | 5%        | 6%        | 4%        | -             |
| Don't know                                   | -         | -         | 4%        | -             |

Base: Respondents who purchased LED bulbs to replace existing LED bulbs

B7 / B10 Concerning the bulbs that you will use to replace existing non-LED bulbs: Do you plan on installing this LED bulb ...

|                                         | 2024          | 2023      | 2022      | 2021      |
|-----------------------------------------|---------------|-----------|-----------|-----------|
| <b>Sample Size</b>                      | <b>18 (#)</b> | <b>28</b> | <b>24</b> | <b>32</b> |
| To replace a bulb that is still working | 15            | 46%       | 54%       | 66%       |
| To replace a bulb once it burns out     | 3             | 46%       | 46%       | 28%       |
| Others                                  | -             | -         | -         | 6%        |
| Don't know                              | -             | 7%        | -         | -         |

Base: Respondents who purchased LED bulbs to replace existing non-LED bulbs

B11. Why do you plan on replacing LED bulbs that are still working?

|                                 | 2024         | 2023         | 2022        | 2021        |
|---------------------------------|--------------|--------------|-------------|-------------|
| <b>Sample Size</b>              | <b>2 (#)</b> | <b>5 (#)</b> | <b>5(#)</b> | <b>8(#)</b> |
| Dislike lighting of these bulbs | 2            | 2            | 3           | 7           |
| Want bulbs to match             | -            | 1            | 0           | 0           |
| Bulbs burn too fast             | -            | 0            | 0           | 1           |
| Others                          | 1            | 2            | 3           | 0           |

Base: Respondents who purchased LED bulbs to replace existing LED bulbs that are still working

Note: One respondent did not receive this question due to upcoding in B6

## C. Awareness of Program and Efficiency Nova Scotia – LED Bulbs

C1 / F1. Have you ever heard of the Efficiency Nova Scotia program that offers instant savings at the cash register for the purchase of energy-efficient lighting, controls or appliances?

|                                                                    | 2024       | 2023       | 2022       | 2021       |
|--------------------------------------------------------------------|------------|------------|------------|------------|
| <b>Sample Size</b>                                                 | <b>200</b> | <b>122</b> | <b>177</b> | <b>120</b> |
| Yes                                                                | 70%        | 65%        | 65%        | 58%        |
| No                                                                 | 30%        | 35%        | 35%        | 42%        |
| Base: Respondents who purchased non-A-type LED bulb or LED fixture |            |            |            |            |

C2 / F2. How did you find out about this program?

|                                                                                      | 2024       | 2023      | 2022       | 2021      |
|--------------------------------------------------------------------------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b>                                                                   | <b>140</b> | <b>79</b> | <b>115</b> | <b>70</b> |
| In-store promotions                                                                  | 43%        | 48%       | 45%        | 46%       |
| Through an Efficiency Nova Scotia representative during an in-store engagement event | 29%        | 23%       | 24%        | 11%       |
| Efficiency Nova Scotia website                                                       | 14%        | 13%       | 8%         | 13%       |
| Store personnel                                                                      | 13%        | 25%       | 22%        | 29%       |
| Word of mouth                                                                        | 12%        | 10%       | 9%         | 9%        |
| Social Media (e.g., Facebook, Twitter/X, Instagram, Snapchat, TikTok, YouTube, etc.) | 12%        | 7%        | 4%         | 3%        |
| Store flyer                                                                          | 8%         | 5%        | 8%         | 6%        |
| Online advertisement on smart phone, computer or tablet                              | 8%         | 3%        | 5%         | 3%        |
| Through another Efficiency Nova Scotia program                                       | 7%         | 6%        | 6%         | 6%        |
| Radio ads                                                                            | 6%         | 6%        | 3%         | 4%        |
| Print ads                                                                            | 4%         | 4%        | 3%         | 3%        |
| TV ads                                                                               | 3%         | 3%        | 2%         | 1%        |
| Billboards and other outdoor advertising                                             | -          | -         | 1%         | -         |
| Others                                                                               | 1%         | 4%        | 1%         | 1%        |
| Don't know                                                                           | 1%         | -         | 1%         | 1%        |
| Base: Respondents who were aware of Instant Savings                                  |            |           |            |           |
| Multiple responses                                                                   |            |           |            |           |

C3. The day you recently bought the LED bulb(s), did you see signs or posters in the light bulb section of the store promoting the discount offered on LED bulbs?

|                    | 2024      | 2023      | 2022      | 2021      |
|--------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b> | <b>41</b> | <b>81</b> | <b>49</b> | <b>67</b> |
| Yes                | 61%       | 53%       | 69%       | 55%       |
| No                 | 29%       | 40%       | 27%       | 40%       |
| Don't know         | 10%       | 7%        | 4%        | 4%        |

Base: Respondents who purchased non-A-type LED bulbs

## D. Free-Ridership - LED Bulbs

D1. Efficiency Nova Scotia offered a discount on non-pear-shaped LED bulbs. Before paying at the cash register, were you aware that a discount was offered on the purchase of LEDs?

D2. To confirm, you did not know about the discount on specific LED bulbs before paying at the register?

|                                          | 2024      | 2023      | 2022      | 2021      |
|------------------------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>                       | <b>41</b> | <b>81</b> | <b>49</b> | <b>67</b> |
| Yes, was aware of discount before paying | 73%       | 48%       | 67%       | 52%       |
| No, was aware of discount before paying  | 27%       | 52%       | 33%       | 48%       |

Base: Respondents who purchased non-A-type LED bulbs and were not aware of the discount

D3. Before the beginning of the rebate campaign on September 23rd, were you aware that discounts on LED bulbs would be offered this fall? \*

|                    | 2024      | 2023      | 2022      | 2021      |
|--------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b> | <b>30</b> | <b>40</b> | <b>33</b> | <b>35</b> |
| Yes                | 17%       | 13%       | 24%       | 6%        |
| No                 | 83%       | 88%       | 76%       | 94%       |

Base: Respondents who purchased non-A-type LED bulbs who were aware of discount prior to purchase

\*Wording change

D4. Were you aware that this would be the last year to take advantage of Efficiency Nova Scotia discounts on LED bulbs?

|                    | 2024         |
|--------------------|--------------|
| <b>Sample Size</b> | <b>5 (#)</b> |
| Yes                | 2            |
| No                 | 3            |

Base: Respondents who were aware of discounts on LED bulbs this fall  
New question in 2024

D5. Did you delay your purchase of LEDs to the beginning of the rebate campaign to take advantage of the discount? \*

|                    | 2024         | 2023         | 2022         | 2021         |
|--------------------|--------------|--------------|--------------|--------------|
| <b>Sample Size</b> | <b>5 (#)</b> | <b>5 (#)</b> | <b>8 (#)</b> | <b>2 (#)</b> |
| Yes                | 2            | 3            | 4            | -            |
| No                 | 3            | 2            | 4            | 2            |

Base: Respondents who purchased non-A-type LED bulbs who were aware of discount prior to campaign beginning

\*Wording change

D6. If the discount on LEDs had NOT been offered, what would you have bought? Would you have...

|                             | 2024      | 2023      | 2022      | 2021      |
|-----------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>          | <b>30</b> | <b>40</b> | <b>33</b> | <b>35</b> |
| Bought LEDs anyway          | 40%       | 60%       | 45%       | 89%       |
| Bought another type of bulb | 17%       | 23%       | 6%        | 3%        |
| Not bought any bulbs        | 43%       | 18%       | 48%       | 9%        |

Base: Respondents who purchased non-A-type LED bulbs who were aware of discount

D7. Which type(s) of bulb would you have purchased instead?

|                    | 2024         | 2023         | 2022         | 2021         |
|--------------------|--------------|--------------|--------------|--------------|
| <b>Sample Size</b> | <b>5 (#)</b> | <b>9 (#)</b> | <b>2 (#)</b> | <b>1 (#)</b> |
| Incandescent       | 3            | 4            | 1            | -            |
| Halogen            | 1            | 5            | -            | -            |
| CFL                | 1            | -            | 1            | 1            |

Base: Respondents who purchased non-A-type LED bulbs who would have purchased another type of bulb instead

D8. How likely would you have been to buy the LED bulbs that you purchased if you had to pay the full price? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely Would Not Have Bought these LEDs” and a 10 indicating that you “Definitely Would Have Bought these LEDs.”

| <b>Likelihood of Buying LEDs without Rebate</b> | <b>2024</b> | <b>2023</b> | <b>2022</b> | <b>2021</b> |
|-------------------------------------------------|-------------|-------------|-------------|-------------|
| <b>Sample Size</b>                              | <b>30</b>   | <b>40</b>   | <b>33</b>   | <b>35</b>   |
| MEAN                                            | 5.4         | 5.5         | 4.9         | 7.3         |

Base: Respondents who purchased non-A-type LED bulbs that were aware of discount prior to purchase

Don't know/Refused excluded from calculations

D9. If the discount had NOT been offered, when would you have purchased the LED bulbs that you did?

|                                      | 2024      | 2023      | 2022      | 2021      |
|--------------------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>                   | <b>30</b> | <b>40</b> | <b>33</b> | <b>35</b> |
| Earlier                              | 0%        | 0%        | 0%        | 0%        |
| Definitely on the same day           | 13%       | 23%       | 21%       | 60%       |
| Probably on the same day             | 13%       | 28%       | 9%        | 20%       |
| Probably at a later date             | 33%       | 23%       | 33%       | 11%       |
| Definitely at a later date           | 27%       | 10%       | 24%       | 6%        |
| Would not have purchased them at all | 13%       | 18%       | 12%       | 3%        |

Base: Respondents who purchased non-A-type LED bulbs that were aware of discount prior to purchase

D10. Without the discount, would you have definitely purchased the same number of LED bulbs, probably purchased the same number, probably purchased fewer or definitely purchased fewer?

|                            | 2024      | 2023      | 2022      | 2021      |
|----------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>         | <b>23</b> | <b>29</b> | <b>29</b> | <b>32</b> |
| Definitely the same number | 13%       | 31%       | 10%       | 50%       |
| Probably the same number   | 26%       | 21%       | 17%       | 31%       |
| Probably fewer             | 30%       | 24%       | 41%       | 13%       |
| Definitely fewer           | 30%       | 24%       | 31%       | 6%        |

Base: Respondents who purchased non-A-type LED bulbs that were aware of discount prior to purchase and would have purchased bulbs at some point without discount

D11. You bought [INSERT NUMBER OF LEDS FROM B1 (IF CORRECT) OR B2.2] LED bulbs, what proportion of these bulbs do you expect to install in the next 12 months?

|                    | 2024         |
|--------------------|--------------|
| <b>Sample Size</b> | <b>2 (#)</b> |
| All or nearly all  | 1            |
| Less than half     | 1            |

Base: Respondents who were aware that this would be the last year to take advantage of Efficiency Nova Scotia discounts on LED bulbs and would probably or definitely purchase fewer LED bulbs.

New question in 2024

## E. Purchase – LED Fixtures

E1. How many LED fixtures did you purchase?

|                    | 2024       | 2023      | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| 1-2                | 37%        | 54%       | 79%        | 64%       |
| 3-4                | 11%        | 34%       | 13%        | 13%       |
| 5-7                | 13%        | 7%        | 5%         | 6%        |
| 8-10               | 4%         | 2%        | 2%         | 9%        |
| 11 or more         | 34%        | 2%        | 1%         | 8%        |
| MEAN               | 6.7        | 2.8       | 2.1        | 3.3       |

Base: Respondents who purchased LED fixtures

E3. Did you purchase these fixtures for your own use (for example, for your home or cottage)?

|                                                                     | 2024       | 2023      | 2022       | 2021      |
|---------------------------------------------------------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b>                                                  | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| I purchased them for my own use                                     | 98%        | 98%       | 97%        | 96%       |
| I purchased them for a client or project outside of my organization | 1%         | -         | 0%         | 2%        |
| Both                                                                | 1%         | -         | 2%         | 0%        |
| Others                                                              | -          | 2%        | 1%         | 2%        |

Base: Respondents who purchased LED fixtures

The wording slightly changes in 2023

E4. Are there any LED fixtures currently installed in your home (other than those you just bought)?

|                    | 2024       | 2023      | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| Yes                | 84%        | 80%       | 84%        | 77%       |
| No                 | 15%        | 15%       | 14%        | 17%       |
| Don't know         | 1%         | 5%        | 2%         | 6%        |

Base: Respondents who purchased LED fixtures

E5. Will the LED fixture(s) you bought be installed indoor or outdoor?

|                    | 2024       | 2023*     | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| Indoor             | 82%        | 95%       | 91%        | 89%       |
| Outdoor            | 4%         | 2%        | 4%         | 8%        |
| Both               | 14%        | 2%        | 5%         | 4%        |

Base: Respondents who purchased LED fixtures

\*Responses do not sum to 100% due to rounding

E6. For which of the following reasons did you buy this LED fixture?

E7. You bought [INSERT NUMBER FROM E1] LED fixtures. How many, if any, of these [INSERT NUMBER FROM E1] LED fixtures will be installed...

|                                                          | 2024       | 2023      | 2022       | 2021      |
|----------------------------------------------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b>                                       | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| To replace a fixture that was still functional           | 40%        | 58%       | 72%        | 45%       |
| To replace a fixture that was broken                     | 11%        | 8%        | 5%         | 7%        |
| To install in a place that did not have a fixture before | 43%        | 34%       | 18%        | 49%       |
| Others                                                   | 5%         | 0%        | 1%         | 0%        |

Base: Respondents who purchased LED fixtures

E8. What types of bulbs were installed in the fixtures that you plan on replacing?

|                              | 2024       | 2023      | 2022       | 2021      |
|------------------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b>           | <b>126</b> | <b>32</b> | <b>104</b> | <b>38</b> |
| LED bulbs                    | 40%        | 38%       | 41%        | 37%       |
| Standard incandescent bulbs  | 37%        | 28%       | 32%        | 32%       |
| CFL bulbs                    | 20%        | 31%       | 19%        | 11%       |
| Halogen bulbs                | 12%        | 6%        | 8%         | 18%       |
| Efficient incandescent bulbs | 6%         | 16%       | 5%         | -         |
| Fluorescent tube             | -          | -         | 3%         | 3%        |
| Others                       | 2%         | -         | 3%         | 5%        |

Base: Respondents who replaced existing fixtures

Multiple responses

## F. Awareness of Program and Efficiency Nova Scotia – LED Fixtures

F3. The day you recently bought the LED light fixture(s), did you see signs or posters in the light fixture section of the store promoting the discount offered on LED fixtures?

|                    | 2024       | 2023      | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| Yes                | 72%        | 76%       | 37%        | 62%       |
| No                 | 21%        | 20%       | 52%        | 30%       |
| Don't know         | 8%         | 5%        | 11%        | 8%        |

Base: Respondents who purchased LED fixtures

## G. Free-Ridership – LED Fixtures

- G1. Efficiency Nova Scotia offered a discount on LED fixtures. Before paying at the cash register, were you aware that a discount was offered on the purchase of LED fixtures?
- G2. [DO NOT ASK IF 'YES' IN G1] To confirm, you did not know about the discount on specific LED fixtures before paying at the register?

|                                                  | 2024       | 2023      | 2022       | 2021      |
|--------------------------------------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b>                               | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| Yes, were aware of the discount before paying    | 82%        | 71%       | 43%        | 66%       |
| No, were not aware of the discount before paying | 18%        | 27%       | 57%        | 34%       |
| Don't know                                       | -          | 2%        | -          | -         |
| Base: Respondents who purchased LED fixtures     |            |           |            |           |

- G3. Thinking about your purchase of LED fixtures, what best describes your situation?

|                                                                                                                   | 2024       | 2023      | 2022       | 2021      |
|-------------------------------------------------------------------------------------------------------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b>                                                                                                | <b>159</b> | <b>41</b> | <b>128</b> | <b>53</b> |
| You were not looking to purchase lighting fixtures                                                                | 48%        | 10%       | 31%        | 0%        |
| You were looking to purchase LED fixtures before you were aware of the discount offered by Efficiency Nova Scotia | 24%        | 51%       | 54%        | 55%       |
| You came to the store to purchase LED fixtures because of the discount offered by Efficiency Nova Scotia          | 18%        | 10%       | 2%         | 19%       |
| You were looking to purchase lighting fixtures but not specifically LED                                           | 10%        | 29%       | 13%        | 25%       |
| Others                                                                                                            | 1%         | 0%        | 0%         | 2%        |
| Base: Respondents who purchased LED fixtures                                                                      |            |           |            |           |

- G4. Were you aware that this would be the last year to take advantage of Efficiency Nova Scotia discounts on LED bulbs?

|                                                                                       | 2024       |
|---------------------------------------------------------------------------------------|------------|
| <b>Sample Size</b>                                                                    | <b>131</b> |
| Yes                                                                                   | 12%        |
| No                                                                                    | 88%        |
| Base: Respondents who purchased LED fixtures and were aware of discount before paying |            |
| New question in 2024                                                                  |            |



G5. If the discount on LED fixtures had NOT been offered, what would you have bought?  
Would you have...

|                                             | 2024       | 2023      | 2022      | 2021      |
|---------------------------------------------|------------|-----------|-----------|-----------|
| <b>Sample Size</b>                          | <b>131</b> | <b>30</b> | <b>55</b> | <b>35</b> |
| Bought LED fixtures anyway                  | 20%        | 50%       | 38%       | 57%       |
| Bought another type of fixture without LEDs | 8%         | 13%       | 7%        | 11%       |
| Not bought any fixtures                     | 72%        | 37%       | 55%       | 31%       |

Base: Respondents who were aware of discount prior to purchase

G6. If you were going to purchase a fixture without LED lighting, what type of bulbs would you have installed?

|                    | 2024          | 2023         | 2022         | 2021         |
|--------------------|---------------|--------------|--------------|--------------|
| <b>Sample Size</b> | <b>11 (#)</b> | <b>4 (#)</b> | <b>4 (#)</b> | <b>4 (#)</b> |
| Incandescent       | 6             | 2            | 3            | -            |
| CFL                | 4             | 1            | 1            | 1            |
| Halogen            | 2             | -            | -            | 3            |
| Others             | -             | 1            | -            | -            |

Base: Respondents who were aware of discount prior to purchase and who would have bought another type of fixture without LEDs if discount had not been offered

Multiple responses

G7. How likely would you have been to buy the LED fixtures that you purchased if you had to pay the full price? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely Would Not Have Bought these LED fixtures” and a 10 indicating that you “Definitely Would Have Bought these LED fixtures.”

| <b>Likelihood of Buying LEDs without Discount</b> | <b>2024</b> | <b>2023</b> | <b>2022</b> | <b>2021</b> |
|---------------------------------------------------|-------------|-------------|-------------|-------------|
| <b>Sample Size</b>                                | <b>131</b>  | <b>30</b>   | <b>55</b>   | <b>35</b>   |
| MEAN                                              | 3.4         | 6.2         | 5.7         | 6.2         |

Base: Respondents who purchased LED fixtures who were aware of discount prior to purchase

Don't know/Refused excluded from calculations

G8. If the discount had NOT been offered, when would you have purchased the LED fixtures that you did?

|                                      | 2024       | 2023      | 2022      | 2021      |
|--------------------------------------|------------|-----------|-----------|-----------|
| <b>Sample Size</b>                   | <b>131</b> | <b>30</b> | <b>55</b> | <b>35</b> |
| Earlier                              | 1%         | 2%        | -         | -         |
| Definitely on the same day           | 5%         | 20%       | 11%       | 20%       |
| Probably on the same day             | 7%         | 17%       | 16%       | 14%       |
| Probably at a later date             | 32%        | 30%       | 25%       | 37%       |
| Definitely at a later date           | 22%        | 20%       | 35%       | 14%       |
| Would not have purchased them at all | 34%        | 13%       | 11%       | 14%       |

Base: Respondents who purchased LED fixtures who were aware of discount prior to purchase

G9. Without the discount, would you have definitely purchased the same number of LED fixtures, probably purchased the same number, probably purchased fewer or definitely purchased fewer?

|                            | 2024      | 2023      | 2022      | 2021      |
|----------------------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>         | <b>71</b> | <b>17</b> | <b>24</b> | <b>20</b> |
| Definitely the same number | 6%        | 29%       | 13%       | 25%       |
| Probably the same number   | 27%       | 29%       | 42%       | 15%       |
| Probably fewer             | 42%       | 24%       | 21%       | 45%       |
| Definitely fewer           | 25%       | 18%       | 25%       | 15%       |

Base: Respondents who purchased LED fixtures who were aware of discount prior to purchase and would have purchased bulbs at some point without discount

G10. You bought [INSERT NUMBER OF FIXTURES FROM E1 (IF CORRECT) OR E2.2] LED fixtures, what proportion of these fixtures do you expect to install in the next 12 months?

|                                                                                           | 2024         |
|-------------------------------------------------------------------------------------------|--------------|
| <b>Sample Size</b>                                                                        | <b>5 (#)</b> |
| All or nearly all                                                                         | 5            |
| Base: Respondents who purchased LED fixtures who were aware of discount prior to purchase |              |
| New question in 2024                                                                      |              |

## H. Cross-Influence

- H1. Before your recent purchase, had you at any time in the past benefitted from a discount on energy efficient products or participated in other programs offered by Efficiency Nova Scotia?

|                    | 2024       | 2023       | 2022       | 2021       |
|--------------------|------------|------------|------------|------------|
| <b>Sample Size</b> | <b>197</b> | <b>122</b> | <b>176</b> | <b>118</b> |
| Yes                | 56%        | 50%        | 57%        | 56%        |
| No                 | 44%        | 50%        | 43%        | 44%        |

Base: Respondents who purchased non-A-type LED bulbs or LED fixtures

- H2. Your previous experience with Efficiency Nova Scotia programs was a major factor in your decision to purchase [LED BULBS/FIXTURES].

|                    | 2024       | 2023      | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>111</b> | <b>61</b> | <b>100</b> | <b>66</b> |
| Agree              | 80%        | 66%       | 65%        | 70%       |
| Disagree           | 20%        | 34%       | 35%        | 30%       |

Base: Respondents who benefitted from ENS program in the past

- H3. Because of your previous experience with Efficiency Nova Scotia programs, you took into account the savings on your energy bill when choosing different lighting options for your home.

|                    | 2024       | 2023      | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>111</b> | <b>61</b> | <b>100</b> | <b>66</b> |
| Agree              | 84%        | 82%       | 83%        | 92%       |
| Disagree           | 16%        | 18%       | 17%        | 8%        |

Base: Respondents who benefitted from ENS program in the past

- H4. Before your recent purchase, had you at any time in the past already seen Efficiency Nova Scotia promotional materials advertising the benefits of LED lighting?

|                    | 2024       | 2023       | 2022       | 2021       |
|--------------------|------------|------------|------------|------------|
| <b>Sample Size</b> | <b>198</b> | <b>122</b> | <b>177</b> | <b>120</b> |
| Yes                | 67%        | 64%        | 67%        | 65%        |
| No                 | 23%        | 22%        | 24%        | 24%        |
| Don't know         | 10%        | 14%        | 10%        | 11%        |

Base: Respondents who purchased LED bulbs or LED fixtures

H5. The Efficiency Nova Scotia promotional materials you saw were a major factor in your decision to purchase [LED BULBS/FIXTURES].

|                    | 2024       | 2023      | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>132</b> | <b>78</b> | <b>118</b> | <b>78</b> |
| Agree              | 80%        | 64%       | 64%        | 62%       |
| Disagree           | 20%        | 36%       | 36%        | 38%       |

Base: Respondents who had previously seen ENS promotional materials

H6. The Efficiency Nova Scotia promotional materials you saw prompted you to take into account the savings on your energy bill when choosing different lighting options for your home.

|                    | 2024       | 2023      | 2022       | 2021      |
|--------------------|------------|-----------|------------|-----------|
| <b>Sample Size</b> | <b>132</b> | <b>78</b> | <b>118</b> | <b>78</b> |
| Agree              | 86%        | 79%       | 76%        | 81%       |
| Disagree           | 14%        | 21%       | 24%        | 19%       |

Base: Respondents who had previously seen ENS promotional materials

## I. Demographics

I1. What type of residence do you live in?

|                                                              | 2024       | 2023       | 2022       | 2021       |
|--------------------------------------------------------------|------------|------------|------------|------------|
| <b>Sample Size</b>                                           | <b>200</b> | <b>122</b> | <b>177</b> | <b>120</b> |
| Detached single-family house                                 | 78%        | 86%        | 84%        | 91%        |
| Semi-detached house                                          | 8%         | 7%         | 5%         | 3%         |
| Townhouse or duplex which share adjacent walls               | 5%         | 2%         | 3%         | 3%         |
| Apartment or condo building that has five or more stories    | 3%         | 2%         | 3%         | 1%         |
| Apartment or condo building that has fewer than five stories | 3%         | 2%         | 2%         | 2%         |
| Mobile home or house trailer                                 | 2%         | 0%         | 1%         | 0%         |
| Row house (single story apartment building)                  | 1%         | 0%         | 0%         | 0%         |
| Others                                                       | 0%         | 0%         | 1%         | 1%         |
| Prefer not to say                                            | 3%         | 1%         | 2%         | 0%         |

I2. Do you own or rent this residence?

|                    | 2024       | 2023       | 2022       | 2021       |
|--------------------|------------|------------|------------|------------|
| <b>Sample Size</b> | <b>200</b> | <b>122</b> | <b>177</b> | <b>120</b> |
| Own/buying         | 93%        | 95%        | 93%        | 95%        |
| Rent/lease         | 5%         | 4%         | 6%         | 3%         |
| Prefer not to say  | 3%         | 1%         | 1%         | 2%         |

13. Do you or does your landlord pay the electric bills for your residence?

|                                             | 2024         | 2023         | 2022          | 2021         |
|---------------------------------------------|--------------|--------------|---------------|--------------|
| <b>Sample Size</b>                          | <b>9 (#)</b> | <b>5 (#)</b> | <b>11 (#)</b> | <b>4 (#)</b> |
| I pay the electric bills                    | 6            | 5            | 11            | 3            |
| My landlord pays the electric bills         | 3            | -            | -             | 1            |
| Base: Respondents who rent/lease their home |              |              |               |              |

14. Which of the following income categories best describes your total annual household income before taxes last year?

|                                           | 2024       | 2023       |
|-------------------------------------------|------------|------------|
| <b>Sample Size</b>                        | <b>200</b> | <b>122</b> |
| Less than \$28,000                        | 5%         | 2%         |
| At least \$28,000 but less than \$39,000  | 4%         | 4%         |
| At least \$39,000 but less than \$47,000  | 5%         | 4%         |
| At least \$47,000 but less than \$54,000  | 2%         | 1%         |
| At least \$54,000 but less than \$61,000  | 3%         | 8%         |
| At least \$61,000 but less than \$100,000 | 23%        | 25%        |
| \$100,000 or more                         | 41%        | 39%        |
| Don't know                                | 2%         | -          |
| Prefer not to answer                      | 17%        | 17%        |
| New question in 2023                      |            |            |

15. How many individuals, including yourself, are part of your immediate household?

|                      | 2024       | 2023       |
|----------------------|------------|------------|
| <b>Sample Size</b>   | <b>200</b> | <b>122</b> |
| 1                    | 8%         | 10%        |
| 2                    | 42%        | 45%        |
| 3                    | 19%        | 21%        |
| 4                    | 19%        | 11%        |
| 5                    | 5%         | 4%         |
| 6                    | 3%         | -          |
| 7                    | 1%         | 1%         |
| Prefer not to say    | 6%         | 7%         |
| New question in 2023 |            |            |

I6. What is your gender?

|                    | 2024       | 2023       | 2022       | 2021       |
|--------------------|------------|------------|------------|------------|
| <b>Sample Size</b> | <b>200</b> | <b>122</b> | <b>177</b> | <b>120</b> |
| Male               | 47%        | 53%        | 55%        | 53%        |
| Female             | 46%        | 43%        | 44%        | 43%        |
| Non-binary         | 1%         | -          | -          | -          |
| Prefer not to say  | 7%         | 4%         | 1%         | 4%         |

## APPENDIX V

### Instant Savings Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

1. Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
2. Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 Instant Savings Corrected Tracked Savings**

| Program Component Results                  | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>Instant Savings</b>                     |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 28.519              | GWh  | 29.151                  | GWh  | 2.2%                |
| Gross Peak Demand Savings at the Generator | 3.477               | MW   | 3.585                   | MW   | 3.1%                |
| Net Energy Savings at the Generator        | 18.925              | GWh  | 19.129                  | GWh  | 1.1%                |
| Net Peak Demand Savings at the Generator   | 2.149               | MW   | 2.206                   | MW   | 2.7%                |

The Evaluator found differences between the tracked and corrected tracked values, which were mainly due to three lighting models having the incorrect product type category and errors in the net energy savings calculation for the ENERGY STAR® certified clothes dryer measure.

## APPENDIX VI

### Instant Savings Algorithms for Free-ridership Calculations

**Table 1: FR Algorithm - LED Bulbs**

| Section 1 – Free-ridership level for those who were unaware of discount before paying                                                                                                                                                                                                                                                                                       |                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <b>D1.</b> Before paying at the cash register, were you aware that a discount was offered on the purchase of LEDs?                                                                                                                                                                                                                                                          | IF Yes : GO TO Section 2<br>IF No OR REF: GO TO D2                                            |
| <b>D2. [ASK IF D1=2, DK]</b> To confirm - You did not know about the discount on specific packages of LED bulbs you purchased before paying at the register?                                                                                                                                                                                                                | IF Yes: GO TO Section 2<br>IF No OR REF: D2 = 100%                                            |
| <b>PA1 Score:</b>                                                                                                                                                                                                                                                                                                                                                           | <b>D2</b>                                                                                     |
| <b>Free-Ridership Level for those who were unaware of discount before paying</b>                                                                                                                                                                                                                                                                                            | <b>PA1</b><br><b>OTHERWISE: GO TO Section 2</b>                                               |
| Section 2 – Free-ridership level for those who postponed their purchase because of the program                                                                                                                                                                                                                                                                              |                                                                                               |
| <b>D3.</b> Before the beginning of the campaign on September 23rd, were you aware that discounts on LED bulbs would be offered this fall?                                                                                                                                                                                                                                   | IF Yes: GO TO D5<br>IF No OR REF: GO TO Section 3                                             |
| <b>D5. [ASK IF D3=1]</b> Did you delay your purchase of LEDs to the beginning of the rebate campaign to take advantage of the discount?                                                                                                                                                                                                                                     | IF Yes: D5 = GO TO D9<br>IF No OR REF: GO TO Section 3                                        |
| <b>D9.</b> If the discount had NOT been offered, when would you have purchased the LEDs that you did? Would it have been...?<br>1. <b>[ASK IF D5=1]</b> Earlier<br>2. Definitely on the same day<br>3. Probably on the same day<br>4. Probably at a later date<br>5. Definitely at a later date<br>96. (Would not have purchased them at all)<br>99. (Don't know / Refused) | IF 1: D9 = 100%<br>OTHERWISE: GO TO Section 3                                                 |
| <b>PA2 Score:</b>                                                                                                                                                                                                                                                                                                                                                           | <b>D9</b>                                                                                     |
| <b>D10.</b> Without the discount, would you have definitely purchased the same number of LED bulbs?<br>1. Definitely the same number<br>2. Probably the same number<br>3. Probably fewer<br>4. Definitely fewer<br>99. (Don't know / Refused)                                                                                                                               | IF 1: D10 = 100%<br>IF 2: D10 = 50%<br>IF 3: D10 = 25%<br>IF 4: D10 = 0%<br>IF 99: D10 = 0%   |
| <b>D11. [IF D4 = 1 AND D10 = 3,4]</b> You bought [LED bulbs] LED bulbs, how many of these bulbs do you expect to install in the next year?<br>1. All or nearly all<br>2. About half<br>3. Less than half<br>4. None                                                                                                                                                         | IF D11 = 1, D10<br>IF D11 = 2, D10 = 50%<br>IF D11 = 3, D10 = 25%<br>IF D11 = 4, D10 is EMPTY |
| <b>PA3 Score:</b>                                                                                                                                                                                                                                                                                                                                                           | <b>D10' (adjusted with D11)</b>                                                               |
| <b>Free-Ridership Level for those who postponed their purchase because of the program</b>                                                                                                                                                                                                                                                                                   | <b>MEAN VALUE OF (PA2;PA3)</b><br><b>OTHERWISE GO TO Section 3</b>                            |



### Section 3 – Free-ridership level for regular participants (aware of discount, did not postpone purchase)

|                                                                                                                                                                                                                                                                                                                                          |                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <b>D8.</b> How likely would you have been to buy the LEDs that you purchased today if you had to pay the full price? (Scale 0 to 10)                                                                                                                                                                                                     | D8 = Answer x 10%<br>IF 99: D8 = EMPTY                                                                   |
| <b>D6.</b> If the discount on LEDs had NOT been offered, what would you have bought?<br>1. Bought LEDs anyway<br>2. Bought another type of bulb<br>3. Not bought any bulbs<br>99. (Don't know / Refused)                                                                                                                                 | IF 1: D6 = 100%<br>IF 2: D6 = Use D7<br>IF 3: D6 = 0%<br>IF 99: D6 = EMPTY                               |
| <b>D7.</b> [ASK IF D6=2] Which type of bulb would you have purchased instead today?<br>1. Incandescent<br>2. Halogen<br>3. CFLs<br>96. Other<br>99.(Don't know / Refused)                                                                                                                                                                | IF 1 OR 2: D7 = 0%<br>IF 3: D7 = 50%<br>IF 96: D7 = EMPTY<br>IF 99: D7 = EMPTY                           |
| <b>PA4 Score:</b>                                                                                                                                                                                                                                                                                                                        | <b>MEAN VALUE OF (D8;D6)</b>                                                                             |
| <b>D9.</b> If the discount had NOT been offered, when would you have purchased the LEDs that you did? Would it have been...?<br>2. Definitely on the same day<br>3. Probably on the same day<br>4. Probably at a later date<br>5. Definitely at a later date<br>96. (Would not have purchased them at all)<br>99. (Don't know / Refused) | IF 2: D9 = 100%<br>IF 3: D9 = 50%<br>IF 4: D9 = 25%<br>IF 5: D9 = 0%<br>IF 96: D9 = 0%<br>IF 99: D9 = 0% |
| <b>PA5 Score:</b>                                                                                                                                                                                                                                                                                                                        | <b>D9</b>                                                                                                |
| <b>D10.</b> Without the discount, would you have purchased the same number of LEDs?<br>1. Definitely the same number<br>2. Probably the same number<br>3. Probably fewer<br>4. Definitely fewer<br>99.(Don't know / Refused)                                                                                                             | IF 1: D10 = 100%<br>IF 2: D10 = 50%<br>IF 3: D10 = 25%<br>IF 4: D10 = 0%<br>IF 99: D10 = 0%              |
| <b>D11.</b> [IF D4 = 1 AND D10 = 3,4] You bought [LED bulbs] LED bulbs, how many of these bulbs do you expect to install in the next year?<br>1. All or nearly all<br>2. About half<br>3. Less than half<br>4. None                                                                                                                      | IF D11 = 1, D10<br>IF D11 = 2, D10 = 50%<br>IF D11 = 3, D10 = 75%<br>IF D11 = 4, D10 is EMPTY            |
| <b>PA6 Score:</b>                                                                                                                                                                                                                                                                                                                        | <b>D10' (adjusted with D11)</b>                                                                          |
| Inconsistency Test #1                                                                                                                                                                                                                                                                                                                    | IF D8 ≥ 70% AND<br>D6-D7 = 0%:<br>PA4 = EMPTY                                                            |

|                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Inconsistency Test #2                                                                                                                                                                                                                                                                                                                                                                                     | IF D8 ≤ 30% AND<br>D10' ≥ 50%:<br>PA6 = EMPTY                                                                 |
| <b>Free-Ridership Level (after inconsistency tests)<br/>for regular participants</b>                                                                                                                                                                                                                                                                                                                      | <b>MEAN VALUE OF:<br/>(PA4; PA5; PA6)</b>                                                                     |
| <b>H2/H5.</b> [Your previous participation With ENS programs]/[The ENS promotional materials you saw] was a major factor in your decision to purchase a [LED BULBS] today?<br><b>H3/H6.</b> [Your previous experience with ENS programs] / [The ENS promotional materials you saw prompted] you took into account the savings on your energy bill when choosing different lighting options for your home. | Cross-influence (CI) =<br>IF(H2 OR H5=Agree;1) +<br>IF(H3 OR H6=Agree;1)                                      |
| <b>Revised Free-Ridership</b>                                                                                                                                                                                                                                                                                                                                                                             | <b>IF CI=0, Revised FR = FR</b><br><b>IF CI=1, Revised FR = FR*.75</b><br><b>IF CI=2, Revised FR = FR*.50</b> |

Retailers were asked to provide sales data for non-A type LED bulbs in advance of their interview. The data provided varied by retailer (e.g., time period, sales or shipments). Therefore, depending on the data provided, for each retailer a series of questions were asked to determine an estimate of the number of all the non-A type LED bulbs sold from January – December 2024(**#LED<sub>Jan-Dec</sub>**).

**Table 2: ME Algorithm - LED bulbs**

| Total Non-A Type Sales                                                                                                                                                                                                   |                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>Non-A type LED bulbs sold from January – December 2024</b> (extrapolated from retailer data and responses in interview)                                                                                               | <b>#LED<sub>Jan-Dec</sub></b> |
| LED Sales During Instant Savings' Campaigns                                                                                                                                                                              |                               |
| <b>LED Bulb Sales during Instant Savings' Spring and Fall Campaigns</b> (from the tracking sheet)                                                                                                                        | <b>#LED<sub>IS</sub></b>      |
| Program Influence                                                                                                                                                                                                        |                               |
| <b>C3.</b> What proportion of the number of Non-A type LED bulbs you will sell this year outside of those that received a rebate will be influenced at least in part by Efficiency Nova Scotia's programs and promotion? | <b>%influence</b>             |
| <b>Final Market Effects (LEDs) = ((#LED<sub>Jan-Dec</sub> - #LED<sub>IS</sub>) x %Influence) / #LED<sub>IS</sub></b>                                                                                                     |                               |

**Table 3: FR Algorithm – LED Fixtures**

| Section 1 – Free-ridership level for those who were unaware of discount before paying                                                                                                                                                                                                                                                                          |                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>G1.</b> Before paying at the cash register, were you aware that a discount was offered on the purchase of LED fixtures?                                                                                                                                                                                                                                     | IF Yes: GO TO Section 2<br>IF No OR REF: GO TO G2                                                             |
| <b>G2. [ASK IF G1=2, DK]</b> To confirm, you did not know about the discount on specific LED fixtures before paying at the register?                                                                                                                                                                                                                           | IF Yes: GO TO Section 2<br>IF No OR REF: G2 = 100%                                                            |
| <b>PA1 Score:</b>                                                                                                                                                                                                                                                                                                                                              | <b>G2</b>                                                                                                     |
| <b>Free-Ridership Level for those who were unaware of discount before paying</b>                                                                                                                                                                                                                                                                               | <b>PA1</b><br><b>OTHERWISE: GO TO Section 2</b>                                                               |
| Section 2 – Free-ridership level for regular participants (aware of discount)                                                                                                                                                                                                                                                                                  |                                                                                                               |
| <b>G7.</b> How likely would you have been to buy the LED fixtures that you purchased if you had to pay the full price? (Scale 0 to 10)                                                                                                                                                                                                                         | G7 = Answer x 10%<br>IF 99. G7 = EMPTY                                                                        |
| <b>G5.</b> If the discount on LED fixtures had NOT been offered, what would you have bought today?<br>1. Bought LED fixtures anyway<br>2. Bought another type of fixture without LEDs<br>3. Not bought any fixtures<br>99. (Don't know / Refused)                                                                                                              | IF 1: G5 = 100%<br>IF 2: G5 = Use G5<br>IF 3: G5 = 0%<br>IF 99: G5 = EMPTY                                    |
| <b>G6. [ASK IF G5=2]</b> If you were going to purchase a fixture without LED lighting, what type of bulbs would you have installed?<br>1. Incandescent<br>2. Halogen<br>3. CFLs<br>96. Other<br>99. (Don't know / Refused)                                                                                                                                     | IF 1 OR 2: G6 = 0%<br>IF 3: G6= 50%<br>IF 96: G6= EMPTY<br>IF 99: G6 = EMPTY                                  |
| <b>PA4 Score:</b>                                                                                                                                                                                                                                                                                                                                              | <b>MEAN VALUE OF (G7;G5)</b>                                                                                  |
| <b>G8.</b> If the discount had NOT been offered, when would you have purchased the LED fixtures that you did? Would it have been...?<br>1. Earlier<br>2. Definitely on the same day<br>3. Probably on the same day<br>4. Probably at a later date<br>5. Definitely at a later date<br>96. (Would not have purchased them at all)<br>99. (Don't know / Refused) | IF 1 OR 2: G8 = 100%<br>IF 3: G8 = 50%<br>IF 4: G8 = 25%<br>IF 5: G8 = 0%<br>IF 96: G8 = 0%<br>IF 99: G8 = 0% |
| <b>PA5 Score:</b>                                                                                                                                                                                                                                                                                                                                              | <b>G8</b>                                                                                                     |
| <b>G9.</b> Without the discount, would you have purchased the same number of LED fixtures?<br>1. Definitely the same number<br>2. Probably the same number<br>3. Probably fewer<br>4. Definitely fewer<br>99. (Don't know / Refused)                                                                                                                           | IF 1: G9 = 100%<br>IF 2: G9 = 50%<br>IF 3: G9 = 25%<br>IF 4: G9 = 0%<br>IF 99: G9 = 0%                        |

|                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>G10. [IF G4 = 1 AND G9 = 3,4]</b> You bought [LED fixtures] LED fixtures, how many of these fixtures do you expect to install in the next year?<br>1. All or nearly all<br>2. About half<br>3. Less than half<br>4. None                                                                                                                                                                                   | IF G10 = 1, G9<br>IF G10 = 2, G9 = 50%<br>IF G10 = 3, G9 = 75%<br>IF G10 = 4, G9 is EMPTY                     |
| <b>PA6 Score:</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>G9' (adjusted with G10)</b>                                                                                |
| Inconsistency Test #1                                                                                                                                                                                                                                                                                                                                                                                         | IF G7 ≥ 70% AND<br>G5-G6 = 0%:<br>PA4 = EMPTY                                                                 |
| Inconsistency Test #2                                                                                                                                                                                                                                                                                                                                                                                         | IF G7 ≤ 30% AND<br>G9' ≥ 50%<br>PA6 = EMPTY                                                                   |
| <b>Free-Ridership Level (after inconsistency tests)<br/>for regular participants</b>                                                                                                                                                                                                                                                                                                                          | <b>MEAN VALUE OF:<br/>(PA4; PA5; PA6)</b>                                                                     |
| <b>H2/H5.</b> [Your previous participation With ENS programs]/[The ENS promotional materials you saw] was a major factor in your decision to purchase a [LED FIXTURES] today?.<br><b>H3/H6.</b> [Your previous experience with ENS programs] / [The ENS promotional materials you saw prompted] you took into account the savings on your energy bill when choosing different lighting options for your home. | Cross-influence (CI) =<br>IF(H2 OR H5=Agree; 1) +<br>IF(H3 OR H6=Agree; 1)                                    |
| <b>Revised Free-Ridership</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>IF CI=0, Revised FR = FR</b><br><b>IF CI=1, Revised FR = FR*.75</b><br><b>IF CI=2, Revised FR = FR*.50</b> |



## APPENDIX VII

### Instant Savings 2024 Recommendations

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The Evaluator made no specific recommendation as part of the 2024 evaluation of Instant Savings.



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EfficiencyOne

# EXISTING RESIDENTIAL PROGRAM

Final Report

2024 DSM EVALUATION

March 26, 2025

In collaboration with:





## ABBREVIATIONS

|                  |                                                                 |
|------------------|-----------------------------------------------------------------|
| <b>AMH</b>       | Affordable Multifamily Housing                                  |
| <b>AMI</b>       | Advanced metering infrastructure                                |
| <b>AR</b>        | Adjustment ratio                                                |
| <b>ASFH</b>      | Affordable Single-family Homes                                  |
| <b>AWHP</b>      | Air-to-water heat pump                                          |
| <b>BNI</b>       | Business, non-profit, and institutional                         |
| <b>CASHP</b>     | Centrally ducted air-source heat pump                           |
| <b>CGH Grant</b> | Canada Greener Homes Grant                                      |
| <b>CIS</b>       | Customer Information System                                     |
| <b>CMHC</b>      | Canada Mortgage and Housing Corporation's                       |
| <b>DA</b>        | Delivery agent                                                  |
| <b>DHW</b>       | Domestic hot water                                              |
| <b>DiD</b>       | Difference-in-difference                                        |
| <b>DR</b>        | Demand response                                                 |
| <b>DSM</b>       | Demand-side management                                          |
| <b>DWHR</b>      | Drain water heat recovery system                                |
| <b>E1</b>        | EfficiencyOne                                                   |
| <b>EA</b>        | Energy auditor                                                  |
| <b>ENS</b>       | Efficiency Nova Scotia                                          |
| <b>EPI</b>       | Efficient Product Installation                                  |
| <b>EPP</b>       | Efficiency Preferred Partners                                   |
| <b>ESA</b>       | Energy Solutions Advisor                                        |
| <b>ETS</b>       | Electric Thermal Storage                                        |
| <b>EUL</b>       | Effective useful life                                           |
| <b>GHG</b>       | Greenhouse gas                                                  |
| <b>HEA</b>       | Home Energy Assessment                                          |
| <b>HER</b>       | Home Energy Report                                              |
| <b>HM</b>        | Housing manager                                                 |
| <b>HPWH</b>      | Heat pump water heater                                          |
| <b>HRAI</b>      | Heating, Refrigeration and Air Conditioning Institute of Canada |
| <b>HRV</b>       | Heat recovery ventilator                                        |
| <b>HSPF</b>      | Heating season performance factor                               |





|                 |                                           |
|-----------------|-------------------------------------------|
| <b>LCEF</b>     | Low Carbon Economy Fund                   |
| <b>LED</b>      | Light-emitting diode                      |
| <b>MA</b>       | Measure Assessment                        |
| <b>MEI</b>      | MyEnergy Insights                         |
| <b>MHEEP</b>    | Mi'kmaw Home Energy Efficiency Project    |
| <b>MLAs</b>     | Members of the Legislative Assembly       |
| <b>MLI</b>      | Mortgage Loan Insurance                   |
| <b>MSHP</b>     | Mini-split heat pump                      |
| <b>MURB</b>     | Multi-unit residential building           |
| <b>NEEP</b>     | Northeast Energy Efficiency Partnerships' |
| <b>NPS</b>      | Net Promoter Score                        |
| <b>NRCan</b>    | Natural Resources Canada                  |
| <b>NS Power</b> | Nova Scotia Power                         |
| <b>NSUARB</b>   | Nova Scotia Utility and Review Board      |
| <b>NTGR</b>     | Net-to-gross ratio                        |
| <b>OHPA</b>     | Oil to Heat Pump Affordability            |
| <b>OR</b>       | Overestimation ratio                      |
| <b>PNS</b>      | Province of Nova Scotia                   |
| <b>PV</b>       | Solar photovoltaic                        |
| <b>RCT</b>      | Randomized controlled trial               |
| <b>UMP</b>      | Uniform Methods Project                   |
| <b>US</b>       | United States                             |

## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life values.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Available Demand Response Capacity</b> | The capacity that is available to Nova Scotia Power (NS Power) to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure available demand response (DR) capacity. Available DR capacity is evaluated on a per-participant basis based on the average demand reduction observed for each event in which the participant was scheduled to participate. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established, providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                                                      |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or a load reduction in response to events called by the electric utility (NS Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.                                                                                                                                                                                                                                                                                             |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and that of the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                                                                 |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both electrical energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Equipment life</b>                     | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



|                                         |                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global warming potential is estimated over a timescale of 100 years.                                                                           |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual electrical energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net electrical energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                                    |
| <b>First-year savings</b>               | The first full year of electrical energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                                    |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an energy efficiency program regardless of why they participated.                                                                                                                                        |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                                 |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems (such as heating and cooling) in a building due to the installation of an energy efficiency measure.                                                                                                                                                                         |
| <b>In-service rate</b>                  | The proportion of incentivized products installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as light-emitting diode (LED) lamps.                                                |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.                        |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                                         |
| <b>Line loss factor</b>                 | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                                 |
| <b>Margin of error</b>                  | The amount of random sampling error.                                                                                                                                                                                                                                                                                            |
| <b>Market effects</b>                   | The impact of a program on the market (in terms of product availability, practices, and prices) and that extends beyond changing program participant behaviours. Market effects include spillover among non-participants.                                                                                                       |

|                                 |                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Net savings</b>              | Electrical energy or peak demand savings that can be reliably attributed to a program. These include effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                               |
| <b>Net-to-gross ratio</b>       | The ratio of net electrical energy savings to gross electrical energy savings.                                                                                                                                                                                                                                                                              |
| <b>Non-sampling error</b>       | Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                 |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                                |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when NS Power's 10-minute reserve is low.                                        |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                                           |
| <b>Random sampling error</b>    | An error in measurement due to the fact that measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                          |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                                          |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                                  |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                                          |
| <b>Spillover</b>                | Savings attributable to participants who implement additional energy efficiency measure(s) introduced by a program after participating in it once and without participating in the program a second time.                                                                                                                                                   |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, with the exception of the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Electrical energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                          |



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# EXECUTIVE SUMMARY

This report presents the 2024 demand-side management (DSM) results of the Existing Residential program administered by EfficiencyOne (E1). This program is comprised of seven components: (1) Affordable Multifamily Housing (AMH); (2) Affordable Single-family Homes (ASFH); (3) Efficient Product Installation (EPI); (4) Green Heat; (5) Home Energy Assessment (HEA); (6) Mi'kmaw Home Energy Efficiency Project (MHEEP); and (7) Residential Behaviour. Combined, these program components encourage energy efficiency upgrades in existing residential homes, affordable housing, and non-profit organizations by providing financial incentives, technical information, and recommendations as well as free-of-charge direct installations of energy efficient products.

## Evaluation Approach

The 2024 Existing Residential evaluation was aimed at calculating program component gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided greenhouse gas (GHG) emissions. Table 1 summarizes the types of evaluation conducted for each program component and the corresponding methodology.

**Table 1: Summary of 2024 Existing Residential Program Evaluation**

| Program Component | Evaluation Type |         |        | Methodology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------|-----------------|---------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | Impact          | Process | Market |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| AMH               | Comprehensive   | X       |        | <ul style="list-style-type: none"> <li>› Program staff interviews</li> <li>› Energy auditor (EA) interviews</li> <li>› Participant, dropped-out participant, and non-participant interviews</li> <li>› Tracking sheet audit</li> <li>› Desk reviews with participant interviews</li> <li>› Effective useful life (EUL) update</li> <li>› Use of a net-to-gross ratio (NTGR) of 1</li> <li>› Calculations using evaluation results</li> <li>› Greenhouse gas (GHG) emission reduction calculations</li> </ul> |
| ASFH              | Condensed       | X       |        | <ul style="list-style-type: none"> <li>› Interviews with program staff and delivery agents (DAs)</li> <li>› Interviews with heat pump contractors</li> <li>› Participant survey</li> <li>› Tracking sheet audit</li> <li>› Unitary savings review</li> <li>› Effective useful life (EUL) update</li> <li>› Use of a net-to-gross ratio (NTGR) of 1</li> <li>› Calculations using evaluation results</li> <li>› GHG emission reduction calculations</li> </ul>                                                |
| EPI               | Comprehensive   |         | X      | <ul style="list-style-type: none"> <li>› Participant survey excluding electrician-installed measures</li> <li>› Site visits</li> <li>› Tracking sheet audit</li> <li>› Use of 2024 net-to-gross ratio (NTGR) results</li> <li>› Calculations using evaluation results</li> </ul>                                                                                                                                                                                                                             |

| Program Component     | Evaluation Type |         |        | Methodology                                                                                                                                                                                                                                                                                                                           |
|-----------------------|-----------------|---------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | Impact          | Process | Market |                                                                                                                                                                                                                                                                                                                                       |
|                       |                 |         |        | › Jurisdictional scan of direct install programs in North America                                                                                                                                                                                                                                                                     |
| Green Heat            | Comprehensive   |         |        | › Tracking sheet audit<br>› Past participant survey<br>› Billing analysis<br>› Unitary savings review<br>› Use of 2023 NTGR results<br>› Calculations using evaluation results<br>› GHG emission reduction calculations                                                                                                               |
| HEA                   | Comprehensive   |         |        | › Tracking sheet audit<br>› Past participant survey<br>› Billing analysis<br>› Unitary savings review<br>› Effective useful life (EUL) update<br>› Calculations using evaluation results<br>› Expired participant survey<br>› Site visits<br>› Use of 2023 net-to-gross ratio (NGTR) results<br>› GHG emission reduction calculations |
| MHEEP                 | Condensed       |         |        | › Tracking sheet audit<br>› Unitary savings review<br>› Effective useful life (EUL) update<br>› Use of a net-to-gross ratio (NTGR) of 1<br>› Calculations using evaluation results<br>› GHG emission reduction calculations                                                                                                           |
| Residential Behaviour | Comprehensive   |         |        | › Billing analysis<br>› Analysis of Participation in Other Programs<br>› GHG emission reduction calculations                                                                                                                                                                                                                          |

## Program Performance

Table 2 below presents the participation levels, NTGRs, evaluated gross and net savings at the generator, annual GHG emission reductions, as well EUL values for each program component and for Existing Residential as a whole.

**Table 2: Overall 2024 Existing Residential Participation and Evaluated Savings**

|                                | Participation Level |          | Gross Savings |                  | NTGR   | Net Savings |                  |
|--------------------------------|---------------------|----------|---------------|------------------|--------|-------------|------------------|
|                                | Value               | Unit     | Value         | Unit             | Value* | Value       | Unit             |
| <b>AMH</b>                     |                     |          |               |                  |        |             |                  |
| Energy Savings                 | 83                  | Projects | 1.159         | GWh              | 1.00   | 1.159       | GWh              |
| Lifetime Energy Savings        |                     |          | 19.397        | GWh              | 1.00   | 19.397      | GWh              |
| Peak Demand Savings            |                     |          | 0.570         | MW               | 1.00   | 0.570       | MW               |
| Annual GHG Emission Reductions |                     |          | 547           | Tonnes of CO2 eq | 1.00   | 547         | Tonnes of CO2 eq |



|                                | Participation Level |                    | Gross Savings |                  | NTGR   | Net Savings |                  |
|--------------------------------|---------------------|--------------------|---------------|------------------|--------|-------------|------------------|
|                                | Value               | Unit               | Value         | Unit             | Value* | Value       | Unit             |
| EUL                            |                     |                    | 16.7          | Years            |        | 16.7        | Years            |
| ASFH                           |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 1,193               | Participants       | 3.719         | GWh              | 1.00   | 3.719       | GWh              |
| Lifetime Energy Savings        |                     |                    | 74.428        | GWh              | 1.00   | 74.428      | GWh              |
| Peak Demand Savings            |                     |                    | 2.089         | MW               | 1.00   | 2.089       | MW               |
| Annual GHG Emission Reductions |                     |                    | 1,756         | Tonnes of CO2 eq | 1.00   | 1,756       | Tonnes of CO2 eq |
| EUL                            |                     |                    | 20.0          | Years            |        | 20.0        | Years            |
| EPI                            |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 9,993               | Participants       | 9.093         | GWh              | 0.98   | 8.948       | GWh              |
| Lifetime Energy Savings        |                     |                    | 52.872        | GWh              | 0.99   | 52.525      | GWh              |
| Peak Demand Savings            |                     |                    | 0.898         | MW               | 0.98   | 0.880       | MW               |
| Annual GHG Emission Reductions |                     |                    | 4,294         | Tonnes of CO2 eq | 0.98   | 4,225       | Tonnes of CO2 eq |
| EUL                            |                     |                    | 5.8           | Years            |        | 5.9         | Years            |
| Green Heat                     |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 1,408               | Measures installed | 1.651         | GWh              | 0.53   | 0.872       | GWh              |
| Lifetime Energy Savings        |                     |                    | 29.724        | GWh              | 0.53   | 15.697      | GWh              |
| Peak Demand Savings            |                     |                    | 2.748         | MW               | 0.56   | 1.529       | MW               |
| Annual GHG Emission Reductions |                     |                    | 780           | Tonnes of CO2 eq | 0.53   | 412         | Tonnes of CO2 eq |
| EUL                            |                     |                    | 18.0          | Years            |        | 18.0        | Years            |
| HEA                            |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 5,367               | Participants       | 38.984        | GWh              | 0.82   | 31.962      | GWh              |
| Lifetime Energy Savings        |                     |                    | 1,070.988     | GWh              | 0.80   | 859.594     | GWh              |
| Peak Demand Savings            |                     |                    | 9.698         | MW               | 0.90   | 8.681       | MW               |
| Annual GHG Emission Reductions |                     |                    | 18,408        | Tonnes of CO2 eq | 0.82   | 15,093      | Tonnes of CO2 eq |
| EUL                            |                     |                    | 27.5          | Years            |        | 26.9        | Years            |
| MHEEP                          |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 192                 | Participants       | 0.401         | GWh              | 1.00   | 0.401       | GWh              |
| Lifetime Energy Savings        |                     |                    | 8.141         | GWh              | 1.00   | 8.141       | GWh              |
| Peak Demand Savings            |                     |                    | 0.481         | MW               | 1.00   | 0.481       | MW               |
| Annual GHG Emission Reductions |                     |                    | 189           | Tonnes of CO2 eq | 1.00   | 189         | Tonnes of CO2 eq |
| EUL                            |                     |                    | 20.3          | Years            |        | 20.3        | Years            |



|                                                                                                                                                                  | Participation Level |                        | Gross Savings |                  | NTGR   | Net Savings |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------|---------------|------------------|--------|-------------|------------------|
|                                                                                                                                                                  | Value               | Unit                   | Value         | Unit             | Value* | Value       | Unit             |
| Residential Behaviour                                                                                                                                            |                     |                        |               |                  |        |             |                  |
| Energy Savings                                                                                                                                                   | 239,309             | Treatment Participants | -             | GWh              |        | 6.270       | GWh              |
| Lifetime Energy Savings                                                                                                                                          |                     |                        | -             | GWh              |        | 6.270       | GWh              |
| Peak Demand Savings                                                                                                                                              |                     |                        | -             | MW               |        | -           | MW               |
| Annual GHG Emission Reductions                                                                                                                                   |                     |                        | -             | Tonnes of CO2 eq |        | 2,961       | Tonnes of CO2 eq |
| EUL                                                                                                                                                              |                     |                        | -             | Years            |        | 1.0         | Years            |
| Total                                                                                                                                                            |                     |                        |               |                  |        |             |                  |
| Energy Savings                                                                                                                                                   |                     |                        | 55.006        | GWh              |        | 53.331      | GWh              |
| Lifetime Energy Savings                                                                                                                                          |                     |                        | 1,255.550     | GWh              |        | 1,036.052   | GWh              |
| Peak Demand Savings                                                                                                                                              |                     |                        | 16.484        | MW               |        | 14.229      | MW               |
| Annual GHG Emission Reductions                                                                                                                                   |                     |                        | 25,974        | Tonnes of CO2 eq |        | 25,183      | Tonnes of CO2 eq |
| EUL                                                                                                                                                              |                     |                        | 22.8          | Years            |        | 19.4        | Years            |
| * The average NTGR values presented in this table correspond to the ratios of net savings to gross savings by program component and then for the entire program. |                     |                        |               |                  |        |             |                  |

Existing Residential was aimed at achieving 46.523 GWh in net electrical energy savings and 11.495 MW in net peak demand savings at the generator for 2024. The program was able to achieve planned energy and peak demand savings. AMH, EPI, Green Heat, MHEEP and Residential Behaviour fell below their energy targets, while ASFH and HEA exceeded theirs. AMH, EPI and Green Heat also fell below their peak demand targets, while ASFH, HEA and MHEEP exceeded theirs. AMH, ASFH, HEA and MHEEP participation levels reached their highest point in 2024, while Residential Behaviour was launched in 2024. HEA was the largest contributor to total program net energy (60%) and peak demand savings (61%).

The following subsections present evaluation results at the program component level.

## AMH Findings and Recommendations

This subsection presents the key findings and recommendations from the 2024 AMH evaluation.

**2024 AMH-Finding:** AMH generated high levels of satisfaction overall. Interviewed participants were highly satisfied with AMH and “would definitely” recommend the program. Energy Auditors (EAs) were also satisfied with AMH overall, particularly with the selection of upgrades. Everyone agreed that the program is simple to understand and easy to complete.

**2024 AMH-Finding:** AMH incentive calculations can cause confusion among participants. Participants do not always realize that they must pay tax on overall project expenditures and that the program component only covers up to 80% of pre-tax costs.

**Recommendation #1:** To further aid understanding, consider providing participants with case study examples of incentive calculations to show pre-tax costs and how incentive amounts may change based on supplier quotes and/or equipment installed.



**2024 AMH-Finding:** Some participants would benefit from project management support. Based on comments from E1, EAs, and participants, project management assistance, technical/maintenance support, and help finding contractors would be useful for participants.

**Recommendation #2:** Ensure that support and handholding are available for participants who may need help navigating the program component and finding various contractors. Make technical guides available, providing general advice to help participants through the program component.

**2024 AMH-Finding:** Among EAs, satisfaction is low with the audit reporting templates.

**Recommendation #3:** Investigate the possibility of improving the audit reporting templates to improve time efficiencies for EAs, for example by streamlining the reports as much as possible.

**2024 AMH-Finding:** Costs and lack of budget are barriers to participation. The majority of dropped-out participants had no budget available for building maintenance and efficiency upgrades, a situation that was echoed among most interviewed non-participants and half of AMH participants.

**Recommendation #4:** In the early stages of participant engagement, ensure that participants are aware of the co-financing options listed in E1's agreement.

**2024 AMH-Finding:** Rental rates in the operating agreement cause division among dropped-out participants and non-participants. Negative perceptions were due to rental rates in the agreement being lower than what dropped-out participants and non-participants currently charge; they were therefore a barrier to program participation. E1 regularly reviews rental rates basis to align with current market conditions.

**2024 AMH-Finding:** Term lengths are not a significant problem. No participants, dropped-out participants, or non-participants expressed significant concern about AMH term lengths.

**2024 AMH-Finding:** In 2024, AMH achieved 1.159 GWh in net electrical energy savings and 0.570 in net peak demand savings at the generator, falling short of planned net electrical energy savings of 1.900 GWh by 39% and planned net peak demand savings of 1.581 MW by 64%.

**2024 AMH-Finding:** Despite a slight increase (5%) in participation compared to 2023, AMH achieved lower savings than in 2023. In total, 83 projects (64 prescriptive and 19 comprehensive) generated electrical savings in 2024. Together, AMH paths generated 21% and 23% fewer electrical energy and peak demand savings respectively compared to 2023.

**2024 AMH-Finding:** Following project reviews, the Evaluator made an overall upward adjustment to electrical energy savings and a downward adjustment to peak demand savings. For electrical energy savings, a small upward adjustment ratio applied to prescriptive heat pump projects was almost cancelled by a one-time downward adjustment from comprehensive projects. For peak demand savings, one-time adjustments were calculated for both prescriptive lighting and comprehensive projects.

**2024 AMH-Finding:** The net evaluated electrical energy savings were nearly the same as the energy savings tracked by E1 and the net evaluated peak energy savings were 2% lower than the peak demand savings tracked by E1. These differences are due to the adjustments applied by the Evaluator following the project reviews.



## ASFH Findings and Recommendations

This subsection presents the key findings and recommendations from the ASFH evaluation in relation to the above objectives.

**2024 ASFH-Finding:** The energy efficient retrofits installed at no cost through ASFH are perceived by participants to be making their homes more comfortable and warmer in winter and less expensive to heat.

**2024 ASFH-Finding:** Surveyed participants, interviewed DAs and heat pump contractors are generally satisfied with ASFH. Participants consider it easy and worthwhile to participate and would highly recommend the program to others. Although DAs and contractors make suggestions for improvements to the program, they widely agree that it is worthwhile being involved.

**2024 ASFH-Finding:** Although satisfaction is good overall, long wait times cause discontent at various program stages and for various stakeholders (participants, DAs, and heat pump contractors). E1 is cognisant of dissatisfaction with wait times. They report that they have expanded the number of staff members and are catching up with the backlog.

**Recommendation #1:** To assess progress with participant wait times, E1 could track wait times as well as program delivery satisfaction levels (e.g. in quarterly customer satisfaction surveys) throughout 2025 to determine how strategies are performing and make adjustments if necessary.

**2024 ASFH-Finding:** Limited participant knowledge about ASFH can cause participant confusion and frustration during the initial DA/contractor visit, particularly if participants are considering taking part in multiple programs (such as ASFH and OHPA).

**Recommendation #2:** Provide participants with more information about ASFH to help them understand program options, eligible measures, and participation steps by implementing the following:

- a) Investigate ways to inform participants about eligible measures in ASFH and to ensure that other program options and their differences (i.e. Oil to Heat Pump Affordability [OHPA]) are clearly presented to participants verbally and through marketing materials.
- b) Review the application template for clarity and adapt it to confirm with participants to which program they are applying (i.e. ASFH, OHPA). Ensure that the information in the application is shared with DAs/contractors.
- c) Once participants have submitted their application, clearly communicate (perhaps using a visual) the touchpoints that will occur along their journey (e.g. who will be contacting them, at what point, and what to expect).

**Recommendation #3:** Reinforce participant awareness of the Energy Solution Advisor's role as E1 program navigator to help participants better understand and navigate E1's programs (including ASFH).



**2024 ASFH-Finding:** Some participants say they did not receive information about the products installed and some still have doubts about how to operate and maintain their new equipment (especially heat pumps) even though contractors report reviewing this with participants after installation.

**Recommendation #4:** To maximize energy savings, ensure that all participants receive the necessary information to operate and maintain the equipment installed in language that is easy to understand. Implement checklists for DAs and heat pump contractors if necessary.

**Recommendation #5:** Ensure that DAs/contractors provide a leave-behind so that participants know who to contact in case of questions or difficulties or to better understand how to operate and maintain their heat pump.

**2024 ASFH-Finding:** Having to use two platforms for filling out the required record keeping/reporting forms (CIS) and uploading documentation (SharePoint) is said to lead to repetitive data entry and unclear requirements for DAs and heat pump contractors. Furthermore, DAs report many changes since the original training on processes and system use, which have never been formally communicated and lead to a lot of back and forth with E1 to resolve issues.

**Recommendation #6:** Look for opportunities to streamline record keeping/reporting processes to reduce the administrative burden for DAs and contractors, taking into account program tracking and evaluation needs.

**Recommendation #7:** Update the DA/contractor training guides on the record keeping/reporting processes and use of the software tools to reflect current practices and offer regular training sessions to provide updates on any changes.

**2024 ASFH-Finding:** ASFH achieved 3.719 GWh in net electrical energy savings and 2.089 MW in net peak demand savings at the generator in 2024, exceeding the planned electrical energy and peak demand savings targets by 32% and 100% respectively .

**2024 ASFH-Finding:** In 2024, 1,210 homes participated in ASFH, nearly five times the number recorded in 2023. While gross electrical energy and peak demand savings were respectively 158% and 233% higher than in 2023 primarily due to increased participation, average savings per participant decreased by 48% due to updated adjustment ratios and a higher number of projects with only non-modelled measures.

**2024 ASFH-Finding:** The evaluated net electrical energy and peak demand savings determined by the Evaluator were respectively lower by 21% and 3% compared to the net savings tracked by E1. These lower savings were mainly due to the new adjustment ratios.

## EPI Findings and Recommendations

This section provides the Evaluator's key findings and recommendations in relation to the above objectives.

**2024 EPI-Finding:** Participants are highly satisfied with the overall program component.

**2024 EPI-Finding:** With 8.948 GWh in net electrical energy savings and 0.880 MW in net peak demand savings at the generator in 2024, EPI net electrical energy and peak demand savings were under targets by 15% and 22% respectively.



**2024 EPI-Finding:** While participation increased by 2% in 2024, average electrical energy savings per participant decreased by 6.3%. This reduction in savings per participant was mainly due to the update to the 2024-2025 DSM MA, notably downward adjustments to smart thermostat and LED lamp unitary savings that respectively represented around 27% and 43% of EPI electrical energy savings in 2024.

**2024 EPI-Finding:** Based on 2024 on-site visit findings, installation rates for most products remained relatively stable. One notable exception was smart thermostats for MSHPs, for which an 84% installation rate was established, which represents a 16% reduction compared to the tracked value.

**Recommendation #1:** To improve the smart thermostat installation rate, explore and implement strategies to reduce the number of participants disconnecting this product due to dissatisfaction. For example, follow-up calls could be conducted, installers could educate more participants on this product, or additional educational material on this product could be shared with participants.

**2024 EPI-Finding:** The overall NTGR value remained stable compared to the 2023 level, although per-product NTGR values varied more significantly. This is due to the increase of the NTGR value for LED lighting being cancelled out by the decrease of the NTGR value for smart thermostats.

**2024 EPI-Finding:** The evaluated net electrical energy savings were 6% lower than the tracked net electrical energy savings, while the evaluated net peak demand savings were 1% higher than the tracked net peak demand savings. The main reasons for this difference are the impact of the downward update to the installation rate for smart thermostats for MSHPs and the hours of use value for LED lamps, the two largest contributors to EPI electrical energy savings in 2024. Since those two changes did not impact peak demand savings, the evaluated net peak demand savings were not similarly reduced.

**2024 EPI-Finding:** The jurisdictional scan revealed several appropriate products to be considered for the EPI electrician-installed measure offer, namely advanced heat recovery ventilator controls, bathroom fans, block heater timers, and heat reflector panels or rolls.

## Green Heat Findings and Recommendations

**2024 Green Heat-Finding:** Green Heat fell short of its net savings targets, achieving 24% and 55% of its electrical energy and peak demand targets respectively.

**2024 Green Heat-Finding:** Green Heat participation decreased for the third consecutive year, particularly for MSHPs (19% reduction) and demand reduction measures (36% reduction). The decrease is attributed to the launch of the CGH Grant in May 2021, which led to participants choosing HEA over Green Heat. Since the CGH Grant was closed to new applicants on February 5, 2024, it is possible that Green Heat participation will increase once again in the upcoming years.

**2024 Green Heat-Finding:** Both the evaluated gross electrical energy and peak demand savings were significantly lower than the savings tracked by E1. The results of the billing analysis conducted as part of the 2024 evaluation led to significant changes to gross electrical energy and peak demand savings parameters and calculations for MSHPs and biomass measures, which resulted in low realization rates of 35% and 71% for net electrical energy savings and net peak demand savings respectively.

**Recommendation #1:** In light of their very low savings and considering their low uptake, consider removing wood fireplace inserts and pellet fireplace inserts from the Green Heat offer.

**2024 Green Heat-Finding:** The nil electrical energy savings found for mainly electrically heated households as part of the billing analysis suggest that the increase in electricity consumption due to transferring a portion of the heating consumption from wood or oil to an electric heat pump cancels out the electricity savings



achieved by replacing some electric resistance heating by a heat pump. While DSM savings only consider electrical savings, there are most likely other fuel savings occurring for these participants.

## HEA Findings and Recommendations

**2024 HEA-Finding:** HEA net electrical energy savings exceeded the target of 19.012 GWh by 68%, and the planned net peak demand savings of 4.799 MW by 81%.

**2024 HEA-Finding:** With 5,367 projects, the 2024 participation level was the highest observed for HEA since the program component was launched. The average gross energy savings per home was 7,264 kWh, a slight decrease of 3% compared to 2023, which was the highest record observed for HEA. The integration of the CGH Grant into HEA contributed to the historically high participation rate and gross savings per participant. With the closure of the CGH Grant to new applicants in early 2024, a decrease in both participation and energy savings is expected in upcoming years.

**2024 HEA-Finding:** The evaluated energy and peak demand savings were 8% and 62% higher than the savings tracked by E1 respectively. A new billing analysis was conducted as part of this evaluation and changes were made to the savings calculation approach to make it more robust. In anticipation of these changes, E1 applied an additional adjustment ratio to their tracked energy savings, which allowed E1 to track energy savings close to the evaluation results. E1 also applied the additional adjustment ratio to their tracked peak demand savings, but since the billing analysis results did not impact the peak demand savings calculation for mini-split heat pumps, the evaluated peak demand savings were higher than those tracked by E1. Unitary electrical energy and peak demand savings for wood and pellet stoves and fireplace inserts were also updated based on the Green Heat billing analysis results. Distinct unitary savings values were determined for stoves and fireplaces, with fireplaces having very low savings.

**Recommendation #1:** In light of their very low savings and considering their low uptake, consider removing wood fireplace inserts and pellet fireplace inserts from the HEA offer.

**2024 HEA-Finding:** Parameters used to calculate unconverted D assessment spillover were reassessed by compiling the results of 19 site visits completed by EAs among surveyed expired participants and remain relatively stable.

## MHEEP Findings and Recommendations

This subsection presents the key findings from the MHEEP evaluation. The Evaluator has no specific recommendation for MHEEP.

**2024 MHEEP-Finding:** MHEEP net electrical energy savings fell short of targets by 35%, while peak demand savings exceeded targets by 189%.

**2024 MHEEP-Finding:** While MHEEP achieved the highest participation since its inception with an increase of 19%, the average energy savings per participant decreased by 41%, generating 31% lower gross energy savings and 29% higher gross peak demand savings in 2024 compared to 2023 levels.

**2024 MHEEP-Finding:** The evaluated net energy and peak demand savings were 31% lower and 15% higher than the values tracked by E1 respectively. This was mainly due to revisions to the adjustment ratios and to peak demand savings per capacity value for heat pumps.





## Residential Behaviour Findings and Recommendations

This subsection presents the key findings from the 2024 Residential Behaviour evaluation. The Evaluator has no specific recommendation for Residential Behaviour.

**2024 Residential Behaviour-Finding:** Residential Behaviour achieved 6.270 GWh in net electrical energy savings in 2024, thus falling short of its net electrical energy savings targets of 8.000 GWh. This outcome is not surprising since the program is still in its ramp-up phase after only 8 months of implementation. With achieved savings percentages ranging from 0.87% to 1.3% in the fall of 2024 depending on the wave, results are promising and indicate that the program component has potential for greater savings as it is scaled up.

**2024 Residential Behaviour-Finding:** The composition of the control and treatment groups remained similar between the initial selection (March 2024) and program component launch (May 2024). Over the first year of evaluation, 13,439 eligible Nova Scotia Power residential customer accounts either became inactive (i.e. customers closed their accounts or moved) or ineligible to continue participating as they installed solar photovoltaic systems, no longer offering a valid billing analysis comparison to non-solar customers. The attrition rate for high and medium electricity consumption users was 5.2% between May 2024 and December 2024 while it was 7.0% for low electricity consumption users.

**2024 Residential Behaviour-Finding:** Treatment group customers showed higher participation in other residential programs compared to the control group. Residential Behaviour successfully encouraged treatment participants to engage in other residential programs.

## Program Tracked and Evaluated Savings

Table 3 below compares E1 tracked electrical energy and peak demand savings to evaluated savings at the generator. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings. The NTGRs are also presented and correspond to the rounded averages obtained by dividing net savings by gross savings, which explains why the values are different from those presented in the other sections. Residential Behaviour relies on a random selection of treatment group participants among all residential customers; therefore, the program component does not have a tracking sheet and there is no realization rate.



**Table 3: Comparison of 2024 Tracked and Evaluated Savings at the Generator**

|            |                       | Gross Savings |      | NTGR | Net Savings |      | Realization Rate |
|------------|-----------------------|---------------|------|------|-------------|------|------------------|
|            |                       | Value         | Unit |      | Value       | Unit |                  |
| AMH        | Energy Savings        |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 1.158         | GWh  | 1.00 | 1.158       | GWh  | 100%             |
|            | Evaluation Results    | 1.159         | GWh  | 1.00 | 1.159       | GWh  |                  |
|            | Peak Demand Savings   |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 0.580         | MW   | 1.00 | 0.580       | MW   | 98%              |
|            | Evaluation Results    | 0.570         | MW   | 1.00 | 0.570       | MW   |                  |
| ASFH       | Energy Savings        |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 4.693         | GWh  | 1    | 4.693       | GWh  | 79%              |
|            | Evaluation Results    | 3.719         | GWh  | 1    | 3.719       | GWh  |                  |
|            | Peak Demand Savings   |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 2.160         | MW   | 1    | 2.160       | MW   | 97%              |
|            | Evaluation Results    | 2.089         | MW   | 1    | 2.089       | MW   |                  |
| EPI        | Energy Savings        |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 9.516         | GWh  | 1.00 | 9.519       | GWh  | 94%              |
|            | Evaluation Results    | 9.093         | GWh  | 0.98 | 8.948       | GWh  |                  |
|            | Peak Demand Savings   |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 0.879         | MW   | 0.99 | 0.872       | MW   | 101%             |
|            | Evaluation Results    | 0.898         | MW   | 0.98 | 0.880       | MW   |                  |
| Green Heat | Energy Savings        |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 4.711         | GWh  | 0.53 | 2.478       | GWh  | 35%              |
|            | Evaluation Results    | 1.651         | GWh  | 0.53 | 0.872       | GWh  |                  |
|            | Peak Demand Savings   |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 3.915         | MW   | 0.55 | 2.143       | MW   | 71%              |
|            | Evaluation Results    | 2.748         | MW   | 0.56 | 1.529       | MW   |                  |
| HEA        | Energy Savings        |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 41.992        | GWh  | 0.70 | 29.552      | GWh  | 108%             |
|            | Evaluation Results    | 38.984        | GWh  | 0.82 | 31.962      | GWh  |                  |
|            | Peak Demand Savings   |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 10.518        | MW   | 0.51 | 5.367       | MW   | 162%             |
|            | Evaluation Results    | 9.698         | MW   | 0.90 | 8.681       | MW   |                  |
| MHEEP      | Energy Savings        |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 0.578         | GWh  | 1.00 | 0.578       | GWh  | 69%              |
|            | Evaluation Results    | 0.401         | GWh  | 1.00 | 0.401       | GWh  |                  |
|            | Peak Demand Savings   |               |      |      |             |      |                  |
|            | Tracked Savings by E1 | 0.420         | MW   | 1.00 | 0.420       | MW   | 115%             |
|            | Evaluation Results    | 0.481         | MW   | 1.00 | 0.481       | MW   |                  |



## INTRODUCTION

EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight of its DSM activities is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electricity DSM activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs, three business, non-profit, and institutional (BNI) programs, and one demand response (DR) program that are marketed to Nova Scotians through the ENS franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2024 DSM program portfolio.

This evaluation report relates to the Existing Residential program comprised of seven components: Affordable Multifamily Housing (AMH); Affordable Single-family Homes (ASFH); Efficient Product Installation (EPI); Green Heat; Home Energy Assessment (HEA); Mi'kmaw Home Energy Efficiency Project (MHEEP); and Residential Behaviour. Table 4 below lists the Existing Residential program components and the types of evaluations conducted for 2024. A comprehensive impact evaluation involves reviewing the following four key elements: (1) The baseline definition; (2) the savings calculation methodology; (3) the values of the parameters used to calculate savings; and (4) NTGRs. A condensed impact evaluation involves using some or all of the previous year's impact evaluation parameters such as unitary savings values, adjustment ratios, installation rates, and NTGRs to provide evaluated results.

**Table 4: Types of Evaluations Conducted for Each Program Component, 2024**

| Program              | Program Component     | 2024    |        |                            |
|----------------------|-----------------------|---------|--------|----------------------------|
|                      |                       | Process | Market | Impact                     |
| Existing Residential | AMH                   | X       |        | Comprehensive              |
|                      | ASFH                  | X       |        | Condensed                  |
|                      | EPI                   |         | X      | Comprehensive              |
|                      | Green Heat            |         |        | Comprehensive              |
|                      | HEA                   |         |        | Comprehensive <sup>1</sup> |
|                      | MHEEP                 |         |        | Condensed                  |
|                      | Residential Behaviour |         |        | Comprehensive              |

For each program component, the Evaluator prepared a DSM evaluation report presenting key findings, electrical first-year and lifetime energy savings, peak demand savings, and avoided greenhouse gas (GHG) emissions.<sup>2</sup>

<sup>1</sup> Does not include update to NTGRs.

<sup>2</sup> Unless specified otherwise, electrical energy savings refer to first-year energy savings rather than lifetime energy savings throughout this report.



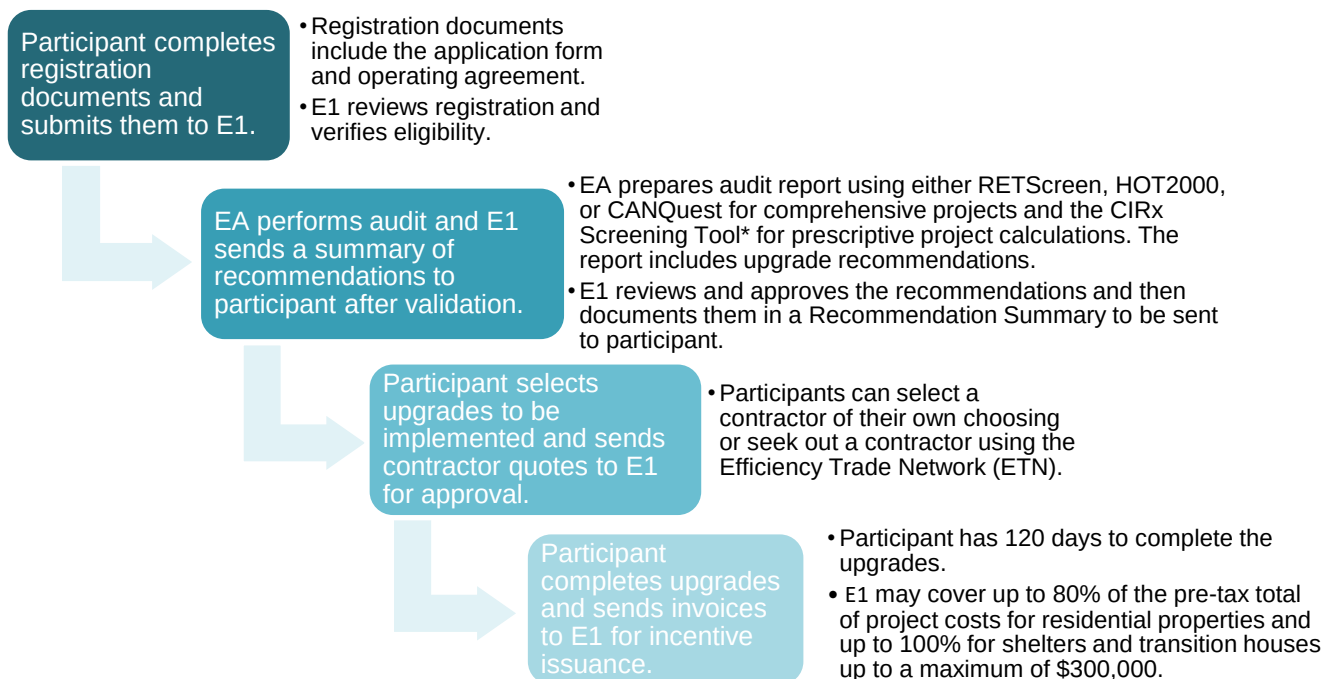
# 1 AMH Overview

This section describes Affordable Multifamily Housing (AMH), follows up on past evaluation recommendations, and provides an overview of AMH participation history.

## 1.1 AMH Description

AMH provides affordable housing owners and non-profit organizations, such as rehabilitation or transition houses, with incentives for building-wide energy retrofit projects with the intent of reducing electrical and non-electrical energy consumption in Nova Scotia. Unless they follow a prescriptive path to install specific measures, AMH projects must undergo a complimentary energy audit at the beginning of the participation process to identify eligible energy efficiency measures such as water and space heating systems and building envelope measures. The audit is conducted by one of five AMH-approved EAs. Further details about the AMH participation process are provided in Figure 1.

**Figure 1: AMH Participation Process Summary**



\* The CIRx Screening Tool is an E1 tool presenting the savings calculation methodologies, assumptions, and equipment parameters specific to each project.

Since 2021, AMH savings have been generated through two project paths, the comprehensive path and prescriptive path.

- › Comprehensive path projects serve to implement measures that are modelled in HOT2000, RETScreen, or CANQuest. Energy savings from comprehensive projects are calculated by comparing the energy models of a base case and a proposed case. Calculations are performed with project-specific parameters.
- › Prescriptive path projects are not modelled because their energy savings are calculated using the CIRx Screening Tool provided by E1, which is a tool presenting the savings calculation methodologies, assumptions, and calculation parameters for measures implemented under AMH.



In July 2023, the maximum incentive amounts were changed from \$15,000 to \$17,254 per affordable unit (multi-unit residential buildings [MURBs] and cooperatives) and from \$5,000 to \$5,751 per affordable room (rooming houses). The maximum rebate was amended in December 2022 to \$300,000 for all building types.

AMH funding comes from two sources: (1) Electricity ratepayer funding is used for measures that reduce electricity consumption; and (2) funding from the Province of Nova Scotia (PNS) is used for measures that reduce non-electrical fuel consumption as well as a portion of upgrades that reduce electricity consumption. Since April 2021, additional funding from Province of Nova Scotia through the Green Fund allows for an increase in the incentive amount of up to 80% of costs for electrical projects in residential properties and up to 100% in shelters and transition houses. This report presents all electrical savings achieved through AMH and allocated to DSM funding.

AMH was aimed at achieving 1.900 GWh in net electrical energy savings and 1.581 MW in net peak demand savings at the generator in 2024.

## **1.2 Follow-up on Past Evaluation Report Recommendations**

No recommendations were made for AMH in the 2023 evaluation.

## **1.3 Participation History**

Since 2021, AMH savings are generated by two types of projects, namely comprehensive and prescriptive projects. In 2024, 83 projects generating electrical energy savings were completed under AMH, including 19 comprehensive and 64 prescriptive projects, which resulted in 1.159 GWh in gross electrical energy savings and 0.570 MW in gross peak demand savings at the generator.

As illustrated in Figure 2 below, the number of projects in 2024 was similar to 2023, with a small increase of 5%. More precisely, the number of prescriptive projects decreased from 68 projects in 2023 to 64 in 2024, while the number of comprehensive projects increased from 11 to 19. The large increases in the number of participants observed in 2022 and 2023 were due to the inclusion of prescriptive heat pump projects, and this trend appears to have stabilized.

As observed in Figure 2 below, energy savings per project considerably vary from year to year mostly due to the various building sizes included in AMH. In 2024, electrical energy savings per prescriptive project decreased compared to 2023 while they slightly increased for comprehensive projects.

**Figure 2: Overview of AMH Participation, 2018-2024**

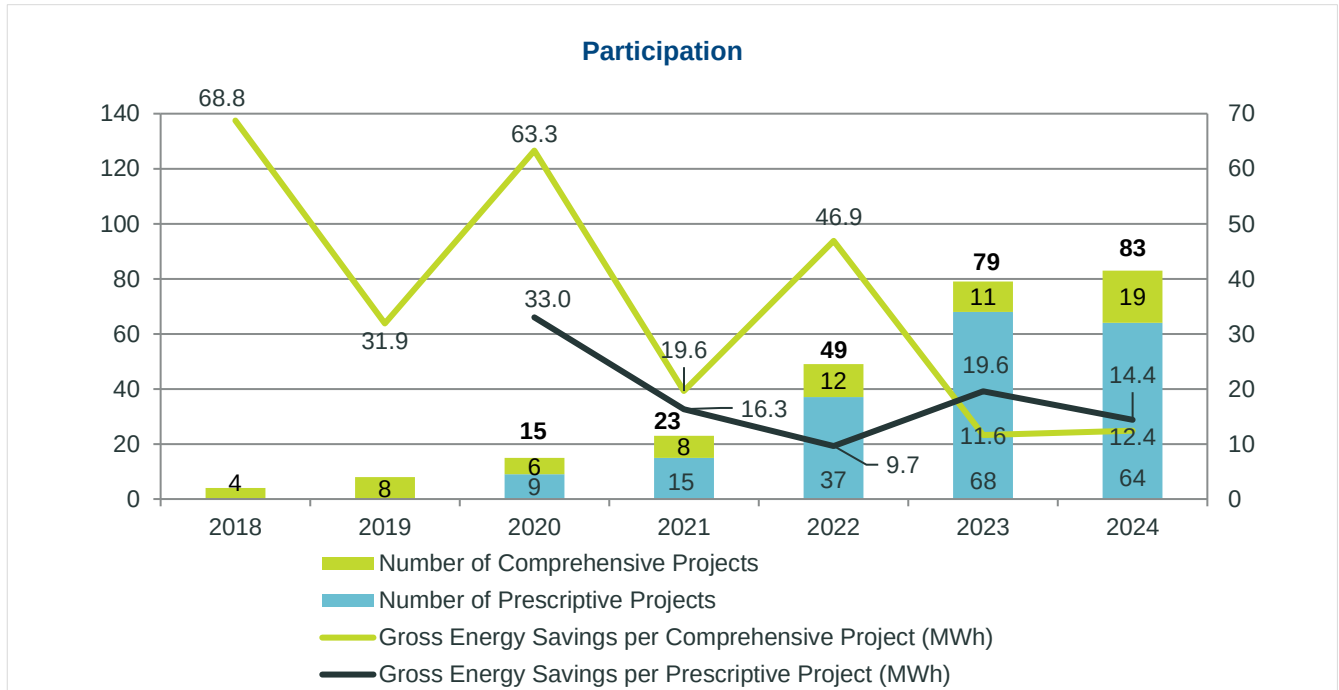
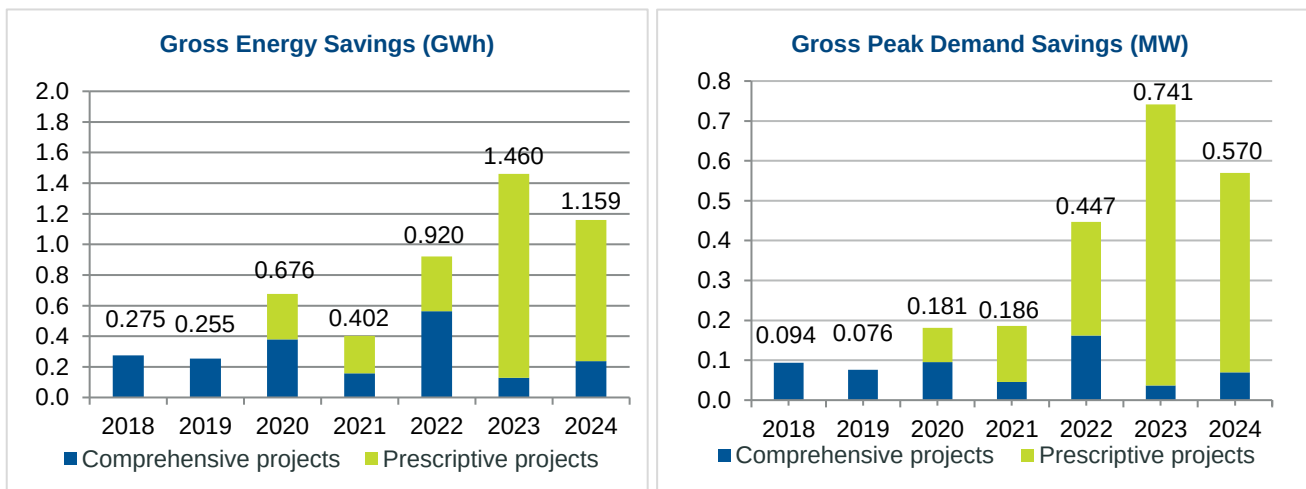


Figure 3 below presents the evolution of AMH gross savings since 2018. Again in 2024, prescriptive projects generated the most electrical energy savings (80%) and the most peak demand savings (88%).

Despite a slightly larger number of overall projects compared to 2023, gross electrical energy and peak demand savings decreased by 21% and 23% respectively mostly due to the lower average savings per prescriptive projects.

**Figure 3: Evolution of AMH Gross Savings at the Generator, 2018-2024**



## 2 AMH Evaluation Approach

The 2024 AMH evaluation comprised a comprehensive impact evaluation as well as a process evaluation. The main objectives of the 2024 AMH evaluation were as follows:

- › Collect information on participant and EA perspectives
- › Calculate AMH gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

The Evaluator identified key research questions aimed at achieving the above objectives. Table 5 outlines the evaluation objectives and maps them to the Evaluator's research questions, methods, and sample sizes (n). Each method is described further below.

**Table 5: 2024 AMH Evaluation Approach**

| Evaluation Objectives                                                  | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Methodology                                                                                              |
|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Collect information on program staff, participant, and EA perspectives | <ul style="list-style-type: none"> <li>› How did participants become aware of the program component?</li> <li>› What is the level of awareness and understanding of participants about the two paths offered under AMH?</li> <li>› What are the participant motivations for taking part in AMH?</li> <li>› Why do most participants select the prescriptive path instead of the comprehensive path?</li> <li>› How satisfied are participants with AMH overall and its aspects such as the products installed, quality of the work completed, services received, program application process (applications, recommendation reports, preapproval reports, rebate request forms) and the information received about the products installed?</li> <li>› Were application forms and reports easy to understand and fill out?</li> <li>› For participants who received a free energy audit, what was their experience with the process and energy auditor (scheduling appointment, customer service, ability to answer questions)?</li> <li>› What challenges, if any, do participants/EAs/program staff experience with AMH?</li> <li>› How likely are participants to recommend the program component to other housing providers or affordable MURB owners?</li> <li>› How can the program component be improved?</li> <li>› What questions do participants have about the different technologies installed?</li> <li>› What information, tools, support, and training would make the program staff/EAs more effective?</li> <li>› How can program communications and marketing be improved to attract more participants?</li> </ul> | <ul style="list-style-type: none"> <li>› Interviews with program staff, EAs, and participants</li> </ul> |

| Evaluation Objectives                                                                                           | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Methodology                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analyze barriers to participation and the design of the operating agreement (affordability covenant) (Optional) | <ul style="list-style-type: none"> <li>› What are the barriers to participation?</li> <li>› What motivated dropped-out participants to initially sign up for the program component?</li> <li>› What are the reasons that dropped-out participants did not complete the participation process? Was it due to any specific AMH requirements?</li> <li>› Were alternatives for implementing energy efficiency measures considered outside of AMH?</li> <li>› What would motivate dropped-out participants to complete the AMH participation process?</li> <li>› How is the operating agreement (affordability covenant) perceived?</li> <li>› Could the operating agreement (affordability covenant) be modified to encourage participation while respecting tenants' rights?</li> </ul> | <ul style="list-style-type: none"> <li>› Interviews</li> <li>› Dropped-out participants</li> <li>› Non-participants</li> </ul>                                                                          |
| Calculate gross results                                                                                         | <ul style="list-style-type: none"> <li>› Are the data in the tracking sheet complete, accurate, and consistent?</li> <li>› Are the gross savings calculated for a sample of projects consistent with E1 tracking and savings calculation methods and with the measures observed in project documentation?</li> <li>› What are the appropriate effective useful life (EUL) values for implemented measures?</li> <li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li> </ul>                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>› Tracking sheet audit</li> <li>› Desk reviews with participant interviews</li> <li>› EUL update</li> <li>› Calculations using evaluation results</li> </ul>     |
| Calculate net results                                                                                           | <ul style="list-style-type: none"> <li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li> <li>› What are the net greenhouse gas (GHG) emission reductions in CO2 eq?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>› Calculations using a net-to-gross ratio (NTGR) of 1</li> <li>› Calculations using evaluation results</li> <li>› GHG emission reduction calculations</li> </ul> |

## Tracking Sheet Audit

Prior to performing the unitary savings review, the Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The results obtained are presented in Appendix I.

## Energy Auditor Interviews

In October and November 2024, Narrative Research conducted interviews with four EAs involved in AMH to obtain their perspectives on the program component and to assess its perceived effectiveness. The guide used for the EA interviews is presented in Appendix II.

## Participant Interviews

A total of 10 AMH participants composed of seven (n=7) prescriptive path participants and 3 (n=3) comprehensive path participants took part in a telephone interview administered by Narrative Research in October and November 2024. Six participants were multi-unit residential building (MURB) owners, four of which had one to three units and two of which had four or more units. Of the remaining four participants, three buildings were non-bed facilities and one was a shelter. The phone interviews lasted on average approximately 21 minutes. The aims of the interviews were to understand motivations for participating and perspectives on the program component. The interview guide used is presented in Appendix III.

## Dropped-out Participant Interviews

In October and November 2024, Narrative Research conducted six telephone interviews among participants who started the program but did not complete the participation process (hereafter referred to as dropped-out participants). All six interviewed dropped-out participants were from the AMH comprehensive path, four had MURBs and two had non-bed facilities. It should be noted that two partial interviews were also conducted with two prescriptive path dropped-out participants. For various reasons, those interviews could not be completed; where possible, the results from the interviews with those two dropped-out participants are included in the analysis. The aims of the six interviews were to understand motivations for dropping out and barriers to participation in the program component. The interview guide used is presented in Appendix IV.

## Non-participant Interviews

In October and November 2024, Narrative Research conducted 10 telephone interviews with customers who had contacted E1 to obtain information about the program component but decided not to take part. Six participants were from the comprehensive path and six from the prescriptive path. Four participants were associated with MURBs, four with rental/co-operative units, and one with a rooming house. The aims of the interviews were to understand reasons for initial interest and barriers to participation in the program component. The interview guide used is presented in Appendix IV.

## Desk Reviews with Participant Interviews

In October and November 2024, the Evaluator reviewed the documentation of 10 prescriptive projects, and LMMW Group Ltd performed simulation model reviews for five comprehensive projects. For comprehensive projects, the simulation model reviews were aimed at validating that the inputs used in the simulation model were appropriate and the savings tracked by E1 were consistent with the simulation outputs. For prescriptive projects, the desk reviews were aimed at validating the consistency of the savings tracked by E1 with the calculations, photos, and invoices included in project files. The protocol used for the desk and simulation model reviews is presented in Appendix V.



## EUL Update

Using the effective useful life (EUL) values for common measures presented in the 2024-2025 Demand-side Management Measure Assessment<sup>3</sup> (DSM MA) and the proportions of savings generated by individual measures implemented through AMH in 2024, the Evaluator calculated an average EUL for comprehensive projects. The EUL value of each measure was used for prescriptive projects based on EUL values from the 2024-2025 DSM MA.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime energy and peak demand savings as per the calculation methodology presented in Subsection 4.2 below.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for AMH, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.

### Note on Margins of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>4</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>5</sup>

As part of the 2024 AMH evaluation, the Evaluator calculated the margins of error for adjustment ratios. The margins of error are listed alongside results in the applicable sections below. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary.

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<sup>3</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the evaluations conducted during the last two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.

<sup>4</sup> Precision refers to how reproducible a set of measurements is. It does not take into account how close the measured values are to the true values since this would refer to accuracy.

<sup>5</sup> As part of this evaluation, the confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.



### 3 AMH Stakeholder Perspectives

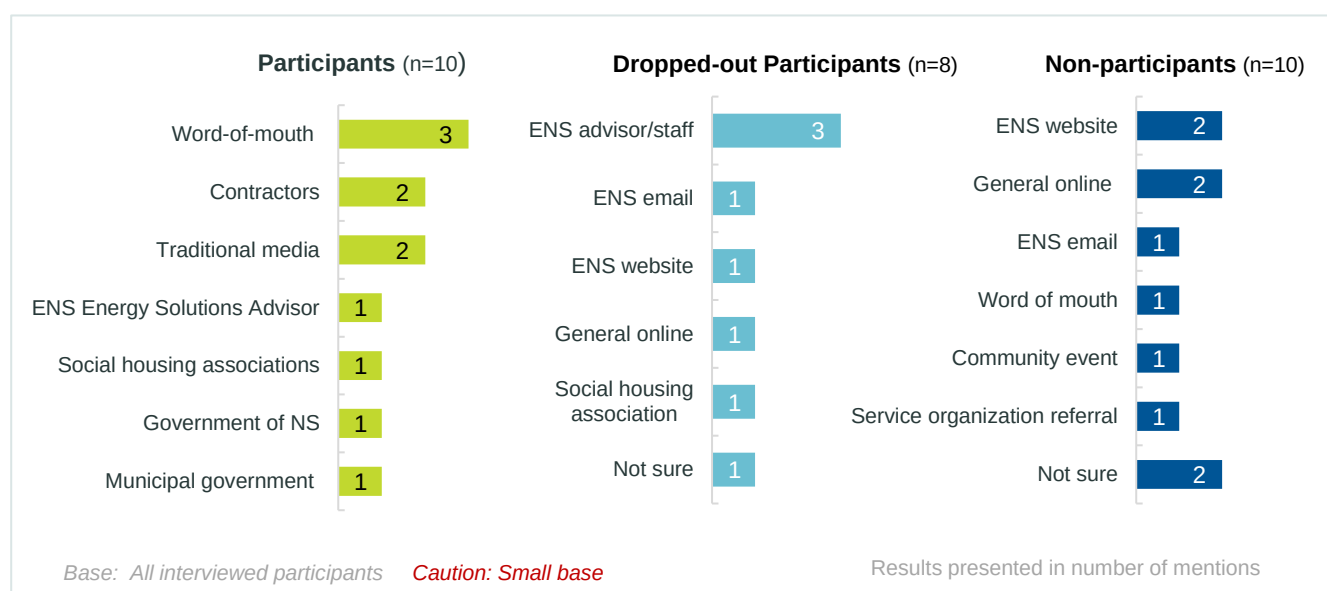
This section presents an analysis of stakeholder perspectives on AMH. Stakeholders include AMH participants, dropped-out participants, non-participants, EAs, and E1 staff. It should be noted that, due to the small sample size for these targets, results are provided as numbers of participants rather than percentages.

#### 3.1 Awareness About AMH

##### 3.1.1 Sources of Program Awareness

Participants, dropped-out participants, and non-participants quoted various sources of AMH program awareness. The most common sources among **participants** were **word-of-mouth** from a colleague, friend, or family member, a **contractor** having informed them of the program, and **traditional media** (that is, radio, TV, print, etc.). For **dropped-out** participants, the top source of AMH awareness was an **E1 advisor** or staff member; for **non-participants**, the top source was the **ENS website** or a general online search. Other mentions across the three participant types included social housing associations, different levels of government, and an ENS email communication. There were no notable differences between how comprehensive versus prescriptive participants became aware of AMH.

**Figure 4: Sources of Program Awareness (Unaided)**



The majority of AMH participants (8/10) and dropped-out participants (6/8) were **unaware of the prescriptive and comprehensive paths** of the program component. Surprisingly, more non-participants reported being aware of the two paths (6/10) than participants and dropped-out participants. It should be noted that E1 staff make participants who apply for the prescriptive path and are eligible for the comprehensive path aware of the latter option. Participants who are only eligible for the prescriptive path due to building size are automatically steered toward that path; therefore, the two paths are not necessarily identified or explained to all participants.

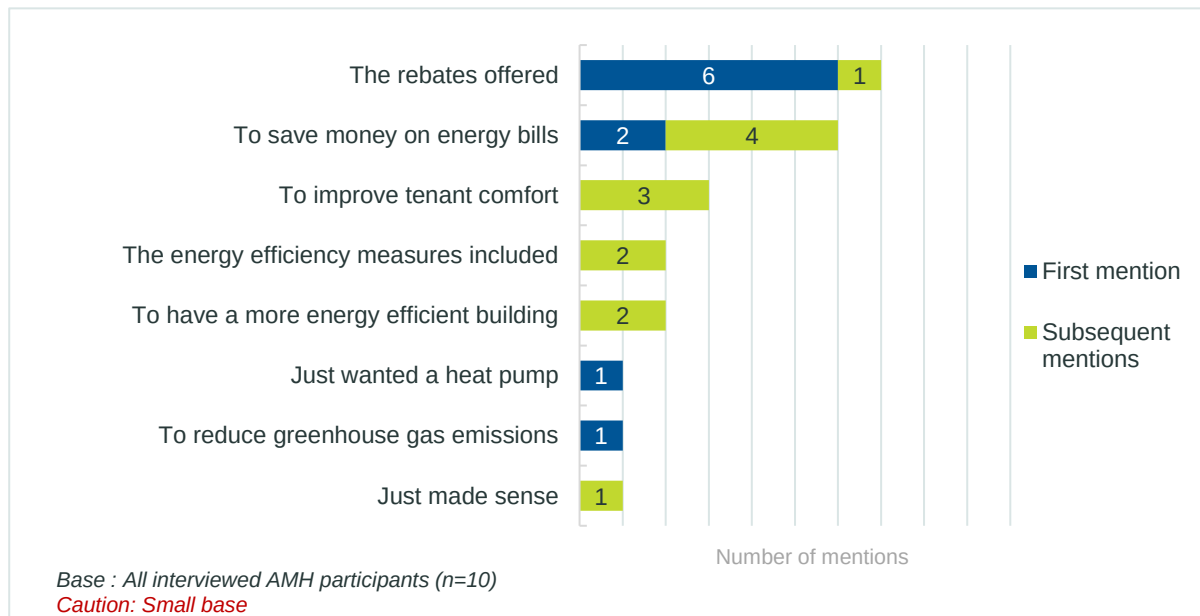
The two AMH participants who recalled that there were two paths both correctly identified that they were enrolled in the prescriptive path and were able to provide an accurate description of the differences between the two pathways, albeit with different levels of detail.

## 3.2 Motivations and Barriers to Participation

### 3.2.1 Motivations for Participating in AMH

Cost savings were the primary motivator for participating in AMH with seven out of 10 mentioning **the rebates offered**, and six of 10 mentioning **saving money on energy bills**. Reasons for taking part cited less frequently included wanting to **improve tenant comfort**, the **energy efficiency measures offered**, and the desire for **a more energy efficient building**. Wanting a heat pump, reducing GHG emissions, and participating in AMH “just making sense” were cited by one participant each.

**Figure 5: Reasons for Participation (Unaided)**

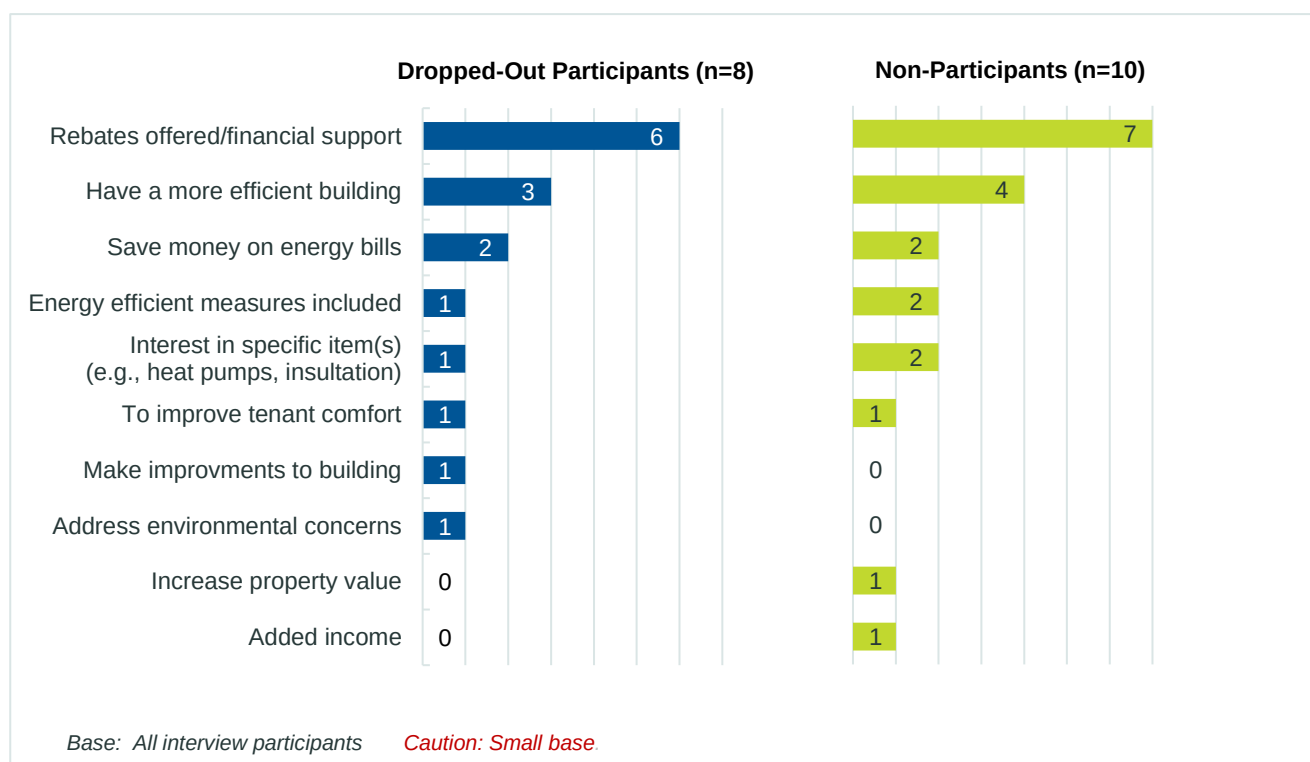


Two out of the five EAs believed that the AMH rebates enable some participants, most likely not-for-profit organizations, to continue to offer affordable housing and keep their rent low. EAs reported that, to some extent, interest in reducing GHG emissions is often factored into a participant’s decision, although it is not considered a primary motivation.

### 3.2.2 Reasons for Initial Interest Among Dropped-out Participants and Non-participants

As seen above among participants, when it comes to why dropped-out participants and non-participants were initially interested in AMH, cost-related factors were again the primary draw; six dropped-out participants and seven non-participants mentioned the **rebates/financial support** offered through AMH (see Figure 6 below). Less frequently mentioned reasons for being interested in AMH among these two groups also aligned with participants’ motivations and include wanting to have a **more efficient building**, **saving money on energy bills**, the **energy efficient measures offered** through the program component, and improved tenant comfort.

**Figure 6: Reasons for Initial Interest Among Dropped-out Participants and Non-participants (Unaided)**



Both dropped-out participants and non-participants generally had **undefined expectations regarding the benefits they thought they would receive from participating** in AMH. While expectations broadly centered around receiving **some form of financial support** for energy efficiency upgrades (and the subsequent financial savings those upgrades would offer), few had set expectations as to what amount would be offered. Three interviewees specifically noted that they expected to receive up to the promoted 80% rebate offered.

Similarly, while six interviewees noted a particular interest in receiving **rebates for heat pumps** and two had interest in receiving funding for insulation and/or windows when first exploring participating in AMH, none had firm expectations as to the extent or type of upgrades specifically covered in AMH. One dropped-out participant specifically noted that their expectations were tempered due to negative past experiences with other rebate programs.

### 3.2.3 Barriers to Participation and Program Completion

For the dropped-out participants who started but did not complete the program component, **financial barriers** were cited most often as reasons for dropping out of AMH. Dropped-out participants noted they **did not have the budget available** to cover their portion of the costs (n=5), including the upfront costs, while waiting for the first part of the incentive, **did not realise how much the upgrades would cost** (n=3), or felt the **incentives were too low** (n=2). **Too long of a payback period** was also cited as a contributing factor (n=1).





Half of dropped-out participants (n=4) noted their decision not to proceed was due, at least in part, to **issues with the operating agreement/affordability covenant**.<sup>6</sup> Specifically, all four felt **the rental rate amounts were too low**. E1 staff reported that dissatisfaction with the rental rates were one of the main reasons they were seeing for participants not continuing with AMH. Although rates are updated every year, rates may still be too low especially with high upfront costs and participants having to commit to a long-term agreement. (See Subsection 3.3.5 below for further information on the affordability covenant.)



Less frequently mentioned reasons for dropping out include **program ineligibility** (finding out their building was not eligible for AMH), **the desired upgrades not being included in the program** (e.g. roof repairs, electric panel upgrades), and **problems related to the renovation work** (e.g. difficulty in finding a contractor). Each of these mentions was cited as a contributing factor, albeit to varying degrees, by at least one dropped-out participant. EAs added that older buildings may require preparation work (e.g. electrical panel upgrade, fixing leaking roof) before the recommended upgrades are completed, with the costs of the work being a barrier to AMH participation if those costs are not covered under the program component.

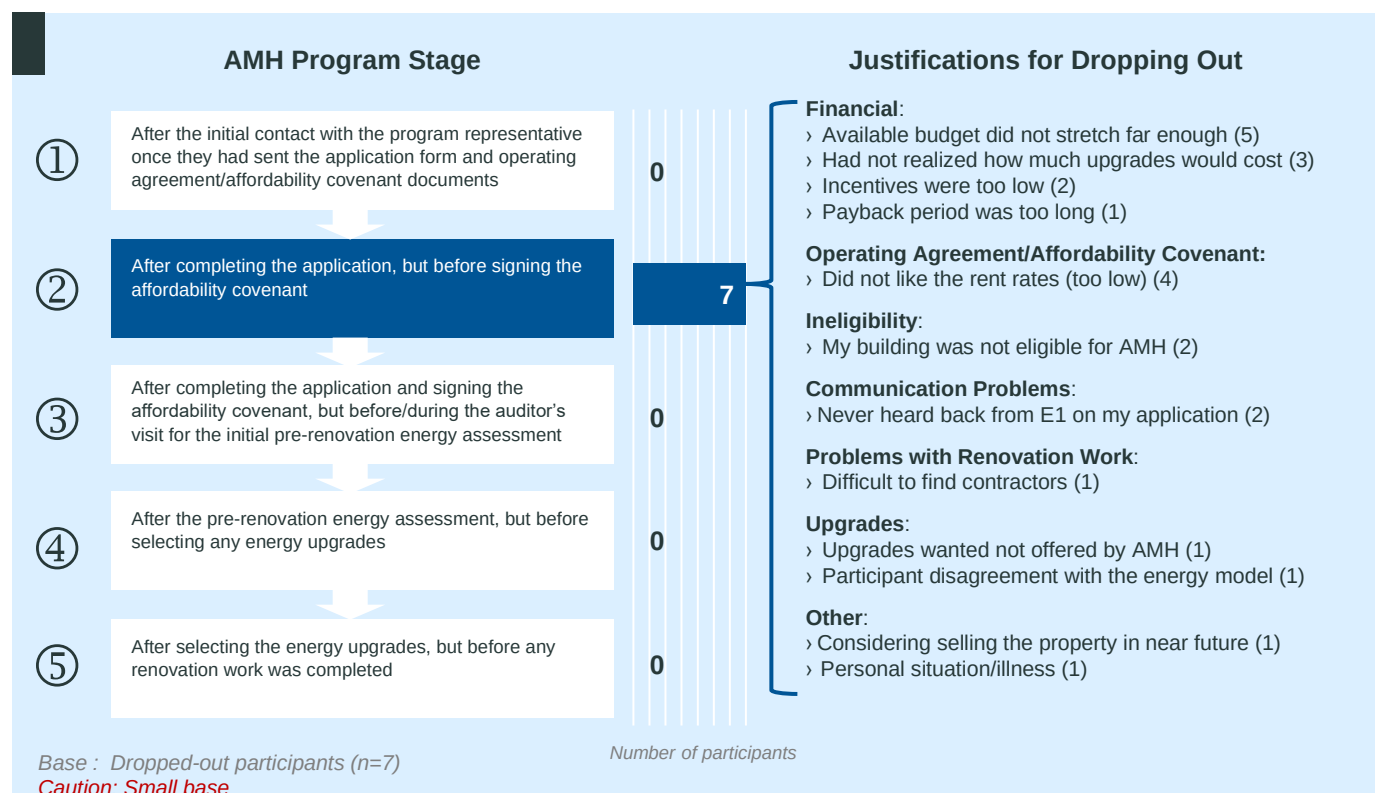
Two dropped-out participants cited external factors for not proceeding. Specifically, one noted they were currently deciding whether or not to sell the property and therefore were not in a position to sign the operating agreement, while the other dropped out due to illness. Of note, in the latter case, the dropped-out participant expressed interest in reapplying to AMH in the near future.

All dropped-out participants reported withdrawing from the program after completing the application form, but before signing the operating agreement/affordability covenant, with one exception who was unable to confirm at what specific step along the process they dropped out of AMH.

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<sup>6</sup> The operating agreement requires that the participant resolve all necessary health and safety repairs to the building before the energy efficiency work is undertaken and maintain rental rents at or below those established through AMH for a period of 12 (comprehensive path) or six (prescriptive path) years.

**Figure 7: Stage at Which AMH Participation Was Ended (Aided) and Justifications**



### 3.3 Program Delivery and Processes

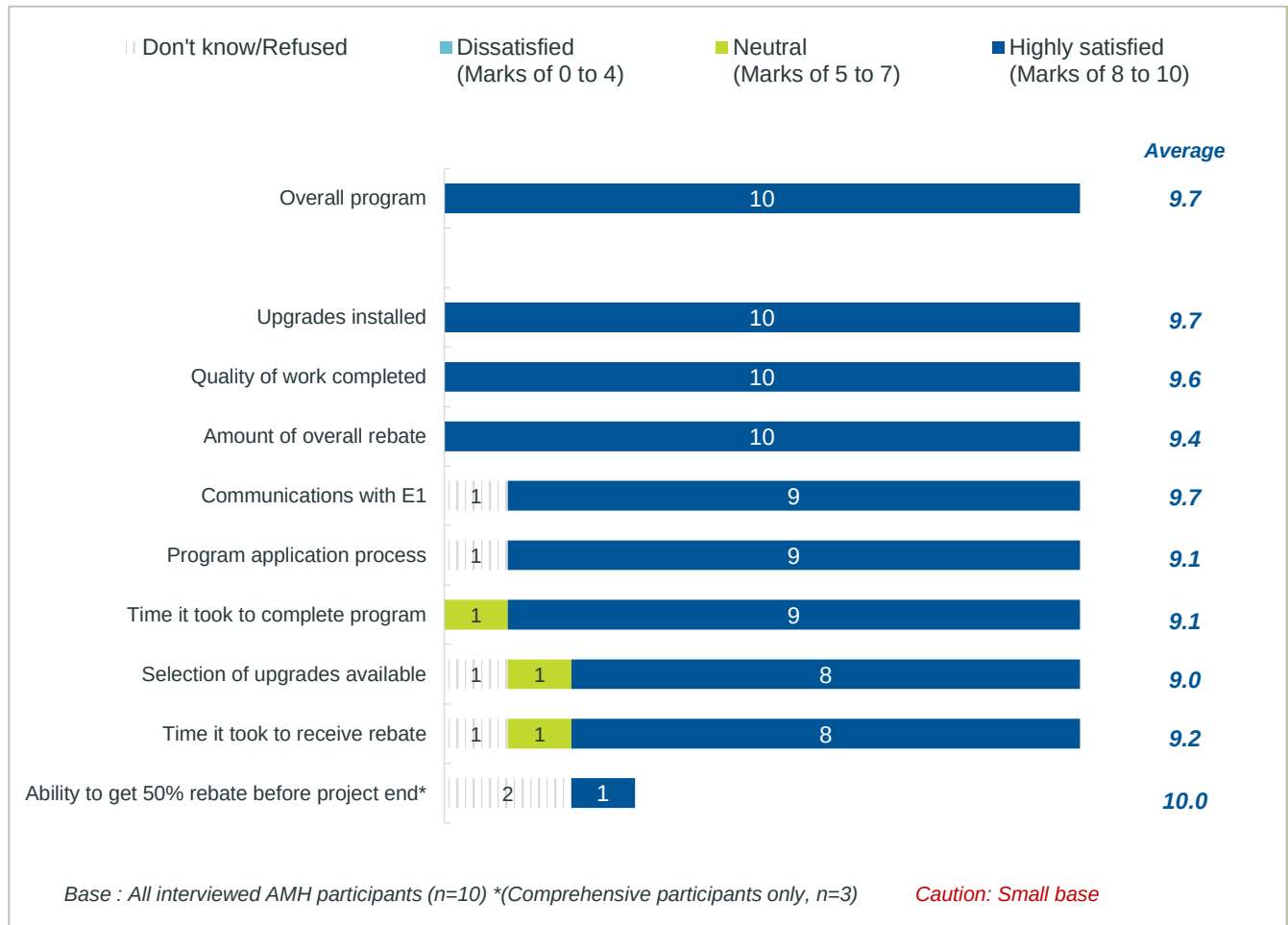
#### 3.3.1 Participant Satisfaction

Overall, participants were **highly satisfied with AMH**, with all 10 participants providing a score of 9 or 10 and the average overall satisfaction score being 9.7.<sup>7</sup>

When asked about their satisfaction with various aspects of AMH, participants continued to express general contentment. All participants were highly satisfied with the **upgrades installed**, the **quality of work completed**, and the **amount of the overall rebate**. All participants were also highly satisfied with the **program application process**, the **ability to get 50% of the rebate before the project ended** (comprehensive participants only), and **communications with E1**. No AMH participants expressed dissatisfaction (scores of 1-4) with any aspects of the program component.

<sup>7</sup> On a 0-to-10 scale where 0 means "Not at all satisfied" and 10 means "Completely satisfied".

**Figure 8: 2024 Satisfaction with AMH Program Elements**



One participant expressed a neutral level of satisfaction (scores of 5 to 7) with each of the selection of upgrades available, the time it took to complete the program component, and the time it took to receive the rebates. Overall, specific complaints about AMH aspects were minimal, isolated instances, and more likely unrelated to AMH itself but rather to associated external factors.

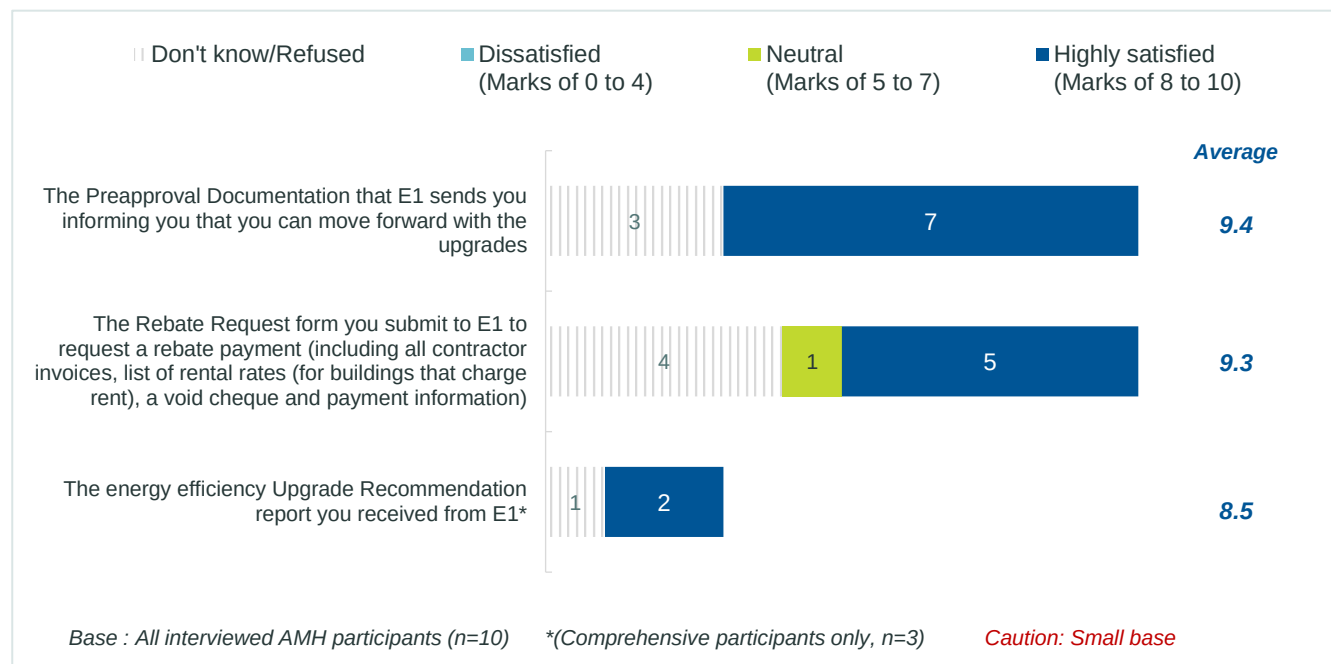
**Table 6: 2024 Elements of Dissatisfaction and Justifications**

| Element of Dissatisfaction<br>(Score of <8) |                                                |   | Reasons for Dissatisfaction (#)<br>(P = Prescriptive participant)                                         |
|---------------------------------------------|------------------------------------------------|---|-----------------------------------------------------------------------------------------------------------|
| n=1                                         | Selection of upgrades available                | › | Would like to see more options for prescriptive upgrades (1P)                                             |
| n=1                                         | Time it took to complete the program component | › | Took longer than estimated due to delays on the contractor side (1P)                                      |
| n=1                                         | Time it took to receive the rebate             | › | Rebate took longer to receive than the estimated timeframe due to paperwork getting lost in the mail (1P) |

## Satisfaction with AMH Forms and Reports

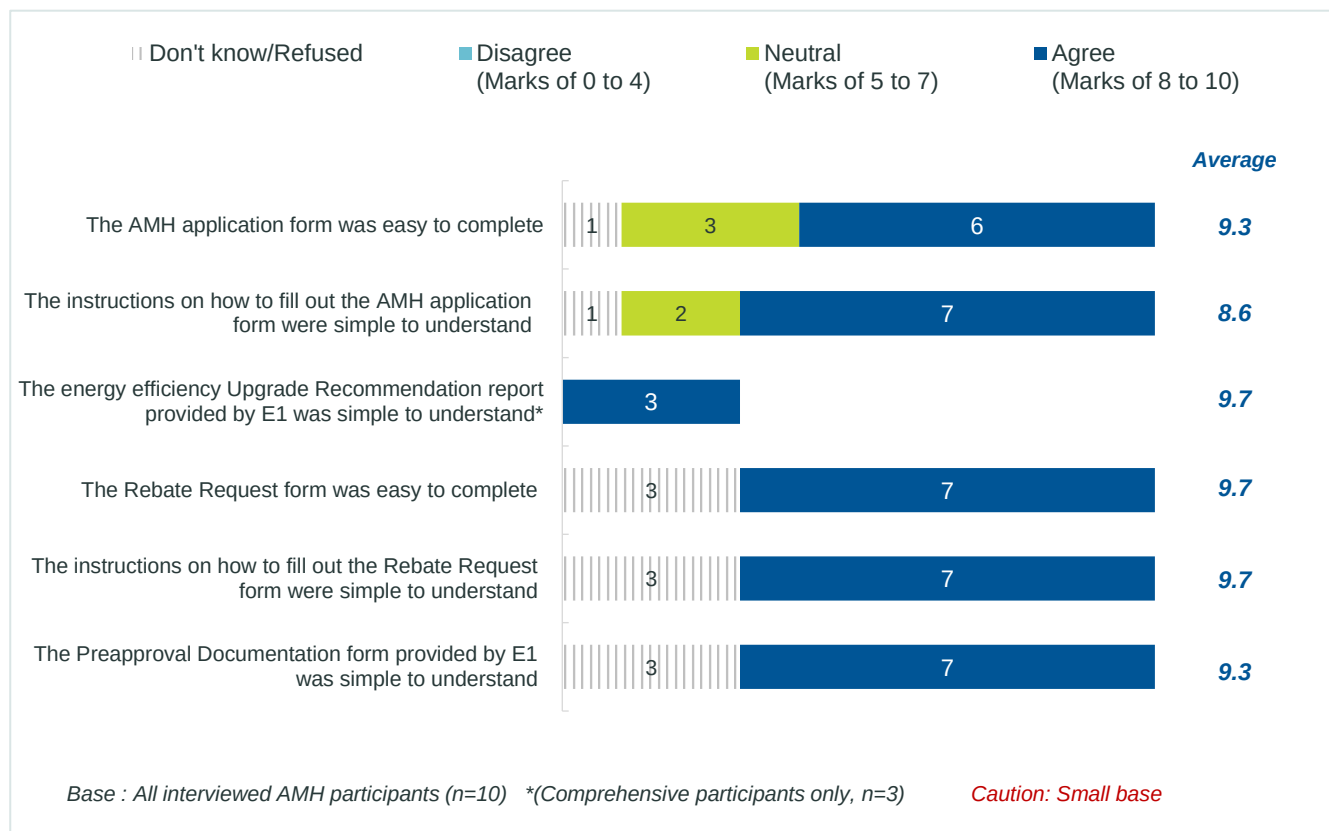
In general, participants who were able to answer were **highly satisfied with the AMH forms and reports**, including preapproval documentation, the rebate request form, and the upgrade recommendation report. The one comprehensive path participant who was less than satisfied with the rebate request form noted that, given their many properties involved in AMH, it would be easier for them if they could do a bulk submission instead of having to submit individual request forms for each property.

**Figure 9: 2024 Level of Satisfaction with AMH Forms and Reports**



A series of statements about AMH forms and reports was read and participants were asked to indicate the extent to which they agreed or disagreed with each. Once again, participants provided generally **positive results**. The preapproval documentation form, the instructions on how to fill out the rebate request form, and the upgrade recommendation report were **simple to understand**, and the rebate request form was **easy to complete**. While the AMH application was considered easy to complete and the instructions provided were simple to understand for most, a low number of participants provided a more neutral score (of 5 to 7). One person mentioned that, since so much information from different sources is needed to complete the report, it would be helpful if the online form could be partially completed and progress saved instead of having to be completed in one sitting. Although ratings were positive overall for both comprehensive and prescriptive participants, it is interesting to note that the limited number of ratings below a score of 8 were all provided by prescriptive participants.

**Figure 10: 2024 Level of Agreement with Statements About AMH Forms and Reports**



## Satisfaction with Aspects of the Energy Audit

The two interviewed participants who participated in the AMH comprehensive path and played a role in their energy audit were asked to comment on their satisfaction with the various aspects of the **energy audit** process. Both participants were highly satisfied with all aspects, including the **overall service provided by the energy auditor, the energy audit appointment scheduling process, the ability of the energy auditor to answer questions, and the information provided by the energy auditor.**

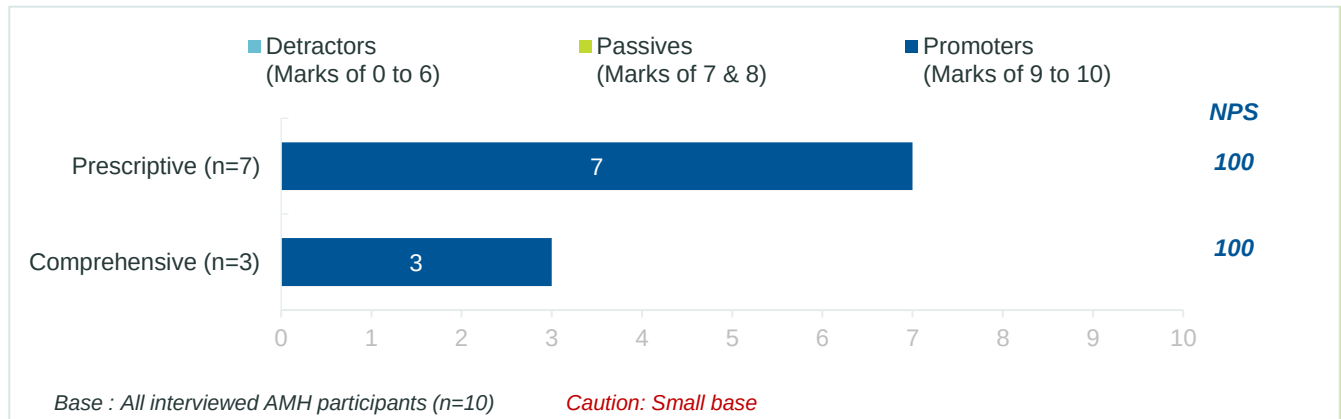
## Net Promoter Score

As illustrated in Figure 11 below, the Net Promoter Score (NPS) is a tool that measures customer experience with and overall perceptions about a brand or program. It is calculated by subtracting the “Promoters” (i.e. those who provide a score of 9 or ten 10 who will refer others and fuel growth) from the “Detractors” (i.e. those who provide a score of 0 to 6 and who can impede growth through negative word of mouth). The NPS can range from a maximum score of 100 (if everyone is a “Promoter”) to a minimum score of -100 (if everyone is a “Detractor”). The higher the NPS is, the better.

All ten AMH participants – including both prescriptive and comprehensive participant sub-groups – were considered “Promoters” of the program, meaning they would recommend it to other affordable housing providers. The NPS provided by each sub-group was 100, the highest possible score.



Figure 11: Likelihood to Recommend AMH, 2024



### 3.3.2 Energy Auditor Satisfaction

As with AMH participants, **EAs appear satisfied** overall with AMH as illustrated in Figure 12 below. They are particularly content with the **selection of upgrades** available through the program component. **Communications with E1**, including overall reporting, are perceived to be satisfactory in general. While the **10-day timeframe** to submit the energy audit report, photos, and analysis and the **simulator software** used to complete the audit and establish energy savings garner **more modest** satisfaction levels, the **audit reporting templates**, especially the **initial** audit template, appears to provoke **more discontent** among interviewed EAs.

The few justifications for lower satisfaction levels are presented in Table 7 further below. Of note, EA dissatisfaction with the reporting templates relate to them **not being user-friendly**, being **Word-based rather than Excel-based**, and providing **little flexibility** in data entry. It should be noted that E1 rolled out an Excel template in the past; however, results were unsatisfactory for the E1 staff and they decided to revert back to using the Word template.

Additionally, a couple of EAs mentioned that they sometimes lacked information on current building systems. Having this information before their initial visit would be helpful to EAs.

**Figure 12: 2024 Energy Auditor Satisfaction with Various Elements of AMH**

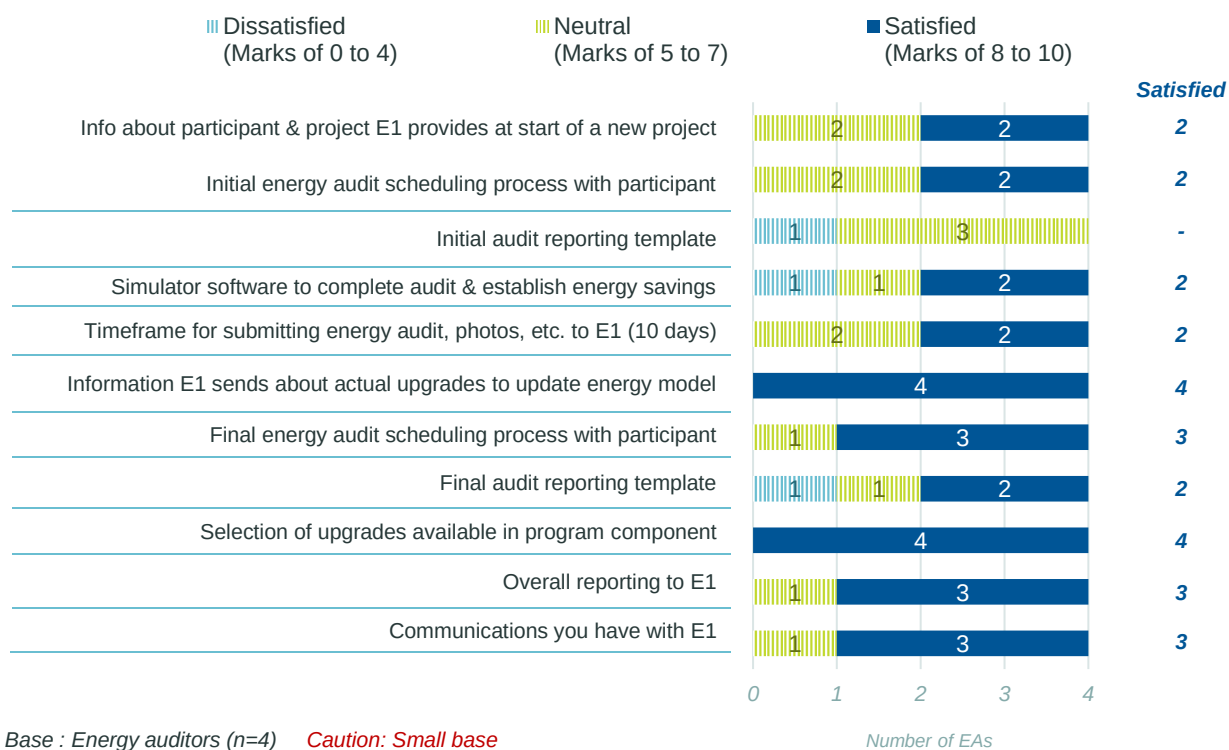


**Table 7: 2024 Elements of Dissatisfaction and Justifications Among EAs**

| Element of Dissatisfaction (Score of <8) |                                                                        | Reasons for Dissatisfaction (#)                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| n=4                                      | Initial audit reporting template                                       | <ul style="list-style-type: none"> <li>› Template is not user-friendly/awkward/lengthy to fill out (n=3)</li> <li>› Would prefer an Excel-based template (n=2)</li> <li>› Template does not provide flexibility for data entry (n=1)</li> </ul>                                                                                                           |
| n=2                                      | Final audit reporting template                                         | <ul style="list-style-type: none"> <li>› Would prefer an Excel-based template (n=2)</li> <li>› Onerous process/finicky (n=2)</li> <li>› Template does not provide flexibility for data entry (n=1)</li> </ul>                                                                                                                                             |
| n=2                                      | Simulator software to complete audit & establish energy savings        | <ul style="list-style-type: none"> <li>› R2000 only provides a two-dimensional approach and gives energy rating as stock rather than real-world performance (n=1)</li> <li>› Issues with using RETScreen (n=1)</li> </ul>                                                                                                                                 |
| n=2                                      | Info about participant & project E1 provides at start of a new project | <ul style="list-style-type: none"> <li>› Insufficient information regarding existing systems provided before the initial visit (n=2)</li> <li>› No consistent format in application – handwritten, printable PDF (n=1)</li> <li>› Lengthy process to obtain historical energy invoices (n=1)</li> </ul>                                                   |
| n=2                                      | Timeframe for submitting energy audit, photos, etc. to E1 (10 days)    | <ul style="list-style-type: none"> <li>› The two-week timeline is no longer relevant now that EnerGuide is not used for audits (n=1)</li> <li>› Limited staffing makes it difficult to handle AMH and non-program workload (especially when AMH workload varies throughout the year, making it difficult to staff at the required level) (n=1)</li> </ul> |
| n=2                                      | Initial energy audit scheduling process with participant               | <ul style="list-style-type: none"> <li>› Tight timelines to contact participants/schedule visits (2 days) (n=1)</li> <li>› Random email notifications from AMH (n=1)</li> </ul>                                                                                                                                                                           |
| n=1                                      | Final energy audit scheduling process with participant                 | <ul style="list-style-type: none"> <li>› Random email notifications from AMH (n=1)</li> </ul>                                                                                                                                                                                                                                                             |
| n=1                                      | Communications you have with E1                                        | <ul style="list-style-type: none"> <li>› Too few communications/check-ins with E1 (n=1)</li> </ul>                                                                                                                                                                                                                                                        |
| n=1                                      | Overall reporting to E1                                                | <ul style="list-style-type: none"> <li>› No evaluation of performance across participants/case-by-case only/no performance metrics (n=1)</li> <li>› SharePoint is not user-friendly (n=1)</li> </ul>                                                                                                                                                      |

### 3.3.3 Other Aspects of Program Delivery

#### Service, Relationship Building, and Flexibility

E1 staff are of the opinion that the AMH **prescriptive** path offers **quick and easy turnaround** and a **hands-on service** to participants. They see the **comprehensive path** as complementing the prescriptive path by providing the option of **full building upgrades**, custom **solutions**, and the chance for E1 to **form relationships** with participants as they navigate projects that can sometimes take a long time and present challenges. EAs add that the comprehensive list of opportunities for upgrading a building, including multiple fuel types and system improvements beyond energy upgrades (e.g. electric system upgrades), can be implemented over time if desired.



## Rebate, Calculations, and Financial Concerns

For EAs, the **AMH rebate** is considered one of AMH's greatest strengths, as confirmed by participant satisfaction levels (see Figure 8 above), along with the **energy cost savings** resulting from any upgrade. E1 staff mention that the ability to **receive 50% of the rebate before project completion** is also well received (as confirmed by the one participant who provided a satisfaction score of 10/10 on this aspect). That said, E1 reports that participants do not always realise that they **must pay the tax on the overall project expenditure** and that the program component only covers **up to 80% of pre-tax costs** based on the costs-to-energy-savings ratio. E1 explains over the phone and in emails to participants how the incentives work and is working on wording to make things clearer, but participants still have difficulties understanding how much rebate they will be given and how the rebate is calculated. Recent **increases in supply chain costs** (labour, equipment) also mean that participants often only receive up to 60-70% of their pre-tax outlay because of high contractor fees affecting the costs-to-energy-savings ratio.<sup>8</sup> To get the best deal and incentive, participants therefore need to shop around for quotes.

Additionally, EAs mention that some participants think that the **estimated incentive** for the upgrades presented in the preapproval report is the **amount they will receive** at the end of their project, although the amount can change based on the actual equipment installed. A situation such as this can cause frustration and disappointment after a project has been completed. E1 staff report that they considered removing the estimated incentive from the preapproval report but feel that participants would still reach out to them anyway to have an idea of how much incentive they might be getting.

Participant confusion with the necessary steps of the program component can also be problematic. Since AMH requires project preapproval, participants need to wait until E1 reviews and approves the quotes, although some participants start the work before preapproval is provided, possibly affecting the incentive amount they receive if they are not approved for all the work.

According to EAs, other participants' financial concerns associated with AMH include difficulty securing upfront capital to pay for the upgrades, the lack of recognized audits that could help participants secure other financial assistance, and AMH rent control requirements (see Subsection 3.3.5 below for more details on perceptions regarding the affordability covenant).

## Managing Projects and Finding Contractors

Over and above the E1 service provided throughout AMH participation, some EAs receive requests from participants for **additional project management assistance**. EAs mention that participants are sometimes ill-equipped to manage implementing the recommended upgrades themselves as they lack project management skills and/or have difficulty securing contractors.

EAs cite **challenges in finding contractors** to provide quotes and perform the work, which can cause significant delays (and also affect incentive levels – see subsection on “Rebate, Calculations, and Financial Concerns” above). This appears to be especially problematic in the Cape Breton area.

E1 staff mention that project management assistance for participants would be advantageous.

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<sup>8</sup> It should be noted that supply chain cost increases have led E1 to modify its incentive calculations accordingly.



## Upgrades

### EA Staff Planning

Finally, one EA mentioned that having a limited number of AMH projects makes it difficult for them to ensure an adequate staff complement at all times and that their staff may forget aspects of AMH if only a few audits are completed in a given year.

### 3.3.4 Affordability Covenant

#### AMH Participant Perceptions

Questions about perceptions of the **affordability covenant** were posed to the six AMH participants with MURBs.<sup>9</sup> All six indicated they charge rent to their tenants and therefore were obligated to agree to the affordability covenant. When asked about their opinions on the affordability covenant, six participants had a **positive or neutral** perception for both the term length and the imposed rental rates. Several participants elaborated that the term length and rates were **fair and acceptable** to them given that they were **already an affordable housing provider** (for example, co-op, housing group for Indigenous people, non-profit or government-owned housing, participating in an affordability program) so the covenant did not change their operations. Only one concern was shared suggesting that, for government-owned buildings, the government could choose to divest from the property before the covenant term is up, but it was stated by this participant that such instances are rare.

Given the positive perceptions about the covenant, few suggestions were offered in terms of modifications that could be made. Only one participant proposed that the rent be adjusted in the Halifax Regional Municipality specifically, saying that the cap was too low compared to what was charged for other properties located in the area.

#### Dropped-out Participant and Non-participant Perceptions

Across the 14 **dropped-out participants and non-participants** who charge rent to tenants, opinions on the AMH operating agreement/affordability covenant tended to be **highly polarized**; six offered positive assessments and five offered negative assessments of the affordability covenant overall. The others either had mixed opinions on the topic (n=1) or were reluctant to offer any type of opinion without reviewing, in detail, the affordability covenant again (n=2).

All those with **positive perceptions** of the affordability covenant recalled the **rental rate being higher than** what they currently charge in rent to their tenants. Conversely, **opposition** was primarily driven by perceptions of the **rental rates being too low**, so much so that the rates were cited as a core reason for not pursuing AMH. For these individuals, **modifications** to the proposed rental rates (i.e. making them more in line with current market rates) were seen as **critical in changing their perceptions** about AMH. As with the one AMH participant mentioned above, one non-participant also took issue with how the rates were differentiated by region, with the rate for Halifax falling in the same category as other communities deemed as non-comparable. As such, they felt Halifax should have its own rental rate that is higher than other communities. It should be noted that E1 reported originally having separate regions for the Halifax area and included two communities under the same umbrella since the market rate was equivalent. E1 is also in the process of developing a new methodology to determine affordability criteria and calculate rental rates.

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<sup>9</sup> The remaining four participants were non-bed facilities (n=3) and a shelter (n=1).



**No dropped-out participants and non-participants**, even those opposed to the affordability covenant, **expressed significant concern over the AMH term lengths**, and reducing the agreement terms from 12 years to 10 years (for comprehensive) and from six years to five years (for prescriptive) had minimal impact on their opinions of the covenant.

### 3.3.5 Participant Questions and Concerns

Participants' questions to EAs during the initial energy audit visit vary based on their level of understanding of AMH, their knowledge of their building's construction, and/or their interest in the potential upgrades. The questions EAs receive generally relate to the **AMH rebate** to be expected, the **next steps**, and building operation questions that are outside of the AMH scope.

With respect to energy efficiency in particular, **heating systems** (e.g. heat pumps) and **insulation generate the most questions** from participants according to EAs. Less commonly, participants enquire about mechanical systems, ventilation, hot water, and windows.

Specific questions included the following:

- › Is a backup heating source required when installing heat pumps?
- › What are the costs to upgrade insulation and windows?
- › What is the current level of insulation and what specific products are eligible?
- › What are the potential energy cost savings from heat pump technology?
- › Will the electrical system accommodate the recommended upgrades?
- › Will the heat pump technology provide adequate heat for tenants?
- › Will the old heating system be removed/can it be removed?
- › Where will the ductwork be located?
- › Which contractors should I use/can I trust?

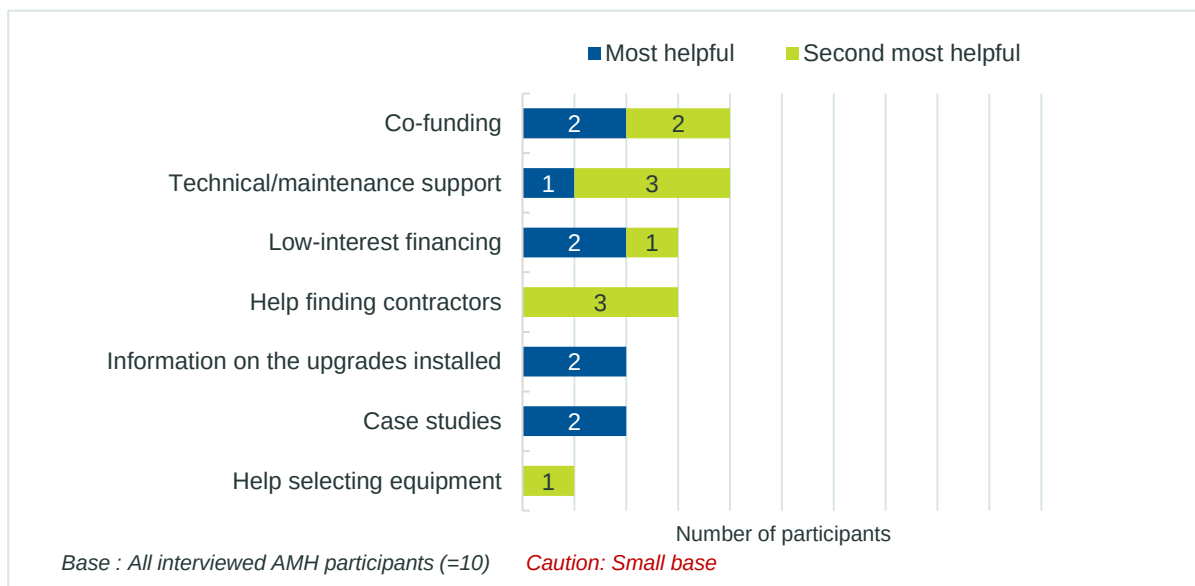
## 3.4 Participant and EA Suggestions for Improvements

AMH participants were presented with a list of seven tools and supports that could be offered to help them navigate the program component. Two of the top three tools/supports mentioned as first or second most helpful (see Figure 13 below) concern monetary aspects, namely **co-funding**<sup>10</sup> and **low-interest financing**. **Technical/maintenance support** and **help finding contractors** follow. **Information on the upgrades installed** and **case studies** were also considered useful by some.

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<sup>10</sup> E1 or another provider shares part of the project cost.

**Figure 13: Helpfulness of Various Tools/Support for AMH (Aided), 2024**



Participants were asked if they had any suggestions for improving AMH. Given the overwhelming perceived positivity about the program component, it is unsurprising that seven of the 10 participants had no recommendations. The two remaining participants each provided a unique suggestion for improvement as follows:

- › One participant suggested that some kind of **tutorial be offered to help participants learn how to maximize the efficiency of their heat pumps.**
- › One participant would like to see AMH cover **window upgrades** in addition to other measures.

Many suggestions were shared by EAs to improve the AMH process, notably around the **administrative functions**. Recommendations included the following:

- › Developing a **portal for delivery agents** to provide access to leads and progress information on current projects
- › Giving EAs more information about **current building systems and participants' goals** before the initial visit
- › Using **Excel** for all reporting templates
- › Simplifying the reporting templates
- › Allowing flexibility in data entry
- › Implementing regular **post-mortem meetings** with EAs to discuss AMH and issues or sharing best practices identified by EAs
- › Using the EnerGuide audit process if using HOT2000
- › Streamlining the application process when a complete audit is not needed
- › Allowing for virtual audits to be completed



EAs also provided specific suggestions for **materials and training** to facilitate their role in AMH. While EAs appreciate the current training, they would like training to include:

- › More free sessions for simulating different scenarios
- › Training specific to CanQuest and RETScreen with sufficient advance notice
- › Training specific to MURB evaluations
- › Greater consistency between the simulation and auditing processes
- › Access to a building imagery tool

Beyond continuing to reach out directly to various organizations, charities, and non-profits to increase participation in AMH, one EA mentioned that E1 should **educate municipalities** about the program component so they can market it to organizations within their jurisdiction.

Finally, one EA would like to see solar panels added as an eligible measure.

## 3.5 Alternatives for Implementing Other Energy Efficiency Measures

### Alternative Programs

Two dropped-out participants and five non-participants stated that they either had taken part in a program other than AMH or had plans to do so in the near future. One dropped-out participant noted that they had not explored other programs due to the perceived administrative burden required to do so.

Dropped-out Participants:

- › One noted participating in another E1 program specifically targeted at affordable new builds since they were ineligible for AMH.
- › One reported participating in AMH for another property in collaboration with Housing Nova Scotia.

Non-participants:

- › Two noted participating in other E1 programs in the past but were unable to recall the program name.
- › Three non-participants were considering taking part in other programs in the near future. Interviewees were under the impression that participation in another program would not necessarily limit their participation in AMH should they wish to reapply.
  - › One is planning to put in an application to the Government of Nova Scotia's Community Housing Infrastructure and Repair Program.
  - › One is looking into programming with the Affordable Housing Association of Nova Scotia (no specific details were provided).
  - › One is interested in Canada Mortgage and Housing Corporation's (CMHC) Mortgage Loan Insurance (MLI) Select program (focused on financing rather than providing grants).

Outside of energy efficiency programs, only two dropped-out/non-participant interviewees noted seeking additional funding to help implement energy efficiency measures in their building.

- › One non-participant reported getting support through Housing Nova Scotia.
- › One dropped-out participant reported having sought funding from multiple sources including:
  - › CMHC's Co-Invents Fund/Affordable Housing Fund
  - › Seed funding for planning and development through the Department of Municipal Affairs and Housing
  - › The Affordable Housing Program
  - › The Community Housing Growth Fund





## Energy Efficiency Upgrades

Only three interviewees noted having completed energy efficiency upgrades in the past year: One dropped-out participant had made several energy efficiency upgrades, including new insulation, installing heat pumps, replacing windows and doors, and putting in new energy efficient appliances (Housing Nova Scotia). Two non-participants also reported completing recent upgrades, with one having recently replaced their insulation (through another E1 residential program) and the other having made several energy efficiency upgrades, including new window siding, heat pumps, and lighting (they had the opportunity to complete the work quickly at a discount contractor price and did not go through any program).

### 3.6 Annual Energy Efficiency Budget and Payback Period

#### Budget

Half (5/10) of interviewed **AMH participants** specified a numeric answer in terms of their **budget for building maintenance and efficiency upgrades**. The remaining five participants indicated they either did not know or did not have a budget but rather made ad hoc repairs and installs **as needed**, and this was especially the case among non-profit organizations or those with smaller buildings. Budgets fell within a very wide range of \$500-\$300,000 annually with \$300,000 being an outlier among this cohort. With the outlier removed, the average budget for maintenance or upgrades was **\$3,625** per year.

Similarly, only two non-participants (one rooming house and one rental/co-op) reported having a budget for building maintenance and efficiency upgrades. The annual building maintenance and efficiency upgrade budget for the rooming house was estimated at approximately \$14,000, while the rental/co-op budget was estimated at \$2,500. All other dropped-out participants and non-participants noted having no formal budget in place, with **expenses dealt with on an ad hoc basis**.

#### Payback Period

Three of the ten AMH participants considered a **payback period** for participation in their AMH project. Of these, two said their required period was **less than five years**, and the other said they would have gone ahead with a period of five to ten years, but when they did the calculation, they determined they would recoup their investment in approximately three to four years. Several of the those who did not consider a payback period indicated that they were either receiving funding elsewhere and **going to move ahead with the project regardless**, or they required 100% of their costs to be covered or would not have been able to proceed with the project. In either case, a payback period was not relevant to these participants.

Dropped-out participants and non-participants generally considered any payback period **over a decade to be unreasonable**. The majority (n=8) would consider a five to 10-year payback period to be acceptable and some (n=4) noted they generally required the period to be less than five years. Two interviewees were uncertain as to what length of time would be acceptable, while an additional two interviewees noted that it would depend on the type of upgrade, with larger upgrades and the corresponding higher price tag and longer product lifetime expected to have a longer payback period.



## Rent

Of the six MURB AMH participants with tenants, four indicated that their tenants **pay their own utility costs**. The other two participants said that utilities were included in their tenants' rent. Among dropped-out participants and non-participants, three reported that their tenants paid full utility costs, and four noted that their tenants paid a portion of the utilities (e.g. paying directly for electricity and heating included in rent). Outside of shelters and non-bed housing, all other interviewees noted that utilities were included in their rent.

### 3.7 Overview of AMH Strengths and Challenges

The following provides a summary of the strengths and challenges associated with AMH.

#### AMH Strengths:

- › Financial support for affordable housing
- › Provides a comprehensive list of upgrades that can be implemented over time
- › 50% incentive received before project end
- › Potential energy cost savings
- › High overall satisfaction with AMH among participants
- › High overall satisfaction with AMH among EAs
- › Participants satisfied with EA service and energy audit
- › AMH forms and reports clear and easy to complete for participants
- › Highest possible Net Promoter Score (likelihood to recommend AMH) of 100
- › No significant concern over the operating agreement term lengths

#### AMH Challenges:

- › Participation limited by availability of capital funds and lack of budget
- › Rent control requirements make AMH unattractive to some
- › Some participant confusion over proportion of costs covered by rebate
- › Increasing supply chain costs
- › Difficulty securing contractors to implement recommended upgrades
- › Older buildings may require costly preparation work before upgrades can be implemented (e.g. electrical upgrades)
- › Some participants need more handholding due to limited project management skills to coordinate the implementation of upgrades
- › Word format reporting templates not user-friendly
- › EAs sometimes lack initial information on current building systems



## 4 AMH Impact Evaluation

The objectives of the 2024 AMH impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as the EUL and associated lifetime energy savings.

### 4.1 Tracking Sheet Audit

To ensure program results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1 as well as correcting the tracked savings as needed. The results are provided in Appendix I. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 4.2 Gross Savings

Gross savings correspond to the change in energy consumption resulting from various electrical energy saving upgrades such as building envelope measures, space heating measures, and domestic hot water (DHW) measures implemented by AMH participants.

The following subsections describe the methodology used to review AMH gross savings for 2024. Interactive effects and EUL values were also assessed.

#### 4.2.1 Energy Savings

For the 2024 AMH evaluation, the Evaluator conducted desk reviews of five comprehensive projects and 10 prescriptive projects. The reviews served to establish the evaluated savings and adjustment ratios if possible.

#### Comprehensive Path Project Desk Review Findings

Through the 2024 comprehensive path project desk reviews, the Evaluator made three types of adjustments:

- › The impacts of some measures on other systems, which correspond to interactive effects, was not properly modelled in RETScreen for three projects. Correcting these errors reduced the electrical energy savings of two projects by 23% and 5% respectively, while the correction for the other project had an impact only on non-electrical energy savings.
  - › Since this change impacted three of the five reviewed projects, the Evaluator recommends that E1 improve the modeller checklist to include a validation of the proper consideration of interactive effects in RETScreen to reduce the likelihood that this situation occurs again in the future.
- › For one project, one measure was not implemented, yet the model included it. Removing this measure reduced the savings by 25%.
- › In two cases, minor discrepancies were found between the parameters used in the models and those included in reporting. The resulting adjustments had an impact of 1% or less on the project savings.

The comprehensive path project reviews resulted in an overall adjustment ratio of 0.873 with a margin of error of 18% for the reviewed projects. This margin of error was too high to extrapolate a ratio to adjust the energy savings of non-reviewed comprehensive path projects. Thus, the Evaluator elected to use the 2024 tracked savings as the evaluated savings for non-reviewed comprehensive path projects.

## Prescriptive Path Project Desk Review Findings

Energy savings for AMH prescriptive path projects are calculated using the 2024-2025 DSM MA equations. Among the reviewed prescriptive path projects, four were lighting projects and six were heat pump projects. For lighting projects, the evaluated energy savings were the same as tracked savings, so no adjustment ratio was necessary.

For AMH heat pump projects, the full-load hours of most projects are based on the residential value from Green Heat. Since the full-load hours are derived from 2017 Green Heat billing analysis results and the heating season performance factor (HSPF) of the heat pumps in that analysis, the full-load hours were adjusted to consider the change from HSPF to HSPF2. This change resulted in an increase of 6% in energy savings for three of the six projects. The full-load hours of the other three projects were not based on the residential value since occupants mostly only sleep in the relevant buildings and do not use them as a residence.

Also, for one project, the HSPF2 value used by E1 was for Region IV while Nova Scotia is in climate zone Region V. This change reduced the energy savings of that project by 10%.

All changes to prescriptive heat pump projects resulted in an overall adjustment ratio of 1.016 with a margin of error of 2.8%, which is below the 10% threshold. Since the update to the residential full-load hours will be implemented by E1 when implementing the 2024-2025 DSM MA, the Evaluator considers that most changes resulting from the 2024 prescriptive heat pump project reviews will not carry over to future evaluations. Therefore, the Evaluator elected to use the adjustment ratio for all prescriptive heat pump projects only in the 2024 evaluation.

### Adjustment Ratio Summary

The above changes resulted in three different adjustment ratios for energy savings. Table 8 summarizes the energy savings adjustment ratios and margins of error obtained for the different AMH project categories. One-time adjustments are also included for AMH project categories with adjustment ratios that were not extrapolatable to non-reviewed projects.

**Table 8: 2024 AMH Energy Savings Adjustment Ratios**

| Project Category       | Adjustment Ratio | Margin of Error | Summary                                                                                             | One-time Adjustment (GWh) |
|------------------------|------------------|-----------------|-----------------------------------------------------------------------------------------------------|---------------------------|
| Comprehensive          | 0.873            | 17.7%           | Not extrapolated to non-reviewed projects                                                           | -0.010                    |
| Prescriptive Lighting  | 1.000            | 0%              | -                                                                                                   | -                         |
| Prescriptive Heat Pump | 1.016            | 2.8%            | Applied to all 2024 projects, including non-reviewed projects; not applicable to future evaluations | -                         |

### 4.2.2 Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity peak demand period in Nova Scotia is defined as the coldest days (with an on-peak temperature estimated at -15 °C) between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays.

Similarly to energy savings, project reviews served to adjust peak demand savings.

## Comprehensive Project Review Findings

For AMH comprehensive projects, peak demand savings are obtained by multiplying the energy savings by a peak demand-to-energy ratio of 0.283 W/kWh as indicated in the 2024-2025 DSM MA. This resulted in the same adjustment ratio and margin of error as for comprehensive project energy savings, which was not extrapolatable due to the margin of error being too high. Therefore, no adjustment ratio was applied to non-reviewed projects.

## Prescriptive Project Review Findings

Similarly to energy savings, peak demand savings for AMH prescriptive projects are calculated using the 2024-2025 DSM MA equations.

For lighting projects, project reviews revealed that E1 used a peak coincidence factor of 1 for all lamps, which implies that all replaced lamps were assumed to be ON during peak hours. The Evaluator adjusted the peak coincidence factor for all lamps based on hours of use,<sup>11</sup> which resulted in 32% less peak demand savings on average for lighting projects. However, the margin of error was too high to extrapolate the resulting adjustment ratio to non-reviewed projects.

For heat pump projects, the Evaluator made no adjustment to peak demand savings, thereby resulting in evaluated savings being equal to tracked savings.

Therefore, no adjustment ratio was extrapolated for non-reviewed prescriptive project peak demand savings.

## Adjustment Ratio Summary

The above changes resulted in three different adjustment ratios for peak demand savings. Table 9 below summarizes the peak demand savings adjustment ratios and margins of error obtained for the different AMH project categories. The table also includes one-time adjustments that were applied to AMH project categories for which adjustment ratios were not extrapolatable to non-reviewed projects.

**Table 9: 2024 AMH Peak Demand Savings Adjustment Ratios**

| Project Type           | Adjustment Ratio | Margin of Error | Summary                                   | One-time Adjustment (MW) |
|------------------------|------------------|-----------------|-------------------------------------------|--------------------------|
| Comprehensive          | 0.873            | 17.7%           | Not extrapolated to non-reviewed projects | -0.003                   |
| Prescriptive Lighting  | 0.676            | 23.1%           | Not extrapolated to non-reviewed projects | -0.006                   |
| Prescriptive Heat Pump | 1.000            | 0%              | -                                         | -                        |

### 4.2.3 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other factors such as heating and cooling. The interactive effects of space heating and DHW measures were already considered in the savings calculations of comprehensive projects since the engineering calculations or the simulation models encompass those effects. For prescriptive projects, the 2024-2025 DSM MA includes interactive effects when applicable.

<sup>11</sup> Since schedules are not documented in project documentation, the Evaluator assumed that lamps that were ON for 10 hours or more per day each were likely ON during peak hours; therefore, the Evaluator maintained a peak coincidence factor of 1. Otherwise, the Evaluator assumed that operating hours were spread equally throughout the year and established the peak coincidence factor by dividing the annual operating hours by the total number of hours in a year.

## 4.2.4 Effective Useful Life

Using the EUL values presented in the 2024-2025 DSM MA and the proportion of savings for measures implemented through AMH in 2024, the Evaluator revised the EUL values for comprehensive projects. For prescriptive projects, EUL values for each measure were drawn from the 2024-2025 MA and remained the same as in the 2023 evaluation. For comprehensive projects, the weighted average EUL increased from 17.7 years in 2023 to 20.5 years in 2024. Table 10 below outlines the shares of savings and the equivalent EUL values for each measure category used to calculate the weighted average EUL for comprehensive projects.

**Table 10: 2024 AMH Equivalent EUL Values for Comprehensive Projects**

| Measure Category            | Share of Savings [%] | Evaluated Equivalent EUL [years] | Reference                                                                                                            |
|-----------------------------|----------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Heating Systems             | 63.9%                | 18                               | GDS, 2007 – Heat Pumps                                                                                               |
| Building Envelopes          | 22.2%                | 30                               | California Public Utilities Commission, 2023                                                                         |
| Fenestration                | 10.6%                | 20                               | DEER, 2014 – Windows                                                                                                 |
| Ventilation                 | 1.8%                 | 10                               | GDS, 2007 – Programmable Thermostats                                                                                 |
| Lighting                    | 1.5%                 | 5.7                              | Lifetime of 50,000 hours based on model specifications; assumption that lamps are in common zones and turned on 24/7 |
| <b>Weighted Average EUL</b> | <b>100%</b>          | <b>20.5</b>                      | <b>Calculation</b>                                                                                                   |

## 4.2.5 Evaluated Gross Savings

The annual gross savings at the generator are presented in Table 11 below.

The gross energy savings at the generator were estimated by using different line loss factors for each participant based on their rate code. The line loss factors correspond to the values submitted to the NSUARB as part of Nova Scotia Power 2014 Cost of Service Study Progress Update.<sup>12</sup> With total gross electrical energy and lifetime electrical energy savings of 1.159 GWh and 19.397 GWh respectively, the average EUL value for AMH was 16.7 years in 2024.

<sup>12</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix 1.

**Table 11: Evaluated 2024 AMH Gross Energy and Peak Demand Savings**

|                                                               | Comprehensive | Prescriptive  |              | Total         |
|---------------------------------------------------------------|---------------|---------------|--------------|---------------|
|                                                               |               | Heat Pumps    | Lighting     |               |
| <b>Number of Projects</b>                                     | <b>19</b>     | <b>57</b>     | <b>7</b>     | <b>83</b>     |
| <b>Energy Savings</b>                                         |               |               |              |               |
| Tracked Gross Energy Savings – at the Meter (GWh)             | 0.226         | 0.681         | 0.153        | 1.061         |
| Adjustment Ratio for Energy Savings                           | 1.000         | 1.016         | 1.000        | -             |
| One-time Adjustment for Energy Savings (GWh)                  | -0.010        | -             | -            | -0.010        |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>0.216</b>  | <b>0.692</b>  | <b>0.153</b> | <b>1.062</b>  |
| Line Loss Factor                                              | 1.0914        | 1.0914        | 1.0914       | -             |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>0.237</b>  | <b>0.755</b>  | <b>0.167</b> | <b>1.159</b>  |
| Equivalent Effective Useful Life (years)                      | 20.5          | 18            | 5.7          | -             |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>4.849</b>  | <b>13.598</b> | <b>0.951</b> | <b>19.397</b> |
| <b>Peak Demand Savings</b>                                    |               |               |              |               |
| Tracked Gross Peak Demand Savings – at the Meter (MW)         | 0.064         | 0.418         | 0.029        | 0.511         |
| Adjustment Ratio for Peak Demand Savings                      | 1.000         | 1.000         | 1.000        | -             |
| One-time Adjustment for Peak Demand Savings (MW)              | -0.003        | -             | -0.006       | -0.009        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.061</b>  | <b>0.418</b>  | <b>0.023</b> | <b>0.502</b>  |
| Line Loss Factor                                              | 1.1346        | 1.1346        | 1.1346       | -             |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.069</b>  | <b>0.475</b>  | <b>0.026</b> | <b>0.570</b>  |

As presented in Table 12, GHG emissions reductions were calculated by applying the Nova Scotia-specific factor<sup>13</sup> for GHG emissions generated by electricity production to AMH gross savings results.

**Table 12: Evaluated 2024 AMH Gross GHG Emission Reductions**

|                                                                                             | Total        |
|---------------------------------------------------------------------------------------------|--------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>1.159</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2        |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>547</b>   |

<sup>13</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

## 4.3 Net Savings

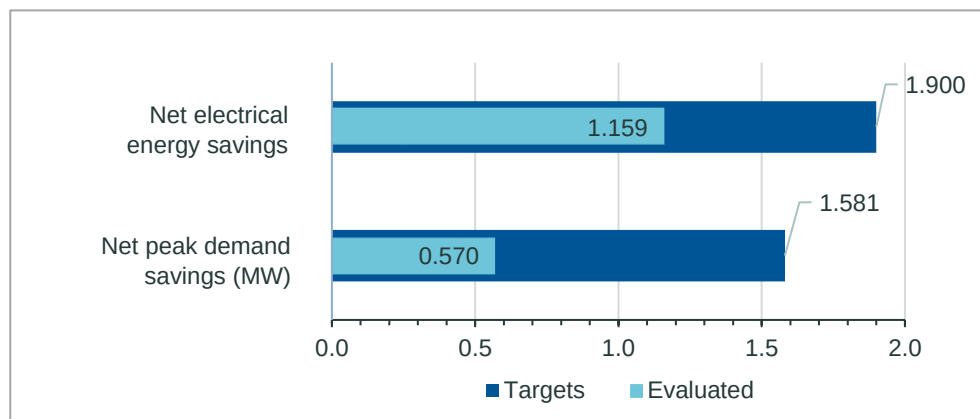
The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to a program component, by estimating the net-to-gross ratio (NTGR). More precisely, the NTGR represents the positive or negative impacts of spillover and free-ridership effects on gross savings. For AMH, free-ridership and spillover effects were considered to be nil since participants are non-profits or low-income housing owners with limited budgets for building improvements. Therefore, a NTGR of 1.00 was applied.

### 4.3.1 Evaluated Net Savings

Net savings are defined as the changes in energy use that are specifically attributable to AMH. Since spillover and free-ridership effects were considered nil, the net energy savings are equal to the gross savings generated by the program component. Likewise, the net annual GHG emission reductions are equal to the gross annual GHG emission reductions.

As outlined in Figure 14, AMH fell short of its electrical energy and peak demand savings targets by 39% and 64% respectively.

**Figure 14: 2024 AMH Targets and Evaluated Results**





## 4.4 Realization Rate

Table 13 below compares the energy and peak demand savings established through this evaluation to those calculated in the 2024 tracking sheet. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and at peak demand savings.

**Table 13: Comparison of 2024 AMH Tracked and Evaluated Savings at the Generator**

|                                                                                                                           | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|---------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                           | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings                                                                                                            |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                     | 1.158         | GWh  | 1.00  | 1.158       | GWh  | 100%             |
| Evaluation Results                                                                                                        | 1.159         | GWh  | 1.00  | 1.159       | GWh  |                  |
| Peak Demand Savings                                                                                                       |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                     | 0.580         | MW   | 1.00  | 0.580       | MW   | 98%              |
| Evaluation Results                                                                                                        | 0.570         | MW   | 1.00  | 0.570       | MW   |                  |
| * The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings. |               |      |       |             |      |                  |

The net evaluated electrical energy savings and evaluated peak demand savings were nearly the same as the values tracked by E1. The differences are due to the application of the adjustment ratio and one-time adjustments.



## 5 AMH Key Findings and Recommendations

As mentioned previously, the main objectives of the 2024 AMH evaluation were as follows:

- › Collect information on participant and distributor perspectives
- › Calculate AMH gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

This section provides the Evaluator's key findings and recommendations in relation to the above objectives.

### **2024 AMH-Finding: The Evaluator surveyed high levels of satisfaction overall.**

All 10 interviewed participants said that they were highly satisfied with AMH and “would definitely” recommend the program component to other housing providers or affordable multifamily residential building owners (Net Promoter Score of 100). Everyone agreed that AMH is simple to understand and easy to complete. EAs were also satisfied with AMH overall, particularly with the selection of upgrades.

### **2024 AMH-Finding: Incentive calculations can cause confusion among participants.**

Participants do not always realize that they must pay tax on overall project expenditures and that the program component only covers up to 80% of pre-tax costs. E1 provides verbal and written explanations to participants on how incentives are determined and is working on wording to make things clearer, but participants still have difficulty understanding how much rebate they will be granted and how the rebate is calculated. Furthermore, some participants believe that the estimated incentive for the upgrades presented in the preapproval report is the amount they will receive at the end of their project, although this amount can change based on whether all the proposed equipment is installed.

**Recommendation #1:** To further aid understanding, consider providing participants with **case study** examples of incentive calculations to show pre-tax costs and how incentive amounts may change based on supplier quotes and/or equipment installed.

### **2024 AMH-Finding: Some participants would benefit from project management support.**

Based on comments from E1, EAs and participants, project management assistance, technical/maintenance support, and help finding contractors would be useful for participants. Without this assistance, project delays are said to occur. Not being able to find a contractor was also cited as a reason for withdrawing from the program component.

Some participants consider that having more information on the upgrades installed (many energy efficiency questions from participants concern heat pumps and insulation) and case studies would also be valuable.

**Recommendation #2:** Ensure that support and handholding are available for participants who may need help navigating the program component and finding various contractors. Make technical guides available, providing general advice to help participants through the program component.



### **2024 AMH-Finding: Among EAs, satisfaction is low with the audit reporting templates.**

The audit reporting templates generate lower satisfaction levels among EAs, particularly the one for the initial audit. EAs consider that the templates are lengthy and awkward to fill out and would prefer them to be Excel-based rather than Word-based for more data entry flexibility.

**Recommendation #3:** Investigate the possibility of improving the audit reporting templates to improve time efficiencies for EAs, for example by streamlining the reports as much as possible.

### **2024 AMH-Finding: Costs and lack of budget are barriers to participation.**

Financial barriers constitute the main reasons most interviewed dropped-out participants withdrew from the program component. The majority had no budget available for building maintenance and efficiency upgrades, a situation that was echoed among most interviewed non-participants and half of AMH participants. Necessary repairs and upgrades are dealt with on an ad-hoc basis. Half of interviewed dropped-out participants also had issues with the operating agreement, specifically that the rental rates were too low (see the next finding below). In view of the constraints faced by many affordable multifamily housing providers, it is not surprising that participants choose co-funding and low-interest financing as tools and support that would be most helpful to them.

Less frequent mentions for withdrawing from AMH included building ineligibility and the desired upgrades not being included (roof repairs, electrical panel upgrades).

**Recommendation #4:** In the early stages of participant engagement, ensure that participants are aware of the co-financing options that are listed in E1's agreement.

### **2024 AMH-Finding: Rental rates in the operating agreement cause division among dropped-out participants and non-participants.**

Opinions on the operating agreement among dropped-out participants and non-participants were polarized. Negative perceptions were due to the rental rates in the agreement being lower than what dropped-out participants and non-participants currently charge and were therefore a barrier to participation (see the next finding above). Modifications to the proposed rental rates (i.e. making them more in line with current market rates) were seen as critical in changing these negative perceptions about AMH among dropped-out participants and non-participants. E1 regularly reviews rental rates to align with current market conditions.

### **2024 AMH-Finding: Term lengths are not a significant problem.**

No participants, dropped-out participants, or non-participants expressed significant concern about AMH term lengths. Reducing the agreement terms from 12 years to 10 years (for comprehensive projects) and from six years to five years (for prescriptive projects) had minimal impact on their opinions of the covenant. The Evaluator is therefore of the opinion that E1 does not need to revise the term lengths because they are not a current barrier to participation.

### **2024 AMH-Finding: AMH net electrical energy savings and peak demand savings fell short of targets.**

In 2024, AMH achieved 1.159 GWh in net electrical energy savings and 0.570 in net peak demand savings at the generator, falling short of planned net electrical energy savings of 1.900 GWh by 39% and planned net peak demand savings of 1.581 MW by 64%.



**2024 AMH-Finding: In 2024, despite a slight increase in participation compared to 2023, AMH achieved lower savings than in 2023.**

AMH reached its highest participation rate since inception with 83 completed projects generating electrical savings in 2024, which represented a 5% increase compared to 2023. Of the 83 projects, 64 were prescriptive and 19 were comprehensive. The prescriptive projects generated 0.922 GWh and 0.500 MW in net electrical energy and peak demand savings respectively, which represented a 31% and 29% decrease respectively compared to 2023 levels. Comprehensive projects generated 0.237 GWh and 0.070 MW in net electrical energy and peak demand savings, which represented an 85% and 89% increase respectively compared to 2023 levels. Together, AMH paths generated 21% and 23% fewer electrical energy and peak demand savings respectively. Electrical energy savings per project were similar for both paths, with 14.4 MWh per prescriptive project and 12.4 MWh per comprehensive project.

**2024 AMH-Finding: Following project reviews, the Evaluator made an overall upward adjustment to electrical energy savings and a downward adjustment to peak demand savings.**

The 2024 AMH project reviews led to two adjustments for electrical energy savings. The first was a 1.016 adjustment ratio applied to prescriptive heat pump projects to compensate for a change in residential full-load hour values when switching from the HSPF factor to the HSPF2 factor. Since E1 will implement the updated full-load hours in 2025, the adjustment ratio for all prescriptive heat pump projects was only applied in the 2024 evaluation and thus will not be applied in future evaluations. The second was a one-time adjustment to comprehensive projects mainly due to improper modelling of interactive effects and a non-implemented measure that was not removed in the final model. Both adjustments mostly cancelled each other, overall resulting in only a negligible difference between the tracked and evaluated electrical energy savings.

For peak demand savings, the project reviews led to two one-time adjustments. The first was because of adjustments to the peak coincidence factors of certain prescriptive lighting projects. The second was an adjustment to comprehensive projects to reflect the adjustment made to electrical energy savings.

**2024 AMH-Finding: The evaluated net electrical energy savings and peak demand savings were nearly the same as the savings tracked by E1.**

The net evaluated electrical energy savings were nearly the same as the energy savings tracked by E1 and the net evaluated peak energy savings were 2% lower than the peak demand savings tracked by E1. These differences are due to the adjustments applied by the Evaluator following the project reviews.



## 6 ASFH Overview

This section describes the Affordable Single-family Homes (ASFH) program component, follows up on past evaluation recommendations, and provides an overview of participation history.

### 6.1 ASFH Description

ASFH provides energy efficient retrofits and heat pump installations to income-qualified Nova Scotian owners of both electrically heated and non-electrically heated homes at no cost to participants. The program component is marketed under the HomeWarming brand and mainly provides building envelope measures such as draft-proofing and insulation for basements, crawl spaces, exposed floors, main walls, and attics. Heat pumps and smart thermostats are also offered under ASFH. Moisture management measures such as bathroom fans, dehumidifiers, and dirt floor coverings may also be provided. Retrofits are selected and implemented on a case-by-case basis.

ASFH also serves to identify opportunities to replace old appliances (dehumidifiers, refrigerators, and freezers) with energy efficient models and facilitates these replacements internally through the E1 Appliance Retirement program component. These are herein referred to as Appliance Replacement measures. Appliance Replacement results were integrated into ASFH reporting in 2023; those results were previously included in Appliance Retirement reporting.

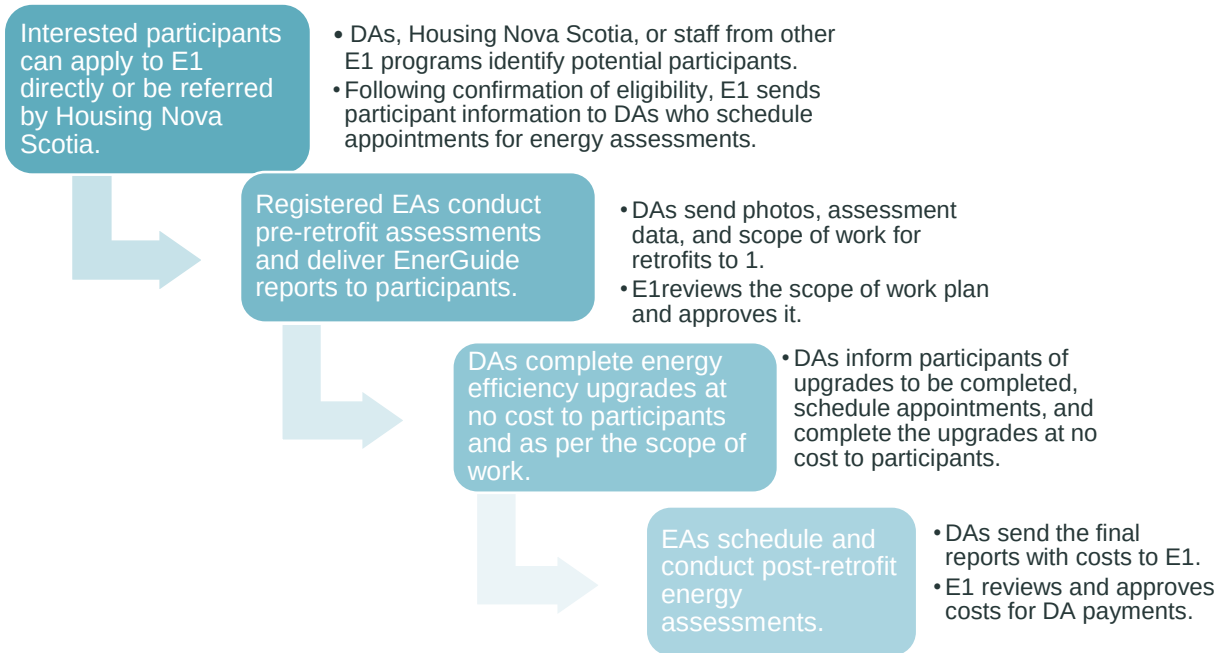
HomeWarming has evolved to provide energy efficiency services for both electrically and non-electrically heated homes. Initially launched in 2012, HomeWarming focused on non-electrically heated homes through government funding, while ASFH, introduced in 2023, targets homes primarily heated with electricity using DSM-approved funding.

Starting on 1 January 2023, E1 assumed full responsibility for HomeWarming delivery, regardless of heating source, and introduced a heat pump only stream for past participants to apply for the new heat pump measure, excluding an energy assessment and additional building envelope upgrades.

ASFH is supported across Nova Scotia by seven delivery agents (DAs) and 43 heat pump contractors who conduct most of the field work. DAs use energy advisors (EAs) to perform pre-retrofit and post-retrofit energy assessments. Pre-retrofit assessments (D assessments) serve to examine the house, provide homeowners with a better understanding of how their house functions in relation to space heating, and identify applicable energy efficient upgrades to be implemented. EAs generate home energy assessment reports that provide a high-level overview of energy usage and send them to homeowners. DAs then recommend retrofits to E1 and complete those approved by the latter. Lastly, EAs conduct post-retrofit assessments (E assessments) to verify implemented measures and provide a final EnerGuide rating calculated using HOT2000, a simulation tool developed by Natural Resources Canada (NRCAN). In the heat pump only stream, heat pump contractors conduct an initial home visit and make recommendations for the heat pump measure to E1. Once approved by E1, the heat pump contractor manages the installation of the heat pump and any electrical upgrades required to facilitate the installation.

Figure 15 below illustrates the participation process.

**Figure 15: ASFH Participation Process Summary**



ASFH participants are also eligible for the Efficient Product Installation (EPI) program component through which energy efficient products are installed at no cost to participants. ASFH participants are internally referred to EPI and generally participate in EPI before receiving a pre-retrofit energy assessment under ASFH.

HomeWarming participants who currently heat their homes with oil can also take advantage of funding available through the Oil to Heat Pump Affordability (OHPA) program to transition from oil systems to electric cold climate heat pumps if they meet OHPA program eligibility criteria (e.g., minimum annual oil usage). OHPA is a federal government program delivered through specific Efficiency Nova Scotia programs. Some ASFH participants who receive DSM support and have electric savings, may also be eligible for the OHPA program and participate in both (e.g., this can be seen when a home has electric and oil heating)

ASFH was aimed at achieving 2.825 GWh in net electrical energy savings and 1.046 MW in net peak demand savings at the generator in 2024.

## 6.2 Follow-up on Past Evaluation Report Recommendations

No recommendations were made for ASFH in the 2023 evaluation.

## 6.3 Participation History

For ASFH, participation is defined as participants (homes) that have completed a project and have positive electrical energy savings, participants that completed a project with no savings, and all participants that had an initial assessment but no final assessment. As presented in Figure 16 below, 1,210 homes participated in ASFH in 2024, nearly five times more participants than in 2023. Building envelope measures were installed in 880 of those homes, with 696 of them also having a heat pump installed. In addition, 313 homes had only non-modelled measures installed. More precisely, 254 homes had a non-modelled heat pump installed and 79 had non-modelled smart thermostats installed, while 20 of these homes also had modelled savings.<sup>14</sup> The figure below also illustrates a 48% decrease in average savings per participant compared to 2023 levels, which was mainly due to the updated adjustment ratios for modelled savings from the HEA billing analysis and the different mix of projects, notably more projects only with smart thermostats or non-modelled heat pumps. Furthermore, 43 appliances were replaced.<sup>15</sup>

Among the 17 homes without energy savings, 15 homes had equal or higher energy consumption in the final assessment,<sup>16</sup> resulting in no modelled energy savings for those participants, and two were discontinued participants.

**Figure 16: Overview of ASFH Participation, 2023-2024**

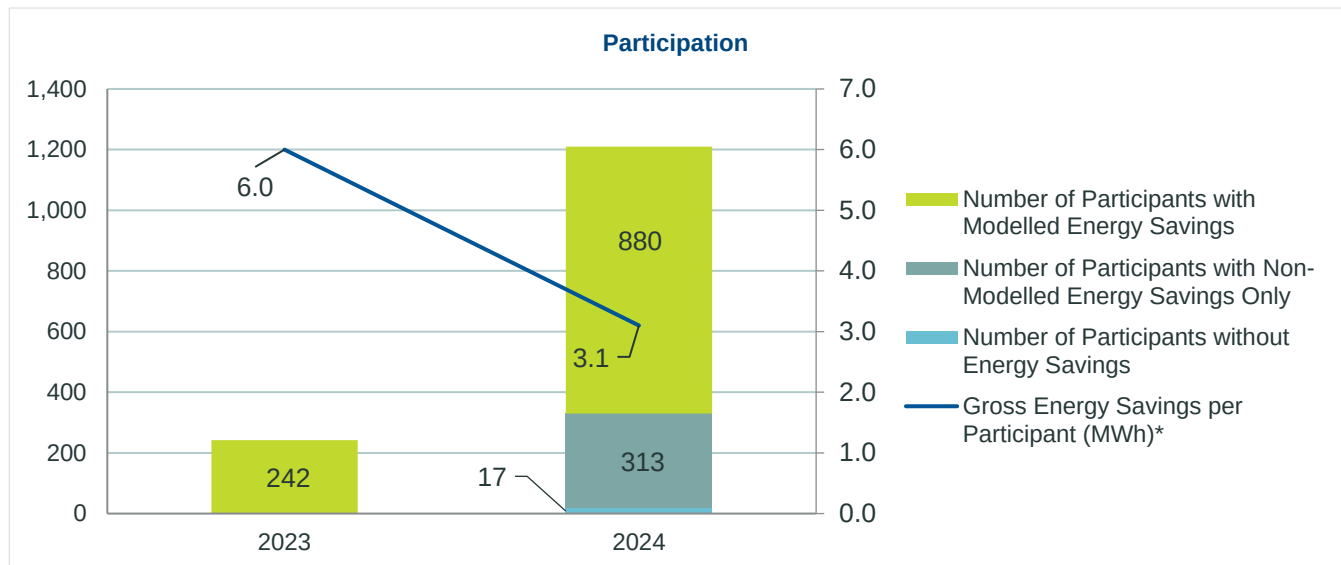


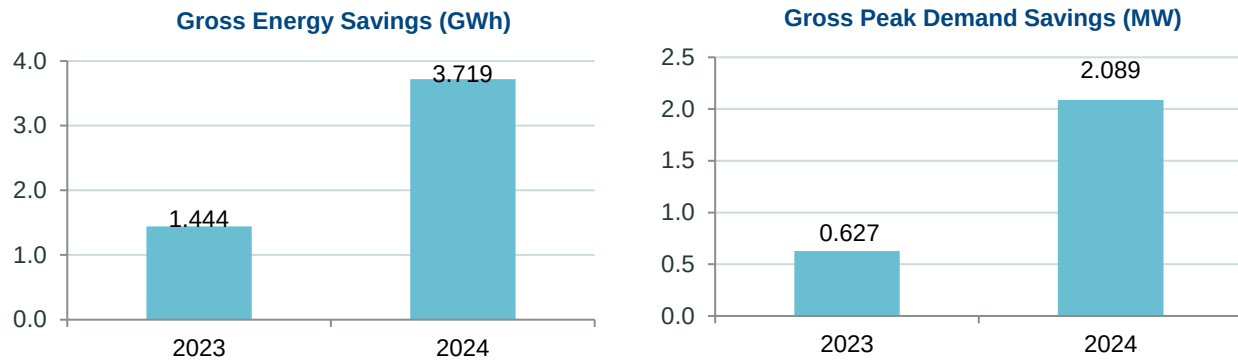
Figure 17 below provides an overview of the evolution of ASFH gross electrical energy and peak demand savings since inception in 2023. Total 2024 ASFH gross energy and peak demand savings were respectively 158% and 233% higher than in 2023 mainly due to the increase in participation.

<sup>14</sup> In Figure 2, participants with both modelled and non-modelled savings are included under Number of Participants with Modelled Energy Savings.

<sup>15</sup> Appliance replacements are not added to the participation numbers since these replacements occur after ASFH participation is completed, so those participants are already included as participants.

<sup>16</sup> Zero and negative savings related to the level of accuracy of the measurement tools used during the pre and post-assessments as well as environmental factors that impacted blower door tests.

**Figure 17: Evolution of ASFH Gross Savings, 2023-2024**





## 7 ASFH Evaluation Approach

The 2024 evaluation consisted of a condensed impact evaluation and a process evaluation. The main objectives of the 2024 ASFH evaluation were as follows:

- › Collect information on program staff, partner, and participant perspectives
- › Calculate gross and net ASFH results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided greenhouse gas (GHG) emissions

The Evaluator identified key research questions aimed at achieving the above objectives. Table 14 outlines the evaluation objectives and maps them to the Evaluator's research questions, methods, and sample sizes (n). Each method is described further below.

**Table 14: 2024 ASFH Evaluation Approach**

| Evaluation Objectives                                                       | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Methodology                                                                                                                                                                                 |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Collect information on program staff, partner, and participant perspectives | <ul style="list-style-type: none"> <li>› How did participants become aware of ASFH?</li> <li>› What are the participant motivations for taking part in the program?</li> <li>› How satisfied are participants/DAs/contractors with ASFH overall and its aspects such as products installed, the quality of work completed, and the information received about the products installed?</li> <li>› What challenges (aside from timeline) have participants, DAs, contractors, and program staff experienced with ASFH?</li> <li>› How likely are participants to recommend ASFH to family or friends?</li> <li>› How can the program component be improved?</li> <li>› What questions do participants have about the different technologies installed or other information they would like to have about ASFH or energy efficiency?</li> <li>› What tools, support, and training would make the program team, DAs, and contractors more effective?</li> <li>› Are there differences between participant perspectives among those with completed D and E assessments and those who simply had a heat pump installed?</li> </ul> | <ul style="list-style-type: none"> <li>› Participant survey</li> <li>› Interviews with heat pump contractors</li> <li>› Interviews with program staff and DAs</li> </ul>                    |
| Calculate gross results                                                     | <ul style="list-style-type: none"> <li>› Are the data in the tracking sheet complete, accurate, and consistent?</li> <li>› What are the savings for heating and building envelope measures calculated with HOT2000, and what are the adjustment ratios from ASFH?</li> <li>› What are the unitary savings for non-modelled measures?</li> <li>› What are the effective useful life (EUL) values for ASFH measures?</li> <li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <ul style="list-style-type: none"> <li>› Tracking sheet audit</li> <li>› Unitary savings review</li> <li>› EUL update</li> <li>› Calculations using evaluation results</li> </ul>           |
| Calculate net results                                                       | <ul style="list-style-type: none"> <li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li> <li>› What are the net GHG emission reductions in CO2 eq?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>› Use of a net-to-gross ratio (NTGR) of 1</li> <li>› Calculations using evaluation results</li> <li>› GHG emission reduction calculations</li> </ul> |

## Participant Survey

A total of 60 ASFH participants took part in a telephone survey administered by Narrative Research in October and November 2024. A segment of 30 previous ASFH participants had only a heat pump installed (hereafter referred to as heat pump only participants); another segment of 30 participants underwent energy modelling (hereafter referred to as modelled participants). The average interview duration was 13.6 minutes. The aim of the survey was to understand participant experiences and perspectives on the ASFH. The survey questionnaire is presented in Appendix VII, and complete survey results are outlined in Appendix VIII.

Table 15 presents the survey time, sample sizes, as well as corresponding margins of error at a 90% confidence level. It should be noted that the margins of error are high due to low population sizes.

**Table 15: 2024 ASFH Survey Sample Sizes and Margins of Error**

| Measure          | Population at Time of Survey | Sample Size | Sample Margins of Error at 90% Confidence Level | Average Survey Duration |
|------------------|------------------------------|-------------|-------------------------------------------------|-------------------------|
| Heat Pump Only   | 160                          | 30          | ±13.6%                                          | 13.6 minutes            |
| Energy Modelling | 576                          | 30          | ±14.7%                                          |                         |
| <b>Total</b>     | <b>736</b>                   | <b>60</b>   | <b>±10.2%</b>                                   | <b>13.6 minutes</b>     |

## Interviews with Heat Pump Contractors

In November 2024, Narrative Research conducted five interviews with heat pump contractors involved in ASFH to obtain their perspectives on program delivery. The guide used for the contractor interviews is presented in Appendix IX.

## Interviews with DAs

In October and November 2024, Econoler conducted four interviews with DAs involved in ASFH to obtain their views on the program component, the effectiveness of delivery, and their suggestions for improvements. The guide used for the DA interviews is presented in Appendix X.

## Tracking Sheet Audit

Prior to performing the savings calculation review, the Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The detailed protocol used for the tracking sheet audit and the results obtained are presented in Appendix XI.

## Unitary Savings Review

A unitary savings review was conducted for all measures (excluding modelled savings) as part of a major update to the 2024-2025 Demand-side Management Measure Assessment (DSM MA).<sup>17</sup> The unitary savings review entailed a literature review of technical reference manuals, metering studies, and program evaluations to determine if there were more appropriate<sup>18</sup> methodologies or parameters to be applied to calculate energy and peak demand unitary savings, including elements such as baseline assumptions, operating hours, efficiency levels, peak demand-to-energy ratios, and interactive effects factors. Modelled savings were adjusted using the adjustment ratios established for HEA in the 2024 evaluation through a billing analysis.

## EUL Update

The Evaluator conducted a review of all EUL values as part of the 2024-2025 DSM MA update in 2024 to determine whether there were more appropriate EUL estimates.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime energy and peak demand savings using the equations and parameters that were determined to be valid for this evaluation.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for ASFH, the Evaluator multiplied net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.

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<sup>17</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the DSM MA includes effective useful life values for all measures offered in E1's DSM program portfolio. For the evaluations conducted during the previous two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.

<sup>18</sup> The Evaluator will judge whether new studies are more appropriate based on various factors, including but not limited by the following: The similarities between the measures implemented in the give study and E1 measures, the similarities in terms of climate or market conditions, the size of the sample studied, whether a study is recent, the quality of the study methodology, etc.



## 8 ASFH Stakeholder Perspectives

This section presents an analysis of stakeholder perspectives on ASFH. Stakeholders include ASFH participants (heat pump only and modelled participants), DAs, heat pump contractors, as well as program staff. It should be noted that results with a sample size of 30 are expressed as percentages while results with smaller sample sizes are expressed as number values.

To provide context for interpreting results, the various stakeholder groups and their involvement in and experiences with the program component are presented below.

### Modelled Participants

Modelled participants go through the entire ASFH process as described in Subsection 6.1 above. They receive an initial home visit and energy assessment from an EA, obtain their approved energy efficiency upgrades from a DA, and receive a final audit assessment after installation. A DA manages the given project throughout the different program stages.

### DAs

A total of four DAs were interviewed for this process evaluation, three of whom began their involvement in January 2023 and one of whom already had experience delivering HomeWarming for the province. Overall, seven DAs manage the modelled participants as they navigate through the program component. It is worth noting that DAs typically have experience delivering many types of energy efficiency programs.

### Heat Pump Only Participants

As mentioned in the program component description (Subsection 6.1) above, since January 2023, past participants of HomeWarming can apply for the heat pump only measure, which excludes an energy assessment and additional building envelope upgrades. E1 contacts these participants directly to inquire about their interest in participation. If interested, they receive an initial visit from a heat pump contractor who makes a heat pump recommendation to E1, carries out the installation, and manages the project. Considering this context, certain interview questions were not asked to heat pump only participants (including questions on program awareness, and satisfaction with specific aspects that were not applicable to their situation).

### Heat Pump Contractors

Heat pump contractors began their direct involvement in the heat pump only path of the program component in January 2023. Overall, 43 contractors support heat pump only participants. According to E1, this program component path has taken some time to ramp up due to high demand and the large number of required contractors with varying levels of knowledge about and engagement with ASFH.

The following analysis has been divided into sections for each program path (modelled and heat pump only), which cover topics such as motivations for participation in ASFH, satisfaction with the program component, and challenges by stakeholder group followed by an overview of ASFH strengths and challenges as well as suggestions for program improvement.

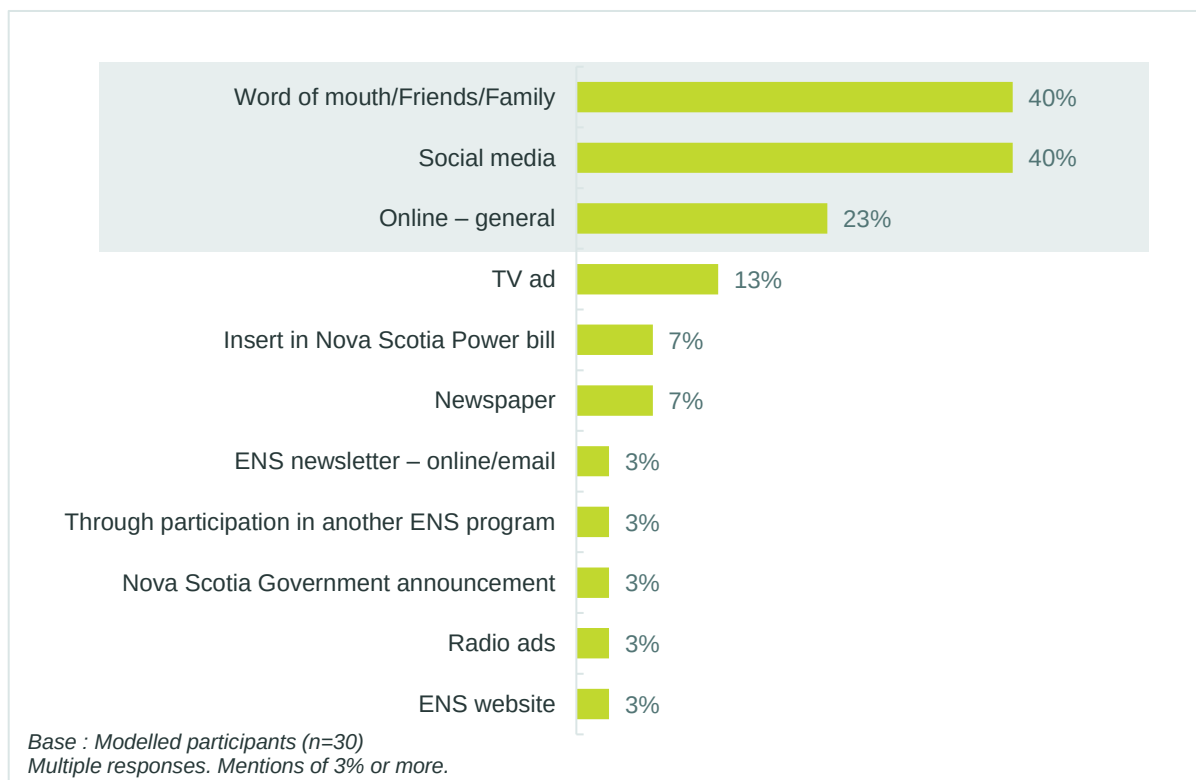
## 8.1 Modelled Path

### 8.1.1 Modelled Participants

#### Awareness About ASFH

Modelled participants mainly learned about ASFH through **word of mouth** (40%) and **social media** (40%). **Online channels** in general were also an important source of awareness about the program (23%).<sup>19</sup>

**Figure 18: Sources of Program Awareness, 2024 (Unaided) – Modelled Participants**

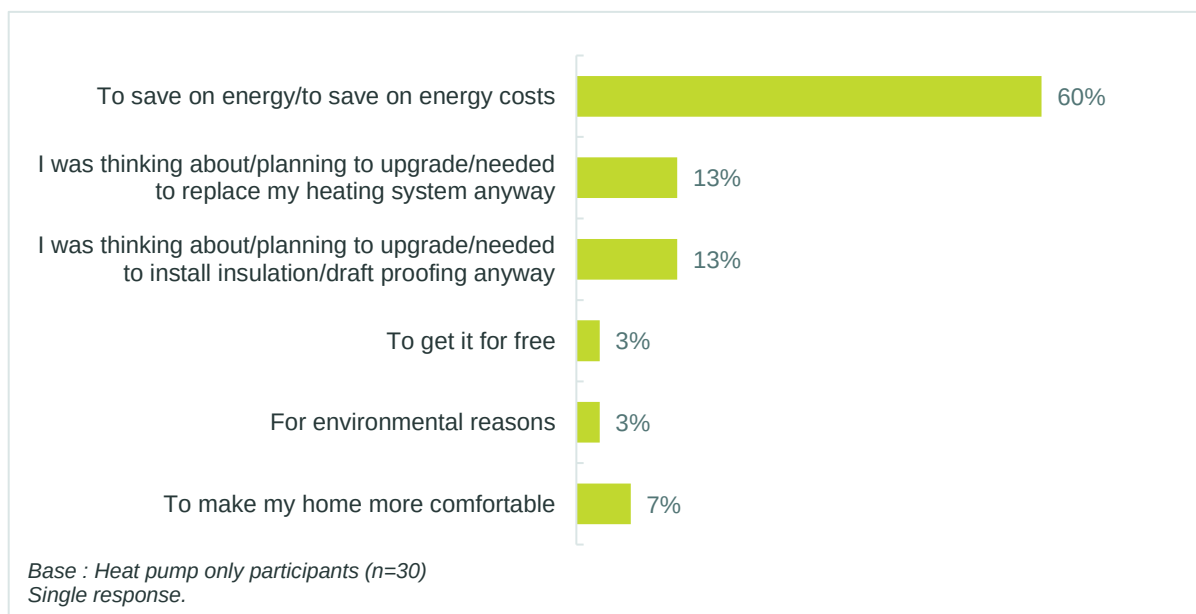


#### Motivations for Participating in ASFH

Modelled participants mainly wanted to participate in ASFH to **save on energy or reduce energy costs** (60%). Distant seconds were the intention to upgrade or replace a heating system (13%) and upgrade or install insulation/draft-proofing (13%).

<sup>19</sup> Note that heat pump only participants, who had taken part in the government funded HomeWarming program, were contacted by E1 directly about the possibility of installing a heat pump; therefore, were not asked this question.

**Figure 19: Main Reason for Participation, 2024 (Unaided) – Modelled Participants**

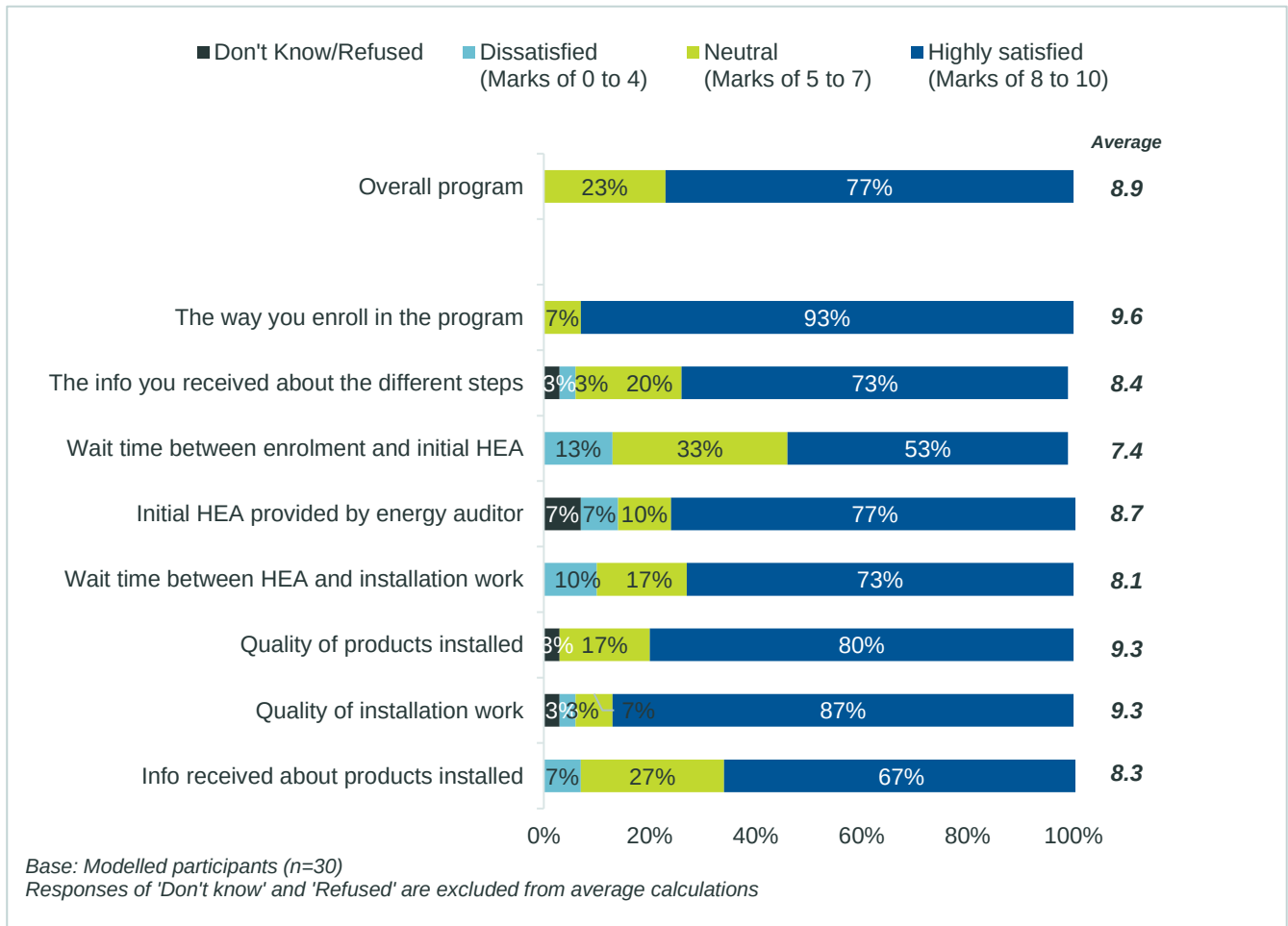


## Satisfaction With ASFH

In terms of overall satisfaction with ASFH, modelled participants generally appear **highly satisfied** on average (8.9), with over three-quarters (77%) providing a rating of 8, 9, or 10 out of 10 (see Figure 20 below). Modelled participants are highly satisfied with the ASFH enrollment process (93%), the quality of the installation work (87%) and the quality of the products installed (80%). Satisfaction is slightly lower in terms of the information received about the different program steps (73%) and the information about the products installed (67%).

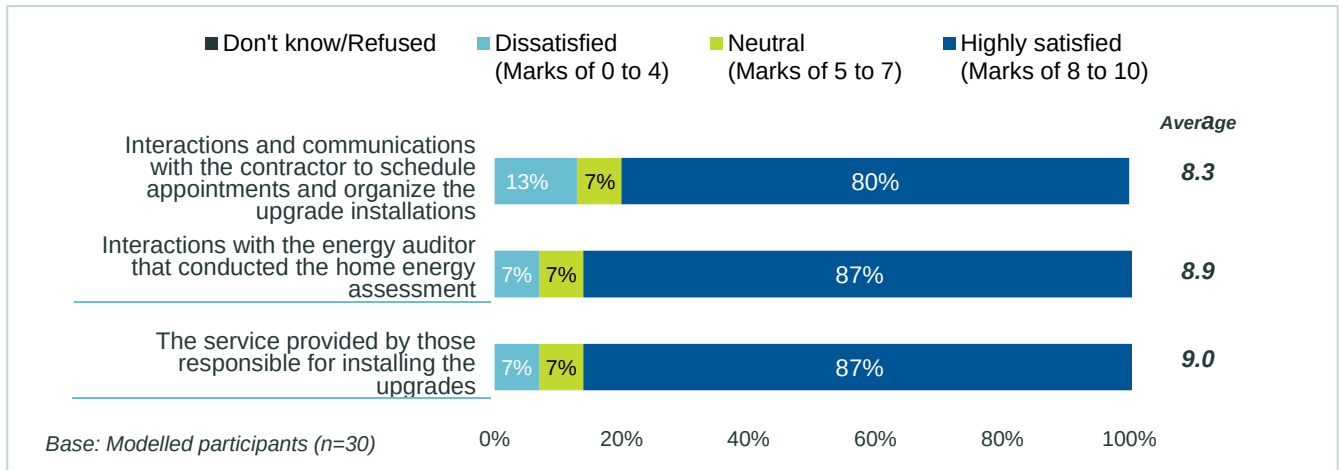
Satisfaction is also lower with the wait times between the various program stages. This is particularly evident between the moment a participant enrolls and the time the initial home energy assessment takes place: only one in two (53%) modelled participants appears highly satisfied with this waiting period. Satisfaction with the wait time between the initial home energy assessment and the installation work is not as problematic (73%). E1 staff recognize that it has taken a long time for ASFH to be ramped up and build capacity and that there can be lengthy wait times. Keeping pace with the volume of applications – particularly since the significant increase in participation due to the announcement of free heat pumps by the provincial government in 2022 – and managing the large number (43) of heat pump contractors involved is challenging for E1 staff. That said, additional staffing resources have led to the application backlog gradually decreasing, and E1 staff are focussing their efforts on communicating with participants to update them on their application status.

**Figure 20: Satisfaction with ASFH Program Elements, 2024 – Modelled Participants**



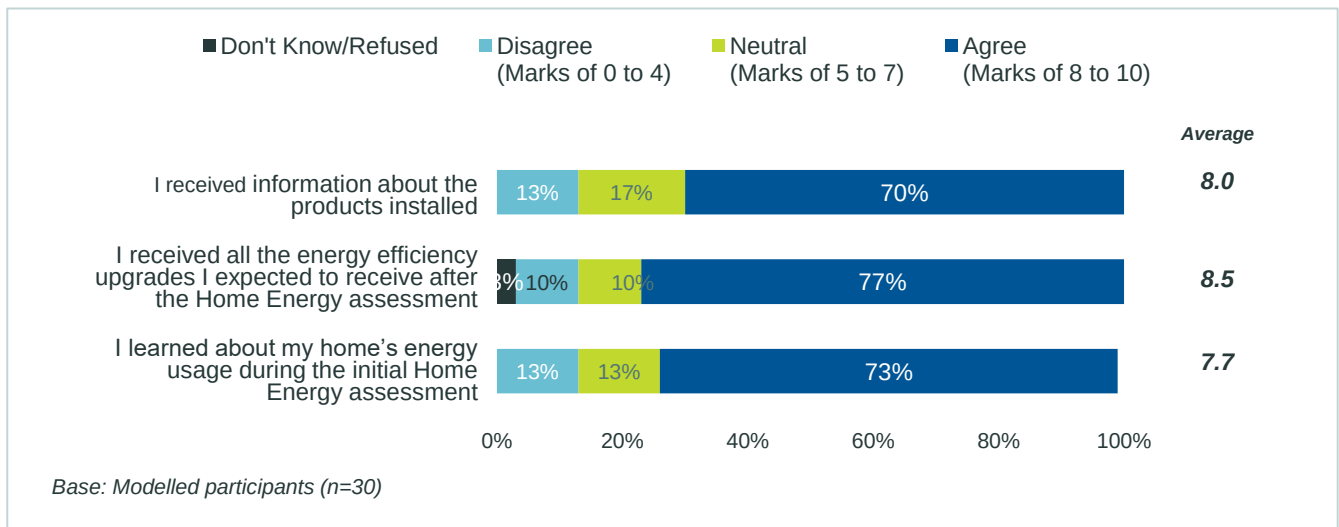
Modelled participants are **generally highly satisfied** with the **communications and service provided by contractors and EAs** throughout all program stages (see Figure 21 below). Participants appreciated the interactions and communications to schedule appointments and organize the installation upgrades with contractors, interactions with EAs, and the installation services provided.

**Figure 21: Satisfaction with Contractor/EA Interactions/Communications, 2024 - Modelled Participants**



As illustrated in Figure 22 below, 70% of modelled participants agreed that they received information about the products installed, while over one in 10 (13%) did not, which could go some way to explaining the lower satisfaction score for this aspect (see Figure 21 above). One in 10 (10%) modelled participants said they did not receive all the upgrades they had expected and approximately one in 10 (13%) did not learn about their home's energy usage during the initial home energy assessment.

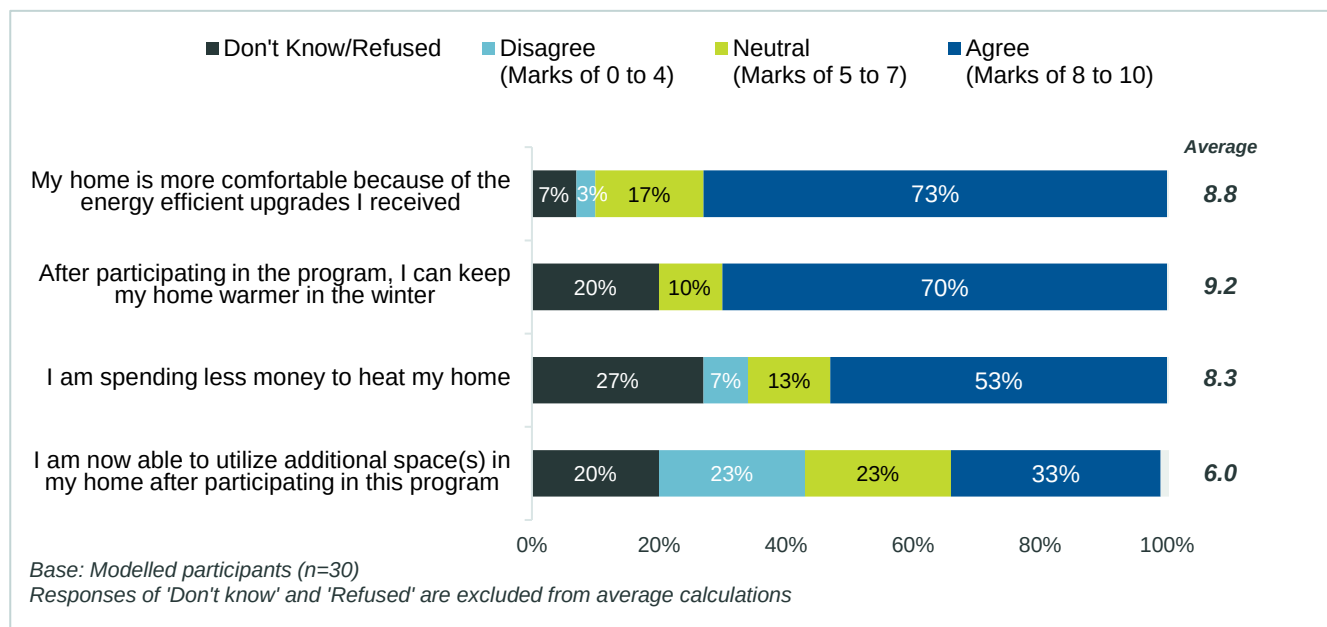
**Figure 22: Level of Agreement with Statements About ASFH Information, 2024 – Modelled Participants**





The majority (73%) of modelled participants agreed that their **home is more comfortable** following the installation of energy-efficient upgrades. For those able to answer the questions, the average results<sup>20</sup> demonstrate that they agree they can keep their home warmer (9.2) and are spending less on heating (8.3). Finally, one in three (33%) modelled participants said they can now utilize previously less comfortable spaces in their home.

**Figure 23: Level of Agreement with Statements About ASFH Benefits, 2024 – Modelled Participants**



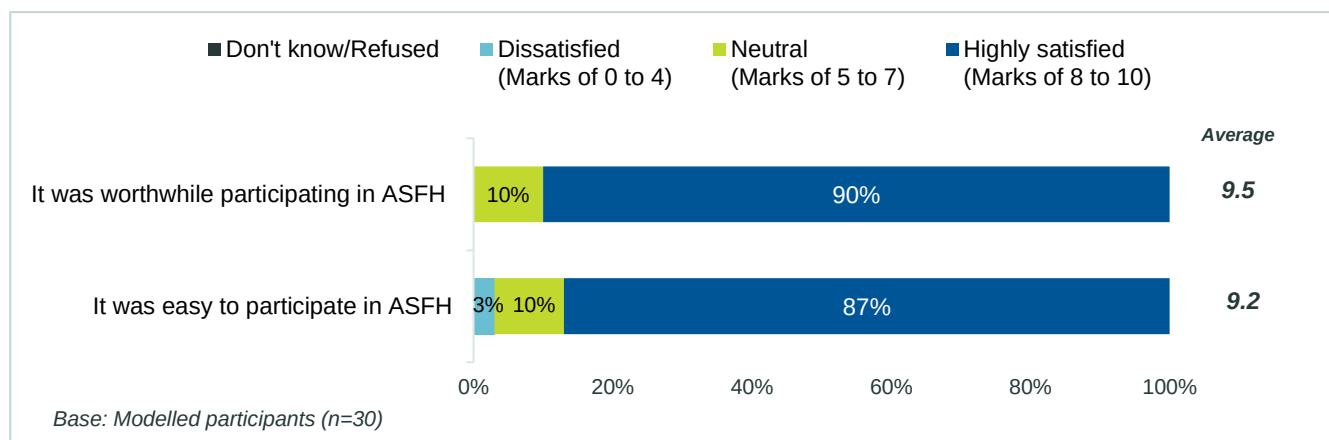
When asked whether they had experienced additional benefits through ASFH, six modelled participants answered affirmatively. Overall, the top three additional benefits experienced are savings/spending less money (n=3), air conditioning (n=2), and better warming capabilities (n=2).

Conversely, when asked whether they had experienced additional issues since the installation of their upgrades, four modelled participants said that they had. Overall, the main additional issues mentioned were poor quality upgrades/work done (n=2), poor communication/unable to reach anyone/get in contact (n=1), and poor customer service (n=1).

Despite the above issues, roughly nine in 10 surveyed modelled participants agree that it is **worthwhile participating** in ASFH (90%) and that it is **easy to participate** (97%), a positive outcome for the program component.

<sup>20</sup> Average results exclude "Don't know" and "Refused" responses.

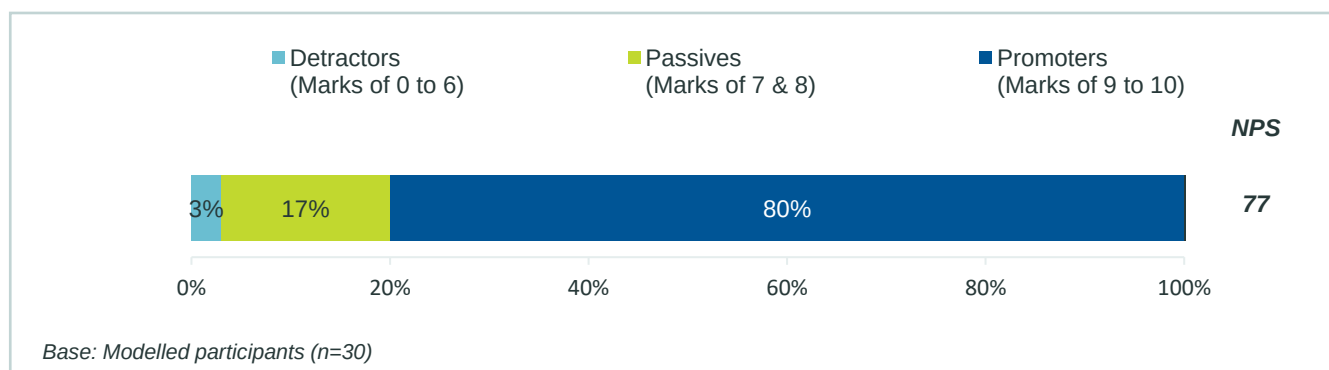
**Figure 24: Level of Agreement with Statements About the Nature of ASFH, 2024 – Modelled Participants**



## Net Promoter Score

The overall Net Promoter Score (NPS) for ASFH among modelled participants is 77, suggesting that the majority would be likely to recommend the program component to someone in their entourage.

**Figure 25: Likelihood of Recommending ASFH, 2024 – Modelled Participants**

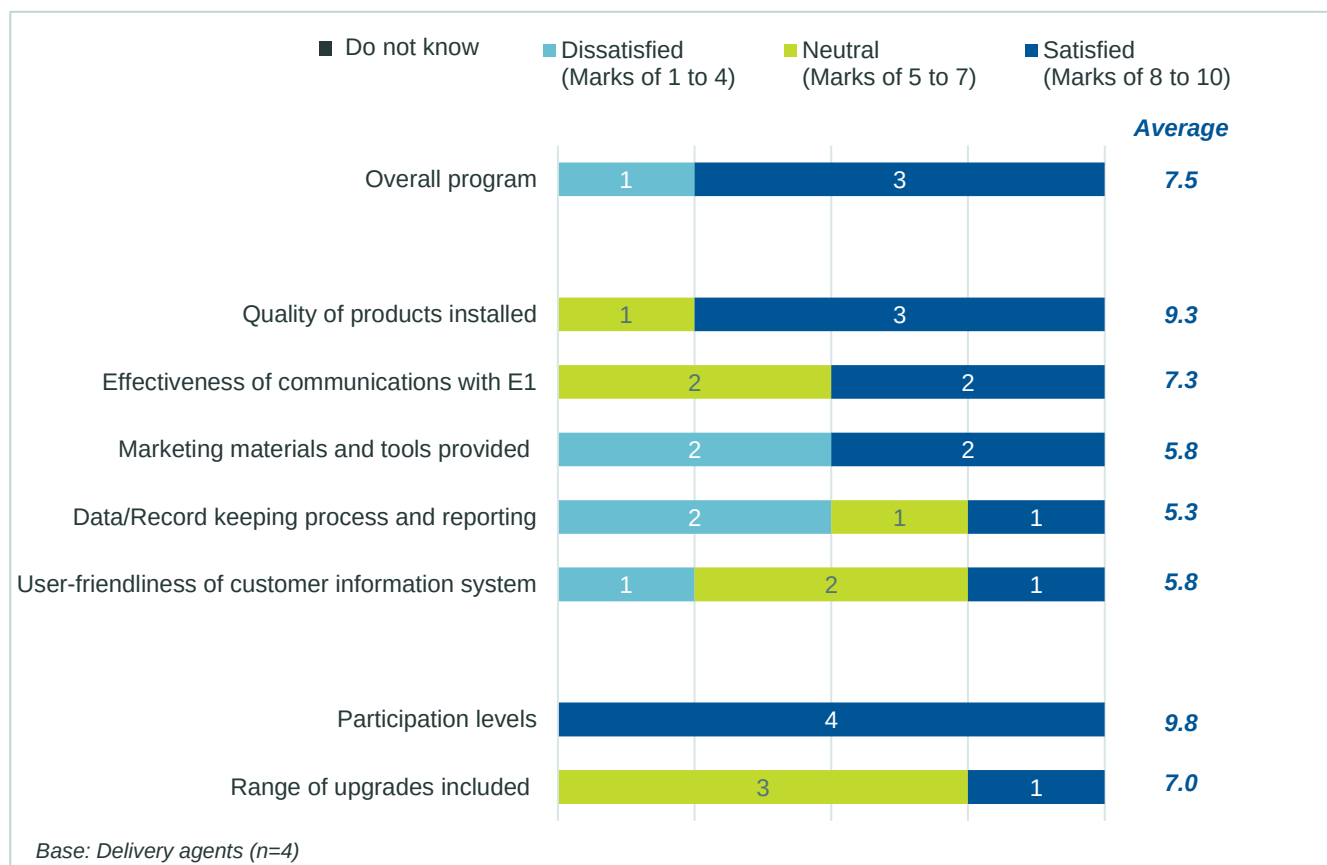


## 8.1.2 Delivery Agents

### Satisfaction

Overall, most interviewed DAs are satisfied with the program (7.5 on average), as illustrated in the figure below. The **participation levels** (9.8) as well as the **quality** (9.3) of the upgrades are the program elements with the highest satisfaction levels. **Communications with E1** (7.3) and the **range of upgrades** included (7.0) are satisfactory according to this stakeholder group.

**Figure 26: Satisfaction with ASFH Program Elements, 2024 – Delivery Agents**



**Dissatisfaction** among some DAs primarily stems from **issues with the data/record keeping and reporting process to E1** (5.3) and the **user-friendliness of the software tools** (the CIS and SharePoint) (5.8) used to deliver and manage the program component and that contribute to program administrative burdens. All DAs mentioned the time-consuming manual processes of preparing documentation using SharePoint to upload files and using the CIS to fill out the required forms. Specifically, having to use two platforms leads to repetitive data entry and unclear requirements. Separate manual invoicing (required due to the incompatibility of DAs' accounting software with the CIS) is said to create redundancy, errors, and discrepancies and leads to delays. It was reported that many changes to the processes that DAs need to follow have occurred since the original training on the system and have not been formally communicated. All DAs mentioned needing a lot of back and forth with E1 to sort out problems.



Finally, among interviewed DAs, there is some dissatisfaction with the fact that marketing materials and tools are not currently provided (5.8). It should be noted that E1 had decided not to create any new marketing materials due to already high demand for the program component.

While DAs generally **do not find ASFH easy to deliver**, they widely agree that **it is worthwhile being involved** in the delivery of the program component.

## Other Challenges Per Program Step

DAs were asked to identify their experience with each step of the ASFH process, both for them and from the perspective of participants. E1 staff and participant observations are included in the following subsections, where relevant.

### Receiving Participant Information from E1

Mixed opinions were offered regarding the process for receiving information about participants interested in ASFH. DAs say they receive list updates directly from E1 every two weeks. While information provided through SharePoint is generally said to be accurate and detailed, some challenges were noted.

Two DAs mentioned that there is sometimes a lack of consistency in the number of leads they receive (since E1 does not always have applications to dispatch to them), making it difficult to ensure adequate staffing and minimal delays in program delivery as well as creating logistical and cost challenges.

Other single mentions from DAs with respect to lead information challenges include:

- › Preferring to get one big list upfront, instead of in smaller batches, to plan for resource allocation
- › Receiving leads from a single geographical area not effective since resources are distributed across the province
- › Incorrect participant details (e.g. the wrong address, especially in rural areas where street names have changed, or deceased persons associated with the property on the lead list)
- › Wanting to receive more information on participant home heating/ducting/electrical systems to better prepare for the initial home visit

### Initial Visit with Participant

DAs believe that the initial visit to complete the energy assessment is generally a simple and easy process to complete. However, DAs observe that it can be more problematic for homeowners who have limited knowledge and understanding about ASFH. DAs notice that some participants are unaware of program processes and eligible measures and/or are confused between ASFH and OHPA.

DAs say that challenges arise with respect to program intake because participants may be considering participation in multiple programs such as ASFH and OHPA. The program that participants choose to participate in can influence timelines and eligible products. For example, a participant may be eligible for either a single zone heat pump system (through ASFH) or a whole home multi-zone system (through OHPA). Participation in the OHPA program may require some participant financial outlay which can lead to the participant choosing to participate in only the ASFH program. E1 staff report having to manage some overlap between the two program components, which can be challenging for them. DAs would like E1 to confirm which program stream a participant wants to enroll in and to share that information with them.<sup>21</sup>

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<sup>21</sup> Since the interviews were conducted, E1 has introduced a step to confirm that the participant understands the stream that they have applied to prior to the initial DA or contractor visit.



Finally, interviewed DAs mentioned that among the biggest issues they have to deal with are schemes whereby fraudsters pose as program contractors and scam vulnerable people. There has been a lot of awareness raised about this issue across the province (and there is also a mention on E1's website), which has made participants hypervigilant and mistrustful. DAs currently provide participants with more context about the name of the contractor assigned to the installation (name, phone number), but scammers continue to operate, and participants remain on high alert.

### **E1 Approval Process**

Once a proposal is submitted, E1 reviews and approves the proposed upgrades. The review process is considered too long by DAs, often taking months and upward of six months in some instances. DAs say they are not informed of E1 timelines or delays, so it is difficult for them to provide clear updates to participants. E1 staff recognize that there have been delays in their processes but that things are improving.

### **Installation of Upgrades**

Once a project is approved, the DA informs the modelled participant and organizes and completes the approved upgrade installations. This step mostly occurs without any major hitches. As illustrated in Figure 20, participants are highly satisfied with the quality of the installation work and products installed.

There are a few cases, however, in which frustrations can occur:

- › For large upgrades, DAs say that participants can become irritated if they do not have access to home heat for a day or two during the installation, forcing them to make alternative living arrangements at their own expense.
- › DAs mention that participants can cause delays when they reschedule installation dates and that heat pump installation bottlenecks can occur due to high demand or a lack of certified installers.
- › Instances whereby participants must bear part of the cost of the upgrades (through the OHPA stream) cause frustration among DAs, contractors, and participants. DAs or contractors are left to explain this situation to homeowners, and, at times, they need to address participants' annoyance.

DAs report a good working relationship with E1 whose staff try to iron out any problems when they occur throughout the delivery process in terms of both administrative hiccups (e.g. wrong or missing information) and at the participant's home (e.g. one DA mentioned that E1 has worked with participants to assist them in moving their belongings). DAs mention that participants sometimes decide to discontinue participation when the installation is not exactly what they expected (e.g. spray foam/cellulose can be refused once people fully understand that they have to clear out their basement/attic or leave their home for a short period). EAs provide participants with explanations about the upgrades as well as information pamphlets and tell them what is expected of them, but upgrades may still be refused.

### **8.1.3 Participant Questions and Concerns**

A majority of modelled participants (63%) does not have questions about energy efficiency or the technologies installed through ASFH. For the minority that does, questions tend to revolve around how to operate the given heat pump or other efficiency upgrades available. This observation was also made by DAs who highlight participants' need to understand the functionality of the mechanical systems (heat pumps, thermostats, and water heaters), maintenance requirements, and operating costs. Additionally, interviewed DAs mention that they receive questions from participants about warranties.

DAs report that, even though contractors leave instructions or a manual and have explained to participants how their heat pump works, it is still difficult for some people to fully understand, especially the elderly.

When it comes to participants' preferred method of having their subsequent questions answered, the majority says over the phone, either with their DA/contractor or through a dedicated phone number.

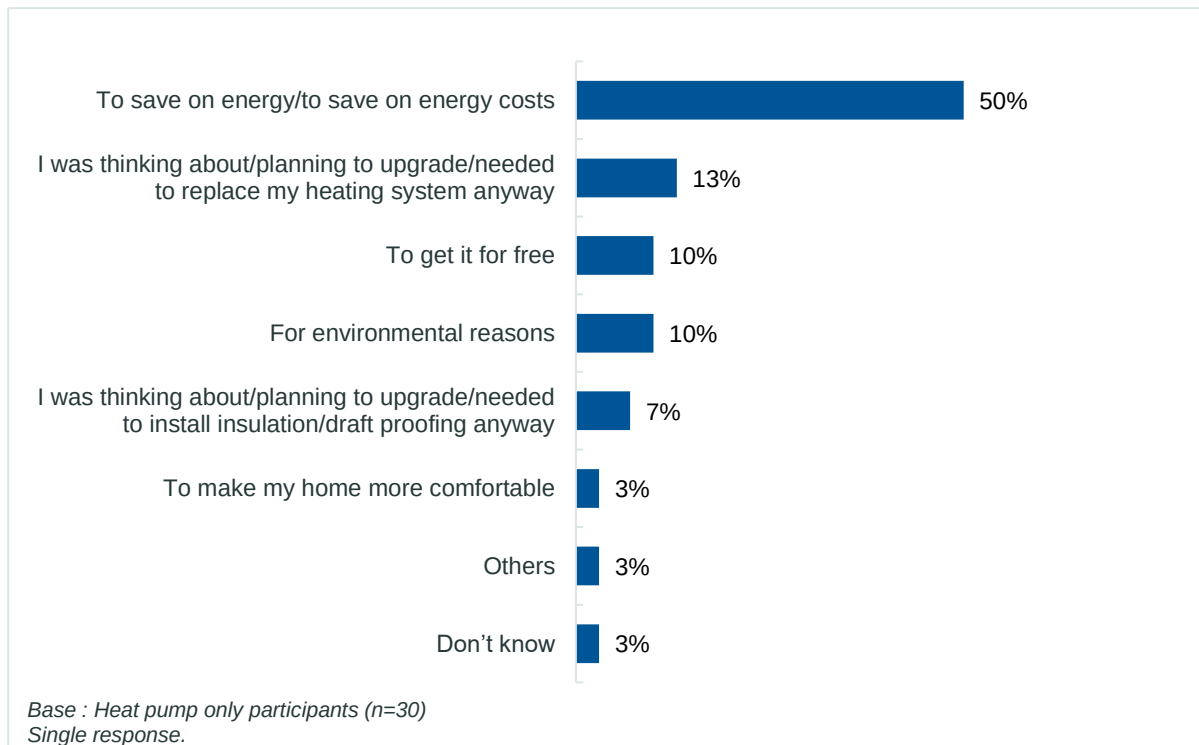
## 8.2 Heat Pump Only Path

### 8.2.1 Heat Pump Only Participants

#### Motivations for Participating in ASFH

The main reason heat pump only participants wanted to take part in the program component was to **save on energy or reduce energy costs** (50%). Other explanations, following far behind, included the intention to upgrade or replace a heating system (13%), the fact that the heat pump installation was free (10%), or for environmental reasons (10%).

**Figure 27: Main Reason for Participation, 2024 (Unaided) – Heat Pump Only Participants**

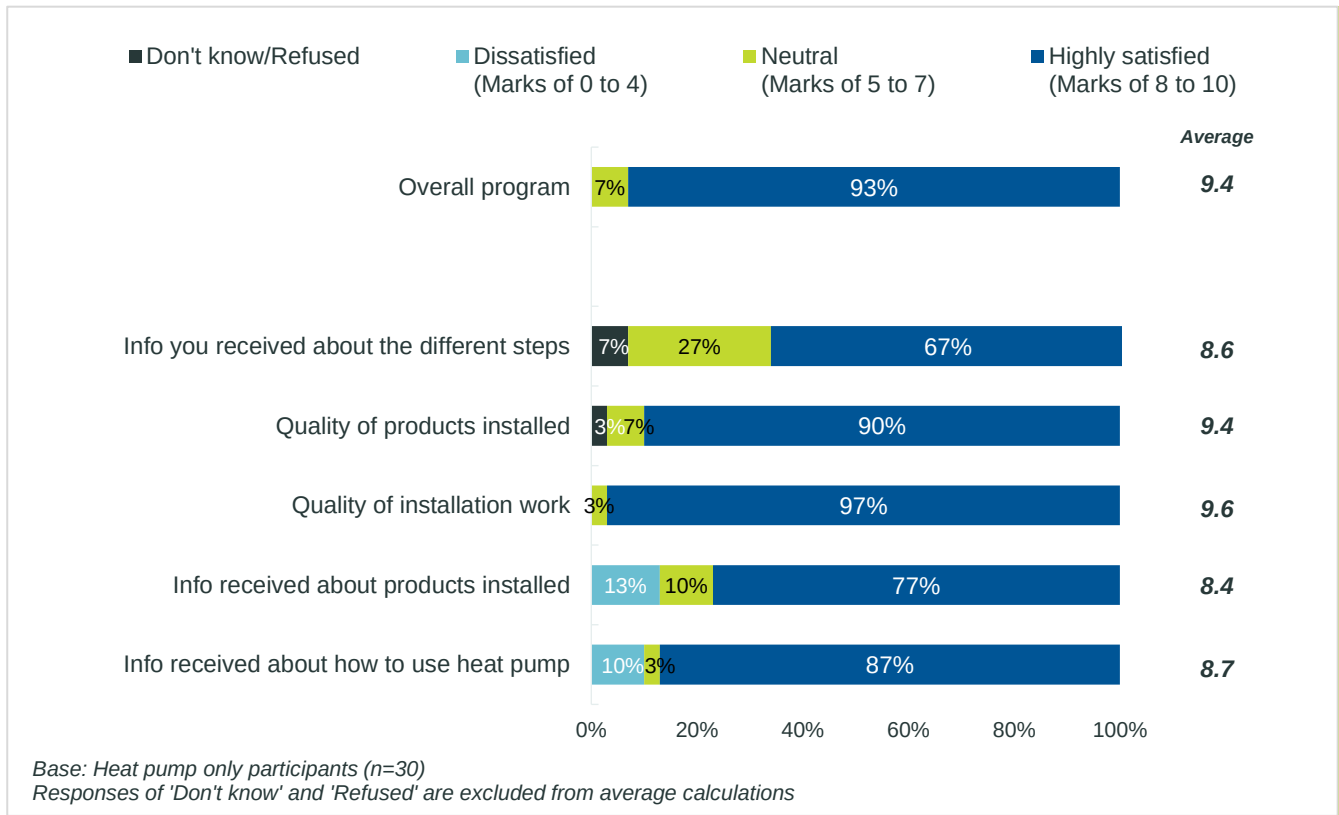


#### Satisfaction With ASFH

In terms of overall satisfaction with ASFH, heat pump only participants appear **highly satisfied** on average (9.4), with over nine in 10 (93%) participants providing a rating of 8, 9, or 10 out of 10.

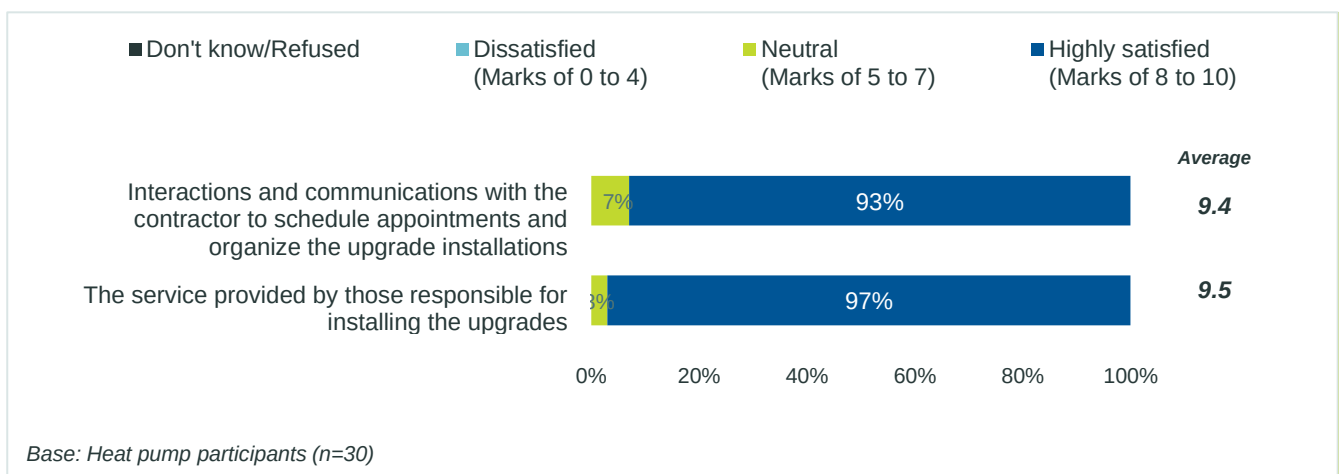
As illustrated in Figure 28 below, heat pump only participants are very content with the quality of the installation work (97%) and the quality of the products installed (90%). Satisfaction is slightly lower in terms of the information received about the program steps (67%). Although the majority is satisfied, about one in 10 participants are dissatisfied with the information they received about the products installed (13%) and the information they received about heat pump utilization (10%).

**Figure 28: Satisfaction with ASFH Program Elements, 2024 – Heat Pump Only Participants**



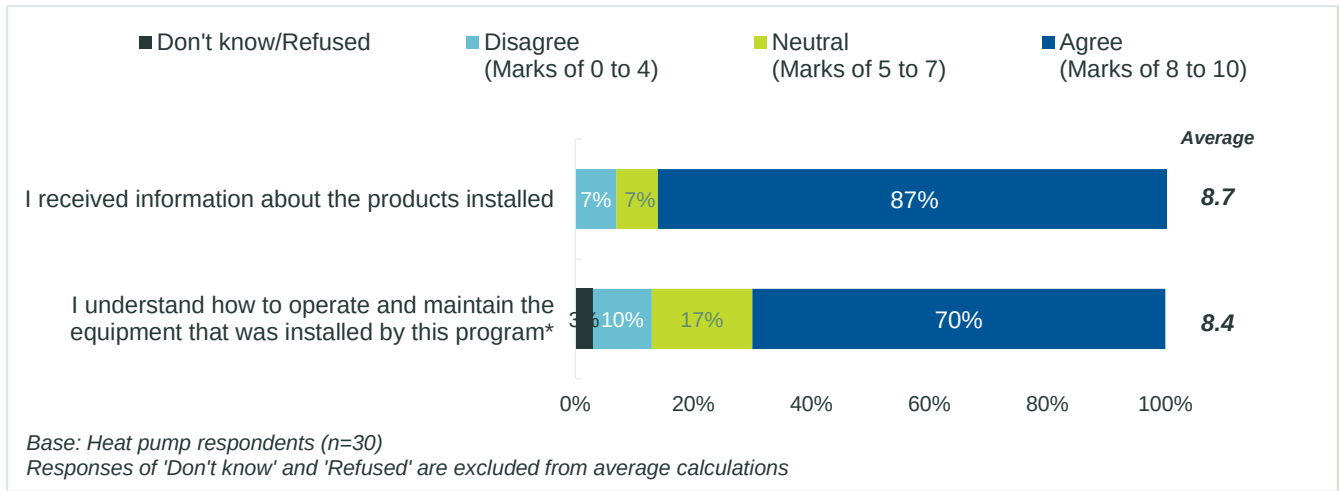
Heat pump only participants are **highly satisfied** with the **communications and service provided by contractors** (see Figure 29 below). Participants appreciate the ease of scheduling appointments and the installation services provided.

**Figure 29: Satisfaction with Contractor/EA Interactions and Communications, 2024 – Heat Pump Only Participants**



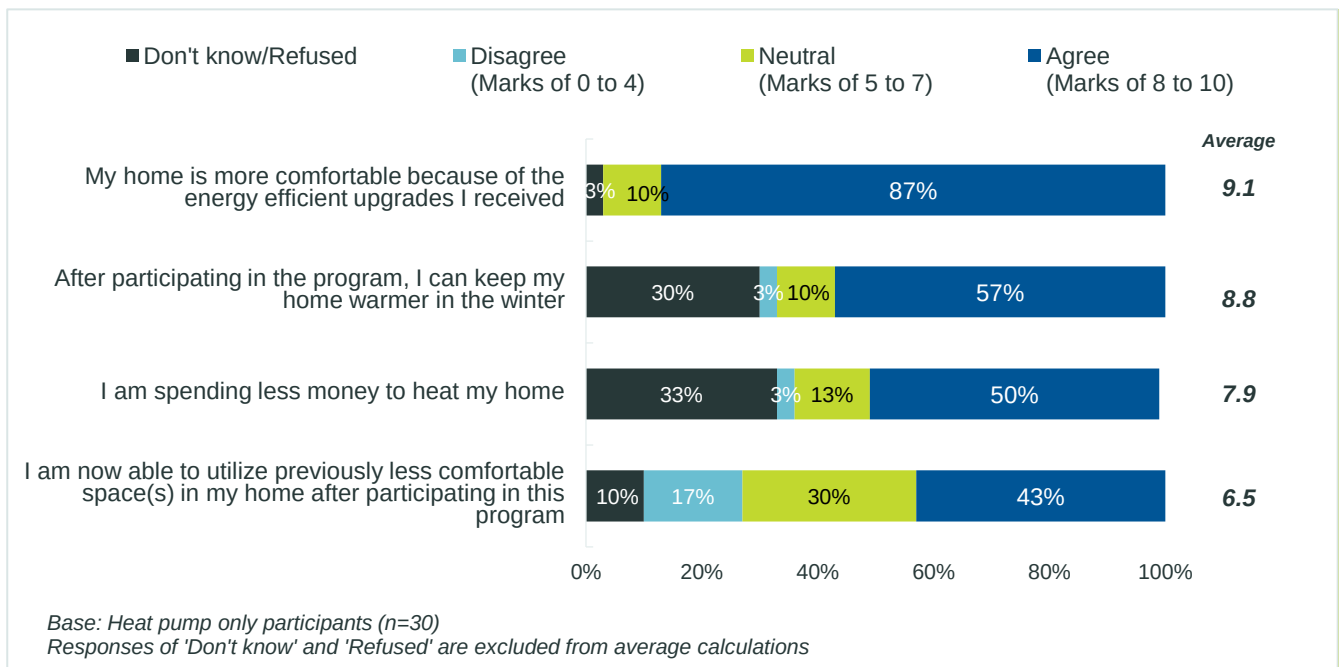
As illustrated in Figure 30 below, heat pump only participants generally agreed that they received information about the products installed (87%). That said, three in 10 (30%) still have some doubts about how to operate and maintain their new equipment, which might be a barrier to ensuring proper heat pump use.

**Figure 30: Level of Agreement with Statements About ASFH Information, 2024 – Heat Pump Only Participants**



The vast majority (87%) of heat pump only participants agree that their home is more comfortable following the installation of energy efficient upgrades (see Figure 31). While significant proportions of participants were unable to determine whether they can keep their home warmer in winter and whether they are spending less money to heat their homes, the average results<sup>22</sup> demonstrate that those who were able to respond generally agree with these statements (8.8. and 7.9 respectively). Finally, thanks to their newly installed air-source heat pump (ASHP), a minority of heat pump only (43%) participants say they can now utilize previously less comfortable spaces in their home.

**Figure 31: Level of Agreement with Statements About ASFH Benefits, 2024 – Heat Pump Only Participants**



<sup>22</sup> Average results exclude "Don't know" and "Refused" responses.

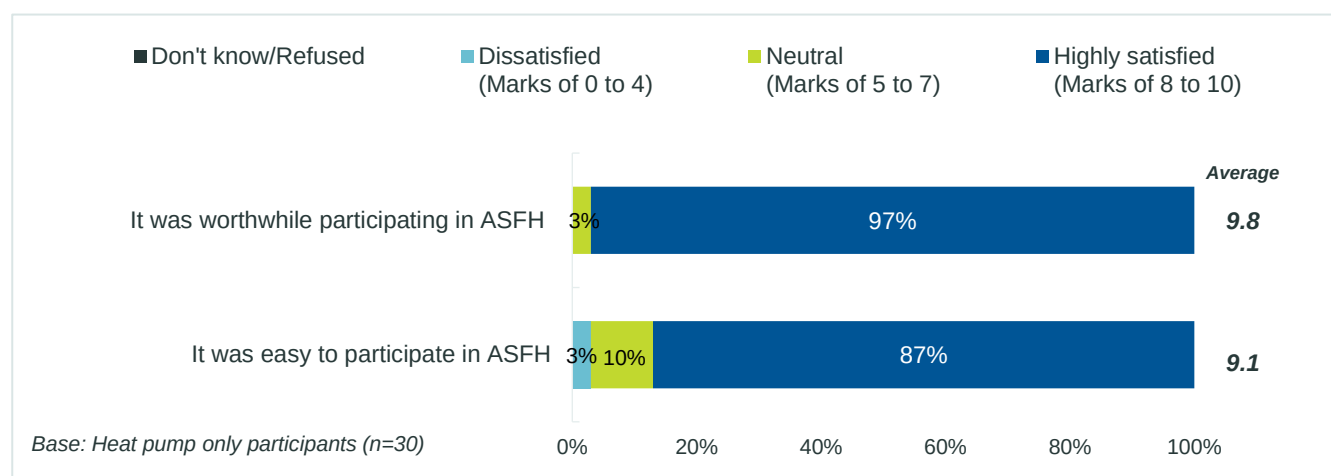


When asked whether they had experienced additional benefits through ASFH, four in 10 heat pump only participants (n=13) answered affirmatively. Overall, the top three additional benefits are air conditioning (n=4), savings/spending less money (n=2), and air quality improvements (n=3).

Conversely, when asked whether they had experienced additional issues since the installation of their upgrades, only a few (n=3) participants said that they had. The issues mentioned by these participants were poor communication/unable to reach anyone/get in contact (n=2) and poor-quality upgrades/work done (n=1).

Roughly nine in 10 or more surveyed heat pump only participants agree that it is **worthwhile participating** in ASFH (97%) and that it is **easy to participate** (87%), a positive outcome for the program component.

**Figure 32: Level of Agreement with Statements About the Nature of ASFH, 2024 – Heat Pump Only Participants**

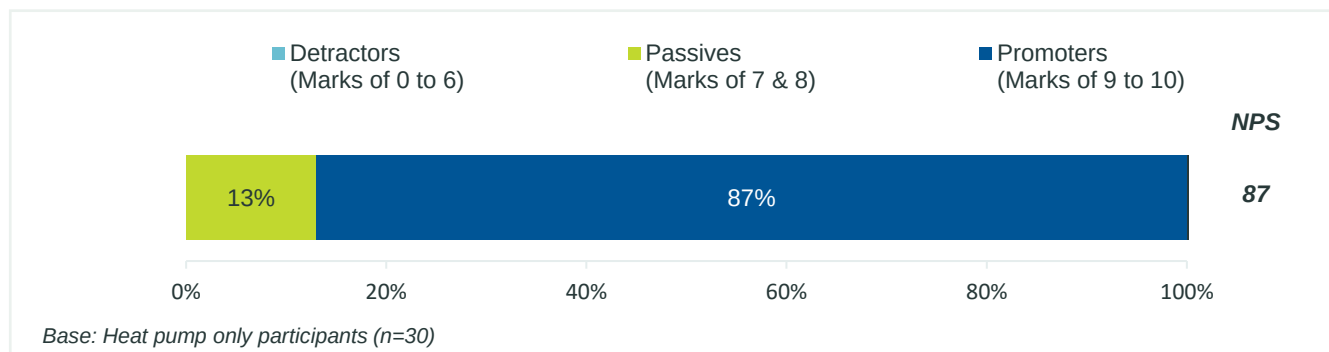


## Net Promoter Score

As illustrated below, the Net Promoter Score (NPS) is a tool that measures customer experience and overall perceptions about a brand or program. The NPS divides responses into three categories, “Promoters” who provide ratings of 9 or 10, “Passives” who provide ratings of 7 or 8, and “Detractors” who provide ratings of 6 or lower. Calculating the NPS involves subtracting the percentage of detractors from the percentage of promoters. The NPS can range from a maximum score of 100 (if everyone is a “Promoter”) to a minimum score of -100 (if everyone is a “Detractor”). The higher the NPS score, the better.

The overall NPS for ASFH among heat pump only participants is 87, a strong result indicating that participants are highly likely to talk about the program component with people they know.

**Figure 33: Likelihood of Recommending ASFH, 2024 – Heat Pump Only Participants**

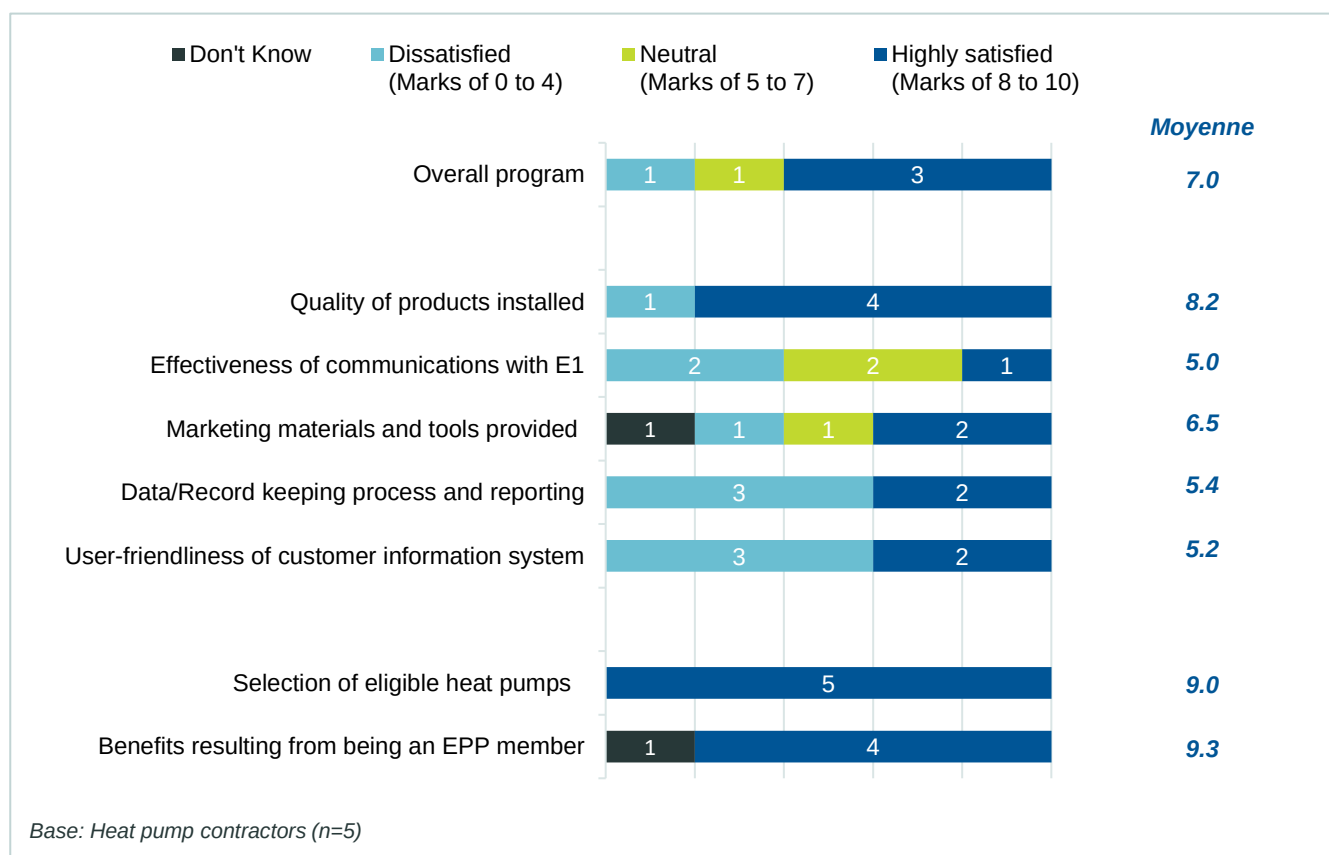


## 8.2.2 Heat Pump Contractors

### Satisfaction

Overall, most interviewed heat pump contractors are **generally satisfied** with the program (7.0 on average), as illustrated in the **Figure 34** below. The selection of eligible heat pumps (9.0) and the quality of the products installed (8.2) as well as the benefits of being an **Efficiency Preferred Partner** (9.3) are the elements generating the most satisfaction.

**Figure 34: Satisfaction with ASFH Program Elements, 2024 – Heat Pump Contractors**



As with DAs (see Section 8.1.1), **dissatisfaction** among some heat pump contractors primarily stems from **issues with the data/record keeping and reporting process to E1** (5.4) and the **user-friendliness of the software tools** (the CIS and SharePoint) (5.2) used to deliver and manage the program component. All heat pump contractors mentioned the time-consuming manual processes of preparing and uploading documentation.

Heat pump contractors also notably mention **untimely responses** from E1 to email enquiries (n=5), a lack of direct access to a contact person or mailbox (n=3) (although a mailbox is currently in operation for contractors), and no notifications when leads are posted (n=2).<sup>23</sup> Finally, as with interviewed DAs, there is some dissatisfaction among heat pump contractors with the lack of marketing materials and tools (n=2).

Similarly to DAs, contractors generally **do not find ASFH easy to deliver** but widely agree that **it is worthwhile being involved** in the delivery of the program component.

## Other Challenges Per Program Step

### Receiving Participant Information from E1

At this step, heat pump contractors are most concerned with the time required to regularly monitor SharePoint for new leads. They say that this can delay the program delivery process.

### Initial Visit with Participant

The interviewed heat pump contractors, similar to the interviewed DAs, believe that the initial visit to complete the energy assessment or size a heat pump is generally a simple and easy process to complete. As with DAs, heat pump contractors also observe that it can be more problematic for homeowners who have limited knowledge and understanding about ASFH.

### E1 Approval Process

The review process is considered too long by heat pump contractors (as with DAs). Heat pump contractors mention that, since they are not notified by email of E1's decisions on applications or questions, they must constantly monitor SharePoint to consult the status of their files. E1 staff recognize that there have been delays in their processes but that things are improving.

## 8.2.3 Participant Questions and Concerns

A majority of heat pump participants (70%) does not have questions about energy efficiency or the heat pump installed through ASFH. As with modelled participants, questions tend to concern heat pump operations. Heat pump contractors highlight participants' need to understand the functionality of the heat pump, maintenance requirements, operating costs, and warranties. It should be recalled that 30% of heat pump participants were not fully aware of how to operate and maintain their equipment (see Figure 30 above).

Following the completion of the upgrades, all interviewed heat pump contractors report reviewing with participants how to operate the heat pump and basic maintenance requirements, including how to change the filter and operate the thermostat controls. All contractors say they leave the instruction manuals with participants, with some also leaving other documents with them, including warranty information and the E1 materials that describe how to operate a heat pump system and what to expect from it. Participants can be directed to their contractors' website for additional information on heat pumps.

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<sup>23</sup> It should be noted that E1 is now communicating with contractors in advance on the number of leads that they will be getting and sending leads at specific intervals together with a notification.



When it comes to participants' preferred method of having their subsequent questions answered, the majority says over the phone, either with their contractor or through a dedicated phone number.

### 8.3 Overview of ASFH Strengths and Challenges

The following provides a summary of the ASFH delivery process key strengths and challenges.

#### **ASFH Strengths:**

- › Participants are appreciative of the program and upgrades
- › Good relationships between DAs and E1
- › EAs comfortable with modelling software
- › Quality of products installed
- › Quality of installation work
- › Enhances vulnerable homeowners' home comfort
- › Ability to keep home warmer in winter

#### **ASFH Challenges:**

- › The software tools used to manage/deliver the program require more training, communications, and efficiencies to reduce administrative burden (DAs and contractors)
- › Existence of scams leads to participant mistrust of program contractors
- › Confusion between ASFH and OHPA
- › Perceived lack of information on different program steps and products installed
- › Long E1 processing times and approval process
- › Untimely communications between E1 and heat pump contractors on queries and follow-up



## 8.4 DA and Heat Pump Contractor Suggestions for Improvements

DAs and heat pump contractors make the following suggestions for program improvements:

- › **Simplify/streamline the administrative process** throughout delivery and **improve the user-friendliness of CIS** by:
  - › Improving E1 processing times (by adding more staff)
  - › Removing the need for manual input (system automation)
  - › Allowing batch uploads
  - › Allowing copy-paste functionality
  - › Including search and filter options
  - › Releasing updated guidelines to help fix recurring errors
  - › Simplifying the invoice format to align with DAs' and contractors' existing accounting software

Additionally, heat pump contractors would like to access **simplified training on program delivery steps and administrative requirements**, including how to prepare a proposal submission and how to size heat pumps. They also suggest that changes to the delivery process be minimized in the future for consistency over time. Webinars and short how-to videos are considered accessible and convenient ways of delivering information and training. Two contractors suggested that E1 partner with the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) to deliver more technical training.

Heat pump contractors and DAs made suggestions to **improve communications** throughout the ASFH delivery process. These include:

- › Improving E1 responsiveness to heat pump contractor questions and communications (suggestion of a designated contact person)
- › Having notification emails to save contractors time monitoring SharePoint/informing contractors of lead projections
- › Setting up a portal for participants to monitor their application progress and communicate directly with E1

On this last point, the introduction of a participant portal would facilitate communications, and some DAs and contractors say they would like E1 to provide a handout that explains the program component, timelines, responsibilities of each party involved, and E1 contact information. This would also help overcome fraud and participant mistrust. It should be noted that E1 already has several communication touchpoints including a welcome letter and further communications should the waiting period be longer than four weeks. After a participant has been assigned to a DA or contractor, the DA or contractor becomes the main point of contact and resource for questions.

DAs suggest **raising program awareness** among the target audience using more traditional routes as well as electronic ones, providing more **clarity and distinction** between different programs. It should be noted that over one in 10 (13%) modelled participants would like more information in general about ASFH. While there is a lot of information about ASFH on social media, other communications channels, such as bill inserts or letters, could work better to inform older people according to DAs.

Finally, two DAs also suggest **improving education** to explain how products are used through more of a grassroots approach in communities. It was mentioned that sending information to and working with local Members of the Legislative Assembly (MLAs) could be helpful, particularly as many seniors are in contact with them.

## 9 ASFH Impact Evaluation

The objectives of the 2024 ASFH impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as the effective useful life (EUL) values and associated lifetime energy savings.

### 9.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1 as well as correcting the tracked savings as needed. The results are provided in Appendix XI. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 9.2 Gross Savings

For ASFH, the gross savings associated with building envelope and heat pump measures are calculated based on pre-retrofit and post-retrofit HOT2000 simulations, while the gross savings of replaced old appliances through the E1 Appliance Retirement program component (dehumidifiers, refrigerators, and freezers) and smart thermostats are calculated using unitary savings values. Gross electrical energy savings for the non-modelled heat pump only measure were determined using the Green Heat calculation approach whereby the specifications of each heat pump were used to obtain energy savings. This subsection describes the methodology used to review ASFH gross savings for 2024.

#### 9.2.1 Electrical Energy Savings

For ASFH, electrical energy savings are calculated based on HOT2000 simulation results adjusted with billing analysis results and unitary savings values for prescriptive measures, as shown in the equation below.

$$\begin{aligned} & \text{Gross Energy Savings (kWh)} \\ &= \left( \frac{(Total\ Energy_D\ (GJ) - Total\ Energy_E\ (GJ))}{0.0036\ GJ/kWh} \times \%_{Elec} \right) \times AR \\ &+ \text{Savings for Non-modelled Measures (kWh)} \end{aligned}$$

Where:

- ›  $Total\ Energy_D$  and  $Total\ Energy_E$  correspond to the modelled energy consumption levels obtained in HOT2000 during the pre-retrofit (D) and post-retrofit (E) assessments respectively. Since modelled energy consumption levels were not directly available in the tracking sheet, the participant EnerGuide ratings were used, which are based on modelled whole-home consumption. Also, if the final E assessment EnerGuide rating was not available, the projected final rating was used.
- ›  $AR$  corresponds to the adjustment ratio (AR) established through a billing analysis and used to adjust the savings obtained from the difference between the modelled electrical energy consumption during the D and E assessments. ARs vary according to different space heating system scenarios. ARs were drawn from billing analyses conducted in 2024 as part of the HEA evaluation.
- ›  $\%_{Elec}$  corresponds to the percentage of electrical space heating estimated by the DA through the D assessment.
- ›  $Savings\ for\ Non-modelled\ Measures$  are obtained by multiplying the prescriptive measures installed through ASFH by their respective unitary electrical energy savings value.

The energy savings methodology for modelled and non-modelled measures is presented below in this subsection.

## Modelled Energy Savings

After the D and E assessments, the EAs model the house in the HOT2000 energy simulation software to obtain the initial and final EnerGuide ratings of that house. These ratings were used to determine the electrical energy savings for modelled measures. ASFH modelled energy savings correspond to the reduction in energy consumption between the D and E assessments.

Since 2018, the methodology used to calculate tracked savings compared electrical D and E assessment space heating consumption levels, both of which being adjusted with an overestimation ratio (OR). The ORs were drawn from billing analyses conducted during the 2015 and 2018 HEA evaluations. The 2018 evaluation served to establish distinct ORs depending on the space heating system in place.

As part of the 2024 evaluation, the Evaluator made some changes to the existing savings calculation methodology to simplify it and make it more robust. To do so, the Evaluator conducted a new billing analysis as part of the HEA 2024 evaluation. The Evaluator used the savings values obtained with billing data to develop adjustment ratios (ARs) that could be directly applied to the modelled savings estimates obtained from HOT2000 using whole-home consumption (not only space heating). The complete billing analysis methodology and results are presented in Appendix XXXI.

The ARs obtained through the HEA billing analysis performed as part of the 2024 evaluation are presented in Table 16 below. They were determined separately for three heat pump scenarios, as was the case for ORs. The tracked ORs are also presented in the table for comparison. The values in parenthesis represent the ratios  $(1 - OR)$  that were multiplied with the D and E space heating consumption values when adjusting consumption with the previous methodology. It is worth reminding that ARs are directly applied to the savings values obtained from the difference between the total initial and final consumption values.

**Table 16: 2024 Adjustment Ratios (ARs)**

| Scenario                                                                            | Tracked                    |                            | Evaluated |
|-------------------------------------------------------------------------------------|----------------------------|----------------------------|-----------|
|                                                                                     | OR <sub>D</sub> Assessment | OR <sub>E</sub> Assessment | AR        |
| A participant who registered <b>with</b> a heat pump                                | 0% (1.00)                  | 0% (1.00)                  | 1.24      |
| A participant who registered <b>without</b> a heat pump and who did not install one | 19% (0.81)                 | 19% (0.81)                 | 0.58      |
| A participant who registered <b>without</b> a heat pump and then had one installed  | 19% (0.81)                 | 0% (1.00)                  | 0.43      |

Participants with non-electrical space heating are eligible for the program component, meaning participants can generate both electrical and non-electrical savings. As indicated in the equation further above, the proportion of electrical savings for each participant is determined by multiplying total energy consumption by the proportion of space heating covered by electrical heating systems during the D assessment.

## Non-modelled Energy Savings

Smart thermostats and replaced appliances are not modelled in HOT2000. Instead, energy savings are calculated based on unitary energy savings values from the 2024-2025 DSM MA, which provides a detailed description of inputs, references, and unitary savings calculations for non-modelled measures offered through ASFH. Since the DSM MA was updated in 2024, the unitary energy savings values of ASFH measures were updated.



For participants that installed a heat pump and had no modelled energy savings, energy savings were calculated using the Green Heat calculation approach (see Subsection 19.2.2 below). The specifications of each heat pump were used to obtain energy savings.

Table 17 summarizes the tracked and evaluated unitary energy savings values for measures for which the unitary savings were changed in 2024.

**Table 17: Tracked and Evaluated 2024 ASFH Unitary Energy Savings**

| Measure                                   | Tracked Savings<br>[kWh/year] | Evaluated Savings<br>[kWh/year] |
|-------------------------------------------|-------------------------------|---------------------------------|
| Smart Thermostats with Heat Pump Baseline | 514                           | 564                             |
| <b>Appliance Replacement</b>              |                               |                                 |
| Refrigerators                             | 735                           | 674                             |
| Freezers                                  | 2,006                         | 1,380                           |
| Dehumidifiers                             | 603                           | 616                             |

## 9.2.2 Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity peak demand period in Nova Scotia is between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays.

For ASFH, modelled peak demand savings were calculated based on electrical savings using a peak demand-to-energy ratio of 0.283 MW/GWh (RES-Elect Space Heat & Cool) for space heating savings, as set by Navigant in the 2016-2018 DSM Plan. This ratio was established based on the modelled system coincident peak demand savings and energy savings for a projected deployment of measures. Navigant used local data to establish the ratio. The Evaluator considered that the approach used by Navigant to establish the peak demand-to-energy ratio was still valid and therefore used it to estimate peak demand savings.

An exception was made for heat pump measures for which peak demand savings were calculated separately to ensure they were accounted for correctly. Hence, the specifications of each heat pump were used to obtain peak demand savings using the HEA calculation approach (see Subsection 23.2.3) for modeled heat pumps. When heat pumps were included in the model, peak demand savings from the modelled savings were adjusted to accurately account for the peak demand savings attributable to heat pumps. For participants that installed a heat pump and had no modelled energy savings, peak demand savings were calculated using the Green Heat calculation approach (see Subsection 19.2.3 below).

Smart thermostats and replaced appliances are not modelled in HOT2000. Instead, peak demand savings are calculated based on unitary peak demand savings values. The detailed calculations for the unitary peak demand savings of each measure installed through ASFH are presented in the 2024-2025 DSM MA. During the 2024-2025 DSM MA update, unitary peak demand savings values for replaced appliances were reviewed and updated, while the value for smart thermostats remained unchanged.

Table 18 summarizes the tracked and evaluated peak demand unitary energy savings values of measures for which those unitary savings changed in 2024.



**Table 18: 2024 Appliance Replacement Tracked and Evaluated Unitary Peak Demand Savings**

|               | Tracked Savings [W/year] | Evaluated Savings [W/year] |
|---------------|--------------------------|----------------------------|
| Refrigerators | 101                      | 93.0                       |
| Freezers      | 277                      | 190                        |
| Dehumidifiers | 202                      | 206                        |

### 9.2.3 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other factors such as heating and cooling. Since ASFH building envelope and heat pump measures target heating and cooling loads directly, the impact of these measures on heating and cooling is considered in the savings. Therefore, no additional interactive effects factors were applied to the savings of these measures.

Smart thermostats and replaced old appliances savings are not modelled in HOT2000. As indicated in the 2024-2025 DSM MA, such measures do not have an impact on the energy consumption of other elements.

### 9.2.4 Effective Useful Life

As part of the 2024-2025 DSM MA activities, the Evaluator reviewed the EUL values used in the calculation of electrical energy savings that are expected to persist over time; the EUL values were not revised for any measure categories except modelled measures (building envelope upgrades and modelled space heating equipment). The EUL value for the modelled savings is based on the measures installed by HEA participants since HEA and ASFH participants install similar measures. Table 19 presents the EUL values that were changed in 2024.

**Table 19: Tracked and Evaluated 2024 ASFH Equivalent EUL Values**

| Measure                            | Tracked Equivalent EUL [years] | Evaluated Equivalent EUL [years] |
|------------------------------------|--------------------------------|----------------------------------|
| Building Envelope (Modelled)       | 20.8                           | 20.5                             |
| Space Heating Equipment (Modelled) | 20.8                           | 20.5                             |

### 9.2.5 Evaluated Gross Savings

The annual gross savings at the meter of modelled and non-modelled measures are presented in Table 20 and Table 21 below respectively. Table 22 further below combines the savings of all ASFH measures to present ASFH total annual gross savings.

**Table 20: Evaluated 2024 ASFH Modelled Measure Gross Energy and Peak Demand Savings**

| Total                                                                                                                                                                                                                                                                                                                              |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                              |               |
| Gross Energy Savings Without Adjustment Ratio (AR) – at the Meter (GWh)                                                                                                                                                                                                                                                            | 4.484         |
| <b>Gross Energy Savings with AR – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                           | <b>3.111</b>  |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                      | 20.5          |
| <b>Gross Lifetime Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                          | <b>63.777</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                         |               |
| Peak Demand-to-energy Ratio (MW/GWh)*                                                                                                                                                                                                                                                                                              | 0.483         |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                               | <b>1.501</b>  |
| * Corresponds to the equivalent peak demand-to-energy ratio obtained by dividing gross peak demand savings by gross electrical energy savings. This value differs from the peak demand-to-energy ratio mentioned in Subsection 9.2.2 above (0.283 MW/GWh) because of the different calculation methodology applied for heat pumps. |               |

**Table 21: Evaluated 2024 ASFH Non-modelled Measure Gross Energy and Peak Demand Savings**

| Measure Category*                                                             | Non-modelled Heat Pumps | Smart Thermostats | Appliance Replacements |              |               | Total        |
|-------------------------------------------------------------------------------|-------------------------|-------------------|------------------------|--------------|---------------|--------------|
|                                                                               |                         |                   | Refrigerators          | Freezers     | Dehumidifiers |              |
| <b>Number of Units Replaced</b>                                               | <b>254</b>              | <b>86</b>         | <b>11</b>              | <b>18</b>    | <b>14</b>     | <b>383</b>   |
| <b>Energy Savings</b>                                                         |                         |                   |                        |              |               |              |
| Unitary Energy Savings (kWh)                                                  | -                       | 564               | 674                    | 1,380        | 616           | -            |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                              | <b>0.197</b>            | <b>0.049</b>      | <b>0.007</b>           | <b>0.025</b> | <b>0.009</b>  | <b>0.286</b> |
| Effective Useful Life (years)                                                 | 18                      | 10                | 5                      | 4            | 5             | -            |
| <b>Gross Lifetime Energy Savings – at the Meter (GWh)</b>                     | <b>3.547</b>            | <b>0.485</b>      | <b>0.037</b>           | <b>0.099</b> | <b>0.043</b>  | <b>4.212</b> |
| <b>Peak Demand Savings</b>                                                    |                         |                   |                        |              |               |              |
| Unitary Peak Demand Savings (W)                                               | -                       | 0                 | 93                     | 190          | 206           | -            |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                          | <b>0.313</b>            | <b>0.000</b>      | <b>0.001</b>           | <b>0.003</b> | <b>0.003</b>  | <b>0.320</b> |
| * Only measures with at least one installed unit were included in this table. |                         |                   |                        |              |               |              |

The gross savings at the generator were estimated by using a line loss factor of 1.0947 for energy savings and 1.1466 for peak demand savings between the meter and the generator. These line loss factors were provided by NS Power and correspond to the values used for residential consumers. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>24</sup>

As presented in Table 22 below, appliances replaced through Appliance Replacement (refrigerator, freezer, and dehumidifier replacements) resulted in gross electrical energy savings at the generator of 0.045 GWh and gross peak demand savings at the generator of 0.008 MW.

<sup>24</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

With total gross electrical energy and lifetime electrical energy savings of 3.719 GWh and 74.428 GWh respectively, the average EUL value for ASFH was 20.0 years in 2024.

**Table 22: Evaluated 2024 ASFH Gross Electrical Energy and Peak Demand Savings**

| Measure Category                                                                                                                                                                              | Modelled Measures | Non-modelled Heat Pumps | Smart Thermostats | Appliance Replacements | Total  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------------|-------------------|------------------------|--------|
| Number of Participants with Savings*                                                                                                                                                          | 880               | 254                     | 79                | -                      | 1,193  |
| <b>Energy Savings</b>                                                                                                                                                                         |                   |                         |                   |                        |        |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                     | 3.111             | 0.197                   | 0.049             | 0.041                  | 3.398  |
| Line Loss Factor                                                                                                                                                                              | 1.0947            | 1.0947                  | 1.0947            | 1.0947                 | -      |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                 | 3.406             | 0.216                   | 0.053             | 0.045                  | 3.719  |
| Effective Useful Life (years)**                                                                                                                                                               | 20.5              | 18.0                    | 10.0              | 4.4                    | -      |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                        | 69.817            | 3.883                   | 0.531             | 0.197                  | 74.428 |
| <b>Peak Demand Savings</b>                                                                                                                                                                    |                   |                         |                   |                        |        |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                 | 1.501             | 0.313                   | -                 | 0.007                  | 1.822  |
| Line Loss Factor                                                                                                                                                                              | 1.1466            | 1.1466                  | 1.1466            | 1.1466                 | -      |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                             | 1.722             | 0.359                   | -                 | 0.008                  | 2.089  |
| *The total number of participants does not correspond to the sum of all measure categories since participants who benefited from appliance replacements also implemented additional measures. |                   |                         |                   |                        |        |
| ** Corresponds to the equivalent EUL obtained from dividing the non-modelled measure lifetime energy savings at the meter by the energy savings at the meter (see Table 21).                  |                   |                         |                   |                        |        |

As presented in Table 23, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>25</sup> for GHG emissions generated by electricity production to ASFH gross savings results.

**Table 23: Evaluated 2024 ASFH Gross GHG Emission Reductions**

|                                                                                             | Total |
|---------------------------------------------------------------------------------------------|-------|
| Gross Energy Savings – at the Generator (GWh)                                               | 3.719 |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2 |
| Gross Annual GHG Emission Reductions (tonnes of CO2 eq)                                     | 1,756 |

<sup>25</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024), and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

## 9.3 Net Savings

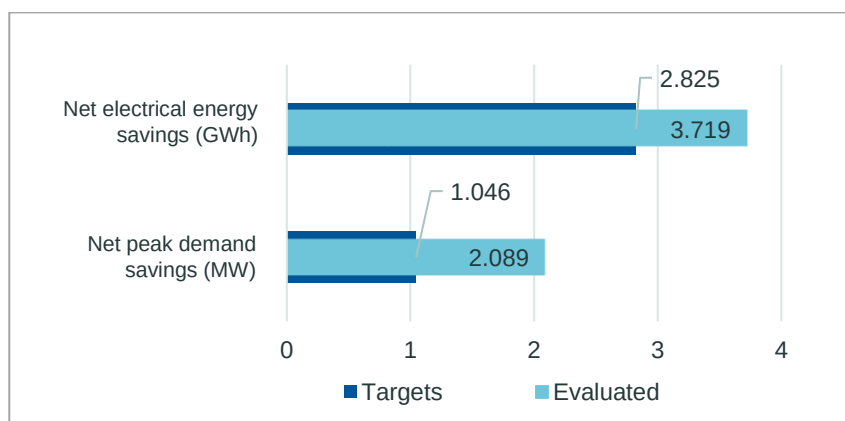
The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to a program component, by estimating the net-to-gross ratio (NTGR). More precisely, the NTGR represents the positive or negative impacts of spillover and free-ridership effects on gross savings. For ASFH, free-ridership and spillover effects were considered to be nil since participants are non-profit organizations or low-income housing owners that traditionally have small housing budgets spread across many competing housing priorities. Therefore, a NTGR of 1.00 was applied.

### 9.3.1 Evaluated Net Savings

Net savings are defined as the changes in energy use that are specifically attributable to ASFH. Since spillover and free-ridership effects were considered nil, the net energy savings are equal to the gross savings generated by the program component. Likewise, the net annual GHG emission reductions are equal to the gross annual GHG emission reductions.

As outlined in Figure 35, ASFH exceeded its electrical energy and peak demand savings targets by 32% and 100% respectively.

**Figure 35: 2024 ASFH Targets and Evaluated Results**



## 9.4 Realization Rate

Table 24 below compares the energy and peak demand savings established through this evaluation to those calculated in the 2024 tracking sheet. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 24: Comparison of 2024 ASFH Tracked and Evaluated Savings at the Generator**

|                       | Gross Savings |      | NTGR  | Net Savings |      | Realization Rate |
|-----------------------|---------------|------|-------|-------------|------|------------------|
|                       | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings        |               |      |       |             |      |                  |
| Tracked Savings by E1 | 4.693         | GWh  | 1.00  | 4.693       | GWh  | 79%              |
| Evaluation Results    | 3.719         | GWh  | 1.00  | 3.719       | GWh  |                  |
| Peak Demand Savings   |               |      |       |             |      |                  |
| Tracked Savings by E1 | 2.160         | MW   | 1.00  | 2.160       | MW   | 97%              |
| Evaluation Results    | 2.089         | MW   | 1.00  | 2.089       | MW   |                  |

The electrical energy and peak demand savings determined by the Evaluator were respectively 21% and 3% lower than the initial savings tracked by E1 mainly due to the revised adjustment ratios. Updated unitary savings also partly explain the differences, although to a much lesser extent.



## 10 ASFH Key Findings and Recommendations

As mentioned previously, the main objectives of the 2024 ASFH evaluation were as follows:

- › Collect information on program staff, partner, and participant perspectives
- › Calculate gross and net ASFH results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided greenhouse gas (GHG) emissions

This section provides the Evaluator's key findings and recommendations in relation to the above objectives.

### **2024 ASFH-Finding: Participants see the value of the program.**

The energy efficient retrofits installed at no cost through ASFH are perceived by participants to be making their homes more comfortable and warmer in winter and less expensive to heat.

### **2024 ASFH-Finding: Overall satisfaction with ASFH is high.**

Surveyed participants as well as interviewed DAs and heat pump contractors are generally satisfied with ASFH. Participants consider it easy and worthwhile to participate and would highly recommend the program to others. Although DAs and contractors make suggestions for improvements to the program, they widely agree that it is worthwhile being involved.

### **2024 ASFH-Finding: Despite overall satisfaction, there are three irritants with the program component.**

Long wait times (participants, DAs, and heat pump contractors), insufficient program and product information (participants), and reporting processes and lack of user-friendly software tools (DAs and heat pump contractors) are causing some dissatisfaction. These are expanded upon below.

### **2024 ASFH-Finding: Long wait times cause discontent at various program stages and for various stakeholders.**

- › Modelled participants are particularly dissatisfied with the wait time between their enrollment in ASFH and the initial home energy assessment. DAs and heat pump contractors are dissatisfied with the time it takes E1 to approve proposed upgrades.
- › Additionally, heat pump contractors mention untimely responses from E1 to email enquiries, hindered by a perceived lack of direct access to a contact person or mailbox..
- › E1 is cognisant of dissatisfaction with wait times and have put strategies in place. They report that they have expanded the number of staff members and are catching up with the backlog. It should be noted that a mailbox for heat pump contractors is already available and E1 recently provided training to improve contractor knowledge about and engagement with ASFH.

**Recommendation #1:** To assess progress with participant wait times, E1 could track wait times as well as program delivery satisfaction levels (e.g. in quarterly customer satisfaction surveys) throughout 2025 to determine how strategies are performing and make adjustments if necessary.



**2024 ASFH-Finding: Participants would like more information to be provided about the program steps.**

Limited participant knowledge about ASFH can cause participant confusion and frustration during the initial DA/contractor visit, particularly if participants are considering taking part in multiple programs (such as ASFH and OHPA).

**Recommendation #2:** Provide participants with more information about ASFH to help them understand program options, eligible measures, and participation steps by implementing the following:

- a) Investigate ways to inform participants about eligible measures in ASFH and to ensure that other program options and their differences (i.e. OHPA) are clearly presented to participants verbally and through marketing materials.
- b) Review the application template for clarity and adapt it to confirm with participants to which program they are applying (i.e. ASFH, OHPA). Ensure that the information in the application is shared with DAs/contractors.
- c) Once participants have submitted their application, clearly communicate (perhaps using a visual) the touchpoints that will occur along their journey (e.g. who will be contacting them, at what point, and what to expect).

**Recommendation #3:** Reinforce participant awareness of the Energy Solution Advisor's role as E1 program navigator to help participants better understand and navigate E1's programs (including ASFH).

**2024 ASFH-Finding: More product information would be helpful for participants.**

Some participants say they did not receive information about the products installed and some still have doubts about how to operate and maintain their new equipment (especially heat pumps) even though contractors report reviewing this with participants after installation. Note that most questions fielded by DAs and contractors concern heat pump usage. This situation could potentially create barriers to proper equipment use and affect energy savings.

**Recommendation #4:** To maximize energy savings, ensure that all participants receive the necessary information to operate and maintain the equipment installed in language that is easy to understand. Implement checklists for DAs and heat pump contractors if necessary.

**Recommendation #5:** Ensure that DAs/contractors provide a leave-behind so that participants know who to contact in case of questions or difficulties or to better understand how to operate and maintain their heat pump.



## **2024 ASFH-Finding: Record keeping/reporting is time consuming.**

Having to use two platforms for filling out the required record keeping/reporting forms (CIS) and uploading documentation (SharePoint) is said to lead to repetitive data entry and unclear requirements for DAs and heat pump contractors. While SharePoint is considered to be an adequate file sharing tool, the CIS is said not to provide effective project management. Furthermore, DAs report many changes since the original training on processes and system use, which have never been formally communicated and lead to a lot of back and forth with E1 to resolve issues.

**Recommendation #6:** Look for opportunities to streamline record keeping/reporting processes to reduce the administrative burden for DAs and contractors, taking into account program tracking and evaluation needs.

**Recommendation #7:** Update the DA/contractor training guides on the record keeping/reporting processes and use of the software tools to reflect current practices and offer regular training sessions to provide updates on any changes.

## **2024 ASFH-Finding: ASFH exceeded its electrical energy and peak demand savings targets.**

ASFH achieved 3.719 GWh in net electrical energy savings and 2.089 MW in net peak demand savings at the generator in 2024, thus exceeding the planned targets of 2.825 GWh and 1.046 MW respectively. This represents electrical energy savings 32% over and peak demand savings 100% over ASFH targets.

## **2024 ASFH-Finding: In 2024, 1,210 homes participated in ASFH, nearly five times the number recorded in 2023.**

Among the 1,210 ASFH participants, 880 implemented building envelope measures, with 696 of them also installing a heat pump. Additionally, 254 participants installed a non-modelled heat pump and 79 installed smart thermostats, and a total of 43 appliances were replaced.

While gross electrical energy and peak demand savings were respectively 158% and 233% higher than in 2023 primarily due to increased participation, average savings per participant decreased by 48%. This decline was mainly attributed to updated adjustment ratios and a different project mix, with a greater number of projects involving only smart thermostats or non-modelled heat pumps.

## **2024 ASFH-Finding: The evaluated net energy and peak demand savings determined by the Evaluator were lower than the initial net savings tracked by E1.**

The energy and peak demand savings determined by the Evaluator were lower by 21% and 3% respectively compared to the initial savings tracked by E1. This was mainly due to revisions to the adjustment ratios.



## 11 EPI Overview

This section describes the Efficient Product Installation (EPI) program component, follows up on past evaluation recommendations, and provides an overview of EPI participation history.

### 11.1 EPI Description

EPI provides participants with free-of-charge direct installations of energy efficient products. EPI has played a pivotal role in transforming the residential lighting market by making energy-efficient products more affordable. Importantly, as LEDs have become the baseline, EPI is set to phase out lighting measures and focus on electrician-installed energy-efficient products. Electrician-installed measures will be key in delivering Residential Demand Response activities. E1 contracts service providers to deliver EPI across the province. EPI is available to both homeowners and renters and encourages participants to also consider other E1 residential program components. Table 25 presents the products available for installation through EPI in 2024 and whether they were aimed at generating electrical savings, non-electrical savings, or both.

**Table 25: 2024 EPI List of Eligible Products**

| Products                                                          | Electrical Savings | Non-electrical Savings |
|-------------------------------------------------------------------|--------------------|------------------------|
| <b>Lighting Products</b>                                          |                    |                        |
| LED Lamps Including A-types, Reflectors, and Chandeliers          | X                  | -                      |
| LED Nightlights                                                   | X                  | -                      |
| Solar Security Fixtures*                                          | X                  | -                      |
| Motion Sensors*                                                   | X                  | -                      |
| Dimmer Switches*                                                  | X                  | -                      |
| <b>Domestic Hot Water (DHW) Products</b>                          |                    |                        |
| Faucet Aerators                                                   | X                  | X                      |
| Low-flow Showerheads                                              | X                  | X                      |
| Thermostatic Shower Valves                                        | X                  | X                      |
| Pipe Insulation                                                   | X                  | X                      |
| Hot Water Tank Wraps                                              | X                  | -                      |
| <b>Smart and Advanced Learning Thermostats</b>                    |                    |                        |
| Advanced Learning Thermostats (for non-electrically heated homes) | -                  | X                      |
| Smart Thermostats (for mini-split heat pumps [MSHPS])*            | X                  | -                      |
| Smart Thermostats (for electric baseboards or in-floor systems)*  | X                  | -                      |
| Advanced Learning Thermostats (for central electric heating)*     | X                  | -                      |
| <b>Air Sealing Products</b>                                       |                    |                        |
| Foam Gaskets                                                      | X                  | X                      |
| Door Sweeps                                                       | X                  | X                      |
| Window Air Sealing                                                | X                  | X                      |
| Door Weather Stripping                                            | X                  | X                      |
| Window Film Kits                                                  | X                  | X                      |



| Products                                                        | Electrical Savings | Non-electrical Savings |
|-----------------------------------------------------------------|--------------------|------------------------|
| <b>Other Products</b>                                           |                    |                        |
| Smart Power Controllers for Audiovisual Equipment <sup>26</sup> | X                  | -                      |
| Domestic Hot Water Heater Load Controllers <sup>27</sup> *      | X                  |                        |
| Humidity Sensors*                                               | X                  |                        |
| * Electrician-installed measures.                               |                    |                        |

Electrician-installed measures were introduced to EPI in 2024, except smart thermostats for electric baseboards and DHW heater load controllers that were introduced with a limited scope in 2023 as well as smart thermostats for MSHP that were introduced in 2022.

EPI funding comes from two sources: (1) Electricity ratepayer funding is used for upgrades that reduce electricity consumption; and (2) funding from the Government of Nova Scotia using funds from the Green Fund for upgrades that reduce the use of other fuels. This report presents the evaluation results for the electricity ratepayer portion of EPI only.

EPI was aimed at achieving 10.569 GWh in net electrical energy savings and 1.127 MW in net peak demand savings at the generator in 2024.

## 11.2 Follow-up on Past Evaluation Report Recommendations

No recommendations were made for EPI in the 2023 evaluation.

## 11.3 Participation History

As presented in Figure 36 below, EPI had 9,993 DSM participants, which represents a 2.4% increase in participation compared to 2023.<sup>28</sup>

In 2024, 150,722 efficient products were installed,<sup>29</sup> which represents a 2% decrease compared to 2023. On average, 15.1 products were installed per household, which is similar to the average of 15.8 products installed in 2023. The average savings per participant decreased by 6.3% in 2024 compared to 2023.

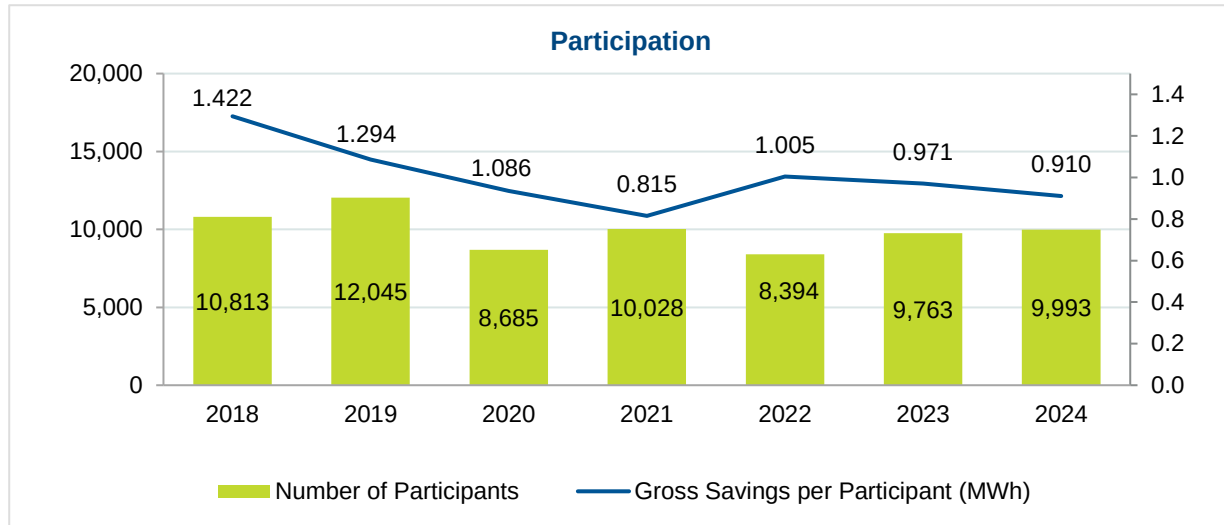
<sup>26</sup> Smart power controllers for audiovisual equipment were removed from EPI in 2021. To allow service providers to use up their remaining stocks, installations were briefly resumed in January 2024 until March 2024.

<sup>27</sup> While DHW heater load controllers were installed through EPI, their savings are claimed under the Demand Response program.

<sup>28</sup> The number of participants is based on the number of unique reference numbers of participants that generated electricity savings.

<sup>29</sup> The number of efficient products installed does not include DHW controllers.

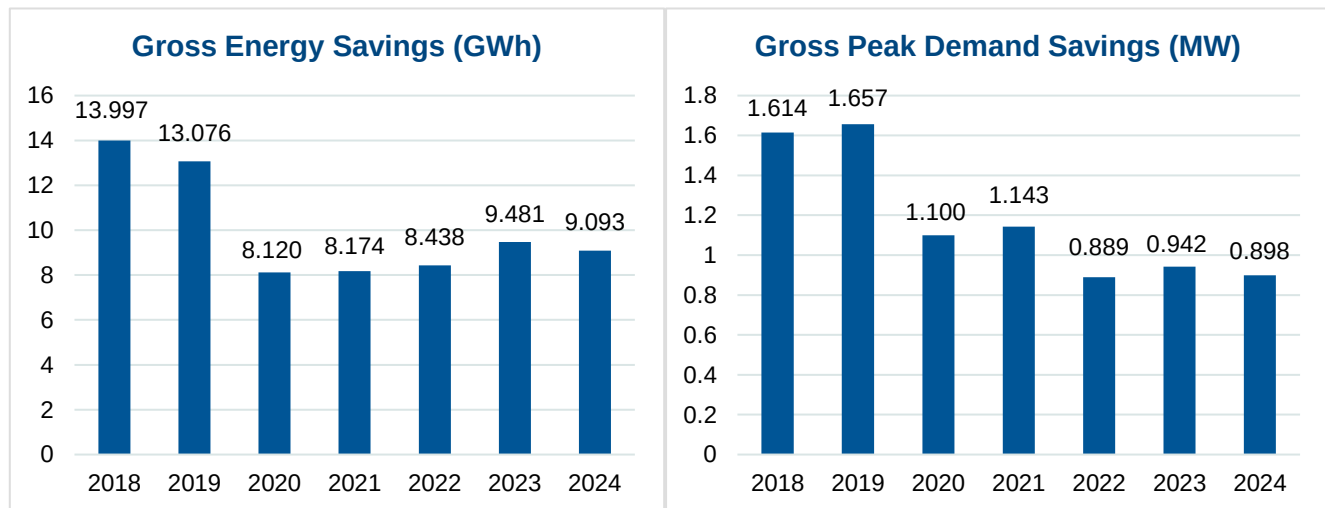
**Figure 36: Overview of EPI Participation, 2017-2024**



The average number of A-type lamps installed per dwelling decreased from 7.8 in 2023 to 7.4 in 2024 and the average number of non-A-type lamps replaced per dwelling decreased from 4.3 in 2023 to 3.8 in 2024. With 111,806 LED lamps generating 3.871 GWh in gross savings, LED lamps remained the most popular product type representing 74% of products installed in EPI and accounting for 43% of gross energy savings. Similarly to 2023, smart thermostats for MSHPs were also a significant contributor, accounting for 20% of EPI gross energy savings.

As illustrated in Figure 37 below, the 2024 gross energy and peak demand savings were slightly lower than those generated in 2023 despite the higher participation level.

**Figure 37: Evolution of EPI Gross Savings, 2018-2024**



## 12 EPI Evaluation Approach

The 2024 EPI evaluation comprised a comprehensive impact evaluation. The main objectives of the 2024 EPI evaluation were as follows:

- › Collect information on participant perspectives
- › Calculate gross and net EPI results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions<sup>30</sup>
- › Analyze market opportunities

The Evaluator identified key research questions aimed at achieving these objectives. Table 26 outlines the EPI evaluation objectives and maps them to the research questions and methods established by the Evaluator. Each method is described further below.

**Table 26: 2024 EPI Evaluation Approach**

| Evaluation Objectives                                                                             | Research Questions                                                                                                                                                                                                                                                                                                                                                                    | Methodology                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Collect information on participant perspectives                                                   | <ul style="list-style-type: none"> <li>› How do participants become aware of EPI?</li> <li>› What is the level of satisfaction with the program component among participants and distributors?</li> <li>› How could E1 improve the program component?</li> </ul>                                                                                                                      | <ul style="list-style-type: none"> <li>› Participant survey</li> </ul>                                                                                                                                                                                                                                |
| Calculate gross results                                                                           | <ul style="list-style-type: none"> <li>› Are the data in the tracking sheet complete, accurate, and consistent?</li> <li>› What are the unitary savings and effective useful life (EUL) values by product?</li> <li>› What is the installation rate by product?</li> <li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li> </ul> | <ul style="list-style-type: none"> <li>› Tracking sheet audit</li> <li>› Unitary savings review</li> <li>› Site visits</li> <li>› EUL update</li> <li>› Calculations using evaluation results</li> </ul>                                                                                              |
| Calculate net results                                                                             | <ul style="list-style-type: none"> <li>› What is the free-ridership level for 2024?</li> <li>› What is the spillover level for 2024?</li> <li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li> <li>› What are the net GHG emission reductions in CO<sub>2</sub> eq?</li> </ul>                                                    | <ul style="list-style-type: none"> <li>› Participant survey (does not include electrician-installed measures introduced in 2025)</li> <li>› Use of a NTGR of 1 for low-income participants</li> <li>› Calculations using evaluation results</li> <li>› GHG emission reduction calculations</li> </ul> |
| Identify new opportunities for electrician-installed measures in residential direct installations | <ul style="list-style-type: none"> <li>› What electrician-installed products are being offered by direct installation programs in other jurisdictions and what is their savings potential?</li> </ul>                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>› Jurisdictional scan of direct install programs in North America</li> </ul>                                                                                                                                                                                   |

### Tracking Sheet Audit

Prior to performing the savings calculation review, the Evaluator audited the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The results obtained are presented in Appendix XIII.

<sup>30</sup> First-year savings are based on typical energy consumption and do not consider changes in energy consumption resulting from the COVID-19 pandemic.



## Participant survey

In October and November 2024, Narrative Research conducted a telephone survey with a total of 100 participants. The average length of the survey was 15 minutes. The questionnaire used is presented in Appendix XIV, while complete survey results are outlined in Appendix XV. Drawing a random sample of 100 participants from a population of 2,361 yields a margin of error of 8.1% at a 90% confidence level.

## Unitary Savings Review

The Evaluator did a complete review and update of unitary savings values and produced the 2024-2025 Demand-side Management Measure Assessment (DSM MA).<sup>31</sup> The unitary savings review entailed a literature review of technical reference manuals, metering studies, and program evaluations to determine if there are more appropriate<sup>32</sup> methodologies or parameters to be applied to calculate energy and peak demand unitary savings, including elements such as baseline assumptions, operating hours, efficiency levels, peak demand-to-energy ratios, and interactive effect factors.

## Site Visits

In September and October 2024, Equilibrium Engineering (a brand under the LMMW Group Ltd.) performed on-site visits in 60 participant homes. The site visits served mainly to establish installation rates, the results of which are discussed in Subsection 14.2.1. The protocol used for the on-site visits is presented in Appendix XVI.

## EUL Update

The Evaluator updated the EUL values of lighting products given the rapid evolution of the lighting market. The 2024-2025 DSM MA was updated accordingly.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime electrical energy and peak demand savings as per the calculation methodology presented in Subsection 14.2 below.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for EPI, the Evaluator multiplied net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NSP) data.

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<sup>31</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross electrical energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the remainder of the evaluations to be conducted during the 2023-2025 DSM cycle, the Evaluator will refer to the values presented in the 2024-2025 DSM MA.

<sup>32</sup> The Evaluator will judge whether new studies are more appropriate based on various factors, including but not limited to the following: The similarities between the measures implemented in the given study and E1's measures; and similarities in terms of climate or market conditions, the size of the sample studied, whether a study is recent, the quality of the study methodology, etc.



## Jurisdictional Scan

In the fall of 2024, the Evaluator performed a scan across 15 jurisdictions throughout Canada and the United States (US) to identify other measures that could be installed by electricians under EPI. The jurisdictional scan findings are presented in Appendix XIX and are discussed in Subsection 15.1 below.

### Note on Margins of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>33</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>34</sup>

As part of the EPI evaluation, the Evaluator calculated the margins of error for installation rates, free-ridership levels, and spillover levels. The margins of error are listed alongside results in the applicable sections below. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary.

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<sup>33</sup> Precision refers to how reproducible a set of measurements is. It does not take into account how close the measured values are to the true values since this would refer to accuracy.

<sup>34</sup> As part of this evaluation, the confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.

## 13 EPI Participant Perspectives

This section summarizes the findings obtained through the EPI participant survey.

A survey of 100 participating households was conducted as part of the 2024 EPI evaluation. Surveyed participants were asked questions regarding their awareness, motivations for participating, satisfaction and concerns about the services provided and their participation, and recommendations for program component improvements.

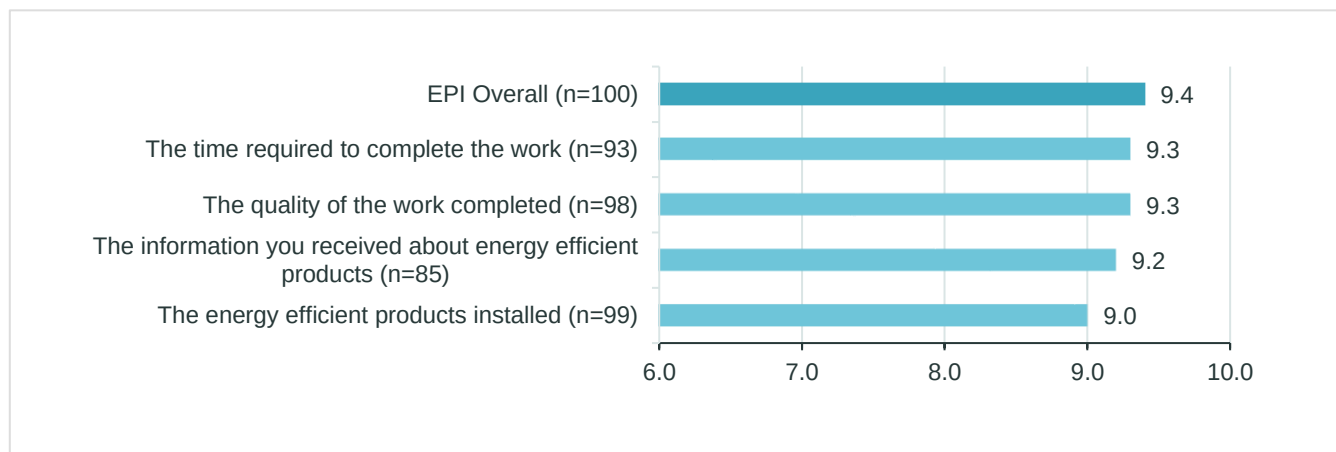
Almost half of participants first learned of EPI by word of mouth (22%), online advertisement (16%), or social media (9%). Participation in EPI was primarily motivated by a desire to save on energy costs (61%), although certain participants were concerned that they would not eventually save money (8%) when they initially thought about participating in EPI. A desire for energy efficient upgrades was the second most cited motivation for participation (26%) despite concerns expressed by a few participants that they would not save energy (8%). Overall, most participants (65%) reported having no concerns about participating in EPI.

Most participants (95%) were present when the energy efficient products were installed and most (88%) received information about energy efficient products during the installer visit. Five out of the 11 participants who did not receive this information expressed interest in it.

Satisfaction with EPI overall is very high with an average of 9.4 on a scale of 1 to 10, where 1 means “Not at all satisfied” and 10 means “Completely satisfied”. Participants were mainly satisfied with the installer (41%), the information received (25%), and the good service provided in general (19%).

As outlined in Figure 38 below, participants also provided high satisfaction ratings for each aspect of the program component. The level of satisfaction is notably high in regard to the installation time and the quality of the work performed.

**Figure 38: 2024 Participant Satisfaction with EPI (10-point Scale)**



Three-quarters of participants (75%) had no improvement recommendations for EPI, although a small proportion recommended offering more product options (12%), a better installation service (6%), more information on products or product guides (3%), and more recommendations (3%).

### 2024 EPI Participant Perspective Highlights

- › Participants learned about EPI mainly through word of mouth followed by online advertisements and social media.
- › Satisfaction with the service overall is very high as is satisfaction with specific aspects.
- › Most participants have no recommendations for how to improve EPI.



## 14 EPI Impact Evaluation

The objectives of the 2024 EPI impact evaluation were to determine gross and net electrical energy and peak demand savings.

### 14.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in Appendix XIII. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 14.2 Gross Savings

For EPI, gross savings correspond to the change in energy consumption resulting from installing energy efficient products in participant homes regardless of why they participated.<sup>35</sup> The Evaluator relied on information from the 2024-2025 DSM MA to calculate gross savings for EPI measures. The Evaluator also applied an adjustment ratio determined as part of the 2019 evaluation to correct observed discrepancies in tracked lamp replacements.

In addition, the Evaluator updated the EUL values of lighting products and referred to the 2024-2025 DSM MA for the EUL values of all other products.

#### 14.2.1 Installation Rates

Installation rates represent the proportions of products recorded in the tracking sheet that remain installed in participant homes. During the 2024 evaluation, the Evaluator conducted 60 on-site visits to update installation rates for measures in the main EPI offering. While the Evaluator selected projects with multiple measures to optimize the number of measures for which the Evaluator would be able to establish an installation rate with an acceptable margin of error, some less installed measures were only encountered in a few visited sites, which did not allow the Evaluator to obtain reliable installation rates for a few products. For those products, the Evaluator used the following assumptions:

- › Thermostatic shower valves: The Evaluator used the 2024 installation rate of 89% even though the margin of error was above 10% since the installation rate was very close to the value of 88% obtained in the previous round of site visits in 2021, thus increasing confidence in the accuracy of the selected installation rate.
- › Smart thermostats for MSHPs: The margin of error being only slightly above 10%, the Evaluator assumed that using that installation rate would result in a more accurate savings estimate than applying no installation rate. The 84% installation rate is mostly due to participants disconnecting their smart thermostats because of arising issues or dissatisfaction with the product. More precisely, one participant reported disconnecting due to issues and two due to dissatisfaction; for two others, the number of thermostats in the tracking sheet did not match what was observed on site.

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<sup>35</sup> Definition adapted from: National Renewable Energy Laboratory, The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices, September 2014, p.3.



- › Foam gaskets: The installations of foam gaskets could not be visually confirmed within the time allotted for site visits. Instead, the Evaluator verbally confirmed if participants received them and if they installed some or all of them. Among the visited participants that received foam gaskets based on the tracking sheet, 83% confirmed having received this product. The Evaluator assumed that seven foam gaskets (out of ten per package) were installed on average based on the number of observed plugs and switches on exterior walls during the visits. Participants had difficulties confirming if the foam gaskets were installed or how many were installed; therefore, the Evaluator also included an uncertainty factor of 50%. The equation below presents the calculation of the foam gasket installation rate.

*Foam Gasket Installation Rate*

$$= \% \text{ of Participants that Confirmed Receiving Foam Gaskets} \times \text{Uncertainty Factor} \\ \times \frac{\text{Average Number Installed}}{\text{Number per Package}} = 83\% \times 50\% \times 7/10 = 29\%$$

- › Door sweeps: Only one door sweep was included in the sample and it was confirmed to be installed. This is aligned with what had been observed in the previous round of site visits, so an installation rate of 100% was used.
- › Window air sealing: Since the margin of error obtained through 2024 site visits (27.8%) was well above 10%, the Evaluator elected to use the installation rate from the previous round of site visits in 2021, which had a margin of error of 11.6% considerably closer to 10%. In addition, the installation rates established in 2021 and 2024 were similar (84% in 2021 and 86% in 2024), thus increasing confidence in the accuracy of the selected installation rate.
- › Door weatherstripping: No door weatherstripping was included in the 2024 site visit sample. Like in 2021, door weatherstripping and window air sealing measures were combined since the decision-making processes of installing or removing those products were considered to be similar. Therefore, the installation rate of 84% used for window air sealing was also used for door weatherstripping.
- › Window film kits: Since window film kits are typically installed during winter, none was confirmed as installed during the site visits conducted in the fall 2024. The Evaluator therefore relied on a literature review that served to identify an installation rate of 57%.
- › For EPI measures introduced in 2024, namely smart thermostats for electric baseboards, advanced learning thermostats for electric heating, solar security fixtures, dimmer switches, indoor motion sensors, outdoor motion sensors, and humidity sensors, the Evaluator assumed an installation rate of 100% given the nature of the program component and because they are all electrician-installed measures.

Table 27 lists the installation rates that the Evaluator applied to gross savings.

**Table 27: EPI Product Installation Rates**

| Product                                                                | Installation Rate Applied to Gross Savings | Margin of Error | Reference                       |
|------------------------------------------------------------------------|--------------------------------------------|-----------------|---------------------------------|
| <b>Lighting Products</b>                                               |                                            |                 |                                 |
| LED Lamps                                                              | 94%                                        | 3.0%            | 2024 EPI on-site visits         |
| LED Nightlights                                                        | 94%                                        | 3.0%            | 2024 EPI on-site visits         |
| Dimmer Switches                                                        | 100%                                       | N/A             | Assumption                      |
| Indoor and Outdoor Motion Sensors                                      | 100%                                       | N/A             | Assumption                      |
| Solar Security Fixtures                                                | 100%                                       | N/A             | Assumption                      |
| <b>DHW Products</b>                                                    |                                            |                 |                                 |
| Faucet Aerators                                                        | 92%                                        | 7.0%            | 2024 EPI on-site visits         |
| Low-flow Showerheads                                                   | 95%                                        | 4.7%            | 2024 EPI on-site visits         |
| Thermostatic Shower Valves                                             | 89%                                        | 17.6%           | 2024 EPI on-site visits         |
| Pipe Insulation (per ft)                                               | 100%                                       | 0%              | 2024 EPI on-site visits         |
| Hot Water Tank Wraps                                                   | 100%                                       | 0%              | 2024 EPI on-site visits         |
| <b>Smart and Advanced Learning Thermostats</b>                         |                                            |                 |                                 |
| Smart Thermostats for MSHPs                                            | 84%                                        | 12.3%           | 2024 EPI on-site visits         |
| Smart Thermostats for Electric Baseboards or Electric In-floor Heating | 100%                                       | N/A             | Assumption                      |
| Advanced Learning Thermostats for Central Electric Heating             | 100%                                       | N/A             | Assumption                      |
| <b>Air Sealing Products</b>                                            |                                            |                 |                                 |
| Foam Gaskets                                                           | 29%                                        | N/A             | 2024 EPI evaluation             |
| Door Sweeps                                                            | 100%                                       | N/A             | Assumption                      |
| Window Film Kits                                                       | 57%                                        | N/A             | 2024 Illinois TRM <sup>36</sup> |
| <b>Other Products</b>                                                  |                                            |                 |                                 |
| Smart Power Controllers for Audiovisual Equipment                      | 100%                                       | 0%              | 2024 EPI on-site visits         |
| Humidity Sensors                                                       | 100%                                       | N/A             | Assumption                      |

## 14.2.2 Unitary Energy Savings

For EPI, E1 establishes separate unitary savings values for single-family homes and apartments. For the 2024 evaluation, the Evaluator used the unitary savings values from the 2024-2025 DSM MA. That document provides a detailed description of inputs, references, and unitary savings calculations for all product types offered through EPI. Since the MA was updated in 2024, the unitary energy savings values of multiple measures were updated. Table 28 summarizes the tracked and evaluated unitary energy savings for each product installed through EPI and for which the unitary energy savings were changed in 2024.

<sup>36</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 12.0, Volume 3*, September 2023, p. 384.

**Table 28: 2024 EPI Updated Tracked and Evaluated Unitary Energy Savings**

| Product                                | EPI – Single-family Homes |                            | EPI – Apartments         |                            |
|----------------------------------------|---------------------------|----------------------------|--------------------------|----------------------------|
|                                        | Tracked Savings [kWh/yr]  | Evaluated Savings [kWh/yr] | Tracked Savings [kWh/yr] | Evaluated Savings [kWh/yr] |
| <b>LED Lamps</b>                       |                           |                            |                          |                            |
| 9 W Replacing 25 W                     | 15.8                      | 15.2                       | 15.8                     | 15.2                       |
| 9 W Replacing 29 W                     | 19.7                      | 19.0                       | 19.7                     | 19.0                       |
| 9 W Replacing 40 W                     | 30.6                      | 29.4                       | 30.6                     | 29.4                       |
| 9 W Replacing 43 W                     | 33.5                      | 32.3                       | 33.5                     | 32.3                       |
| 9 W Replacing 60 W                     | 50.3                      | 48.4                       | 50.3                     | 48.4                       |
| 9 W Replacing 72 W                     | 62.1                      | 59.8                       | 62.1                     | 59.8                       |
| 9 W Replacing 100 W                    | 89.7                      | 86.4                       | 89.7                     | 86.4                       |
| 9 W Replacing 150 W                    | 139                       | 134                        | 139                      | 134                        |
| 9.5 W Replacing 25 W                   | 15.3                      | 14.7                       | 15.3                     | 14.7                       |
| 9.5 W Replacing 29 W                   | 19.2                      | 18.5                       | 19.2                     | 18.5                       |
| 9.5 W Replacing 40 W                   | 30.1                      | 28.9                       | 30.1                     | 28.9                       |
| 9.5 W Replacing 43 W                   | 33.0                      | 31.8                       | 33.0                     | 31.8                       |
| 9.5 W Replacing 60 W                   | 49.8                      | 47.9                       | 49.8                     | 47.9                       |
| 9.5 W Replacing 72 W                   | 61.6                      | 59.3                       | 61.6                     | 59.3                       |
| 9.5 W Replacing 100 W                  | 89.2                      | 85.9                       | 89.2                     | 85.9                       |
| 9.5 W Replacing 150 W                  | 138                       | 133                        | 138                      | 133                        |
| 18 W Replacing 75 W                    | 56.2                      | 54.1                       | 56.2                     | 54.1                       |
| 18 W Replacing 100 W                   | 80.8                      | 77.8                       | 80.8                     | 77.8                       |
| PAR20 7 W Replacing 50 W               | 42.4                      | 40.8                       | 42.4                     | 40.8                       |
| PAR38 15 W Replacing 90 W              | 73.9                      | 71.2                       | 73.9                     | 71.2                       |
| PAR38 15 W Replacing 120 W             | 103                       | 99.6                       | 103                      | 99.6                       |
| PAR38 15 W Replacing 150 W             | 133                       | 128                        | 133                      | 128                        |
| GU10 7 W Replacing 35 W                | 27.6                      | 26.6                       | 27.6                     | 26.6                       |
| GU10 7 W Replacing 50 W                | 42.4                      | 40.8                       | 42.4                     | 40.8                       |
| 4.5 W G25 Replacing 40 W <sup>37</sup> | 31.3                      | 33.7                       | 31.3                     | 33.7                       |
| 5 W E12 Chandelier Replacing 40 W      | 34.5                      | 33.2                       | 34.5                     | 33.2                       |

<sup>37</sup> EPI now offers 4.5 W G25 lamps and not 7 W lamps. The tracked savings represent last year's unitary savings value for 7 W G25 lamps, whereas the evaluated savings show this year's unitary savings value for 4.5 W G25 lamps.

## 2024 EPI Tracked and Evaluated Unitary Energy Savings (Continued)

| Product                                                                                                                                                                                                                                                                                                                                            | EPI – Single-family Homes |                            | EPI – Apartments         |                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------|--------------------------|----------------------------|
|                                                                                                                                                                                                                                                                                                                                                    | Tracked Savings [kWh/yr]  | Evaluated Savings [kWh/yr] | Tracked Savings [kWh/yr] | Evaluated Savings [kWh/yr] |
| <b>Other Lighting Products</b>                                                                                                                                                                                                                                                                                                                     |                           |                            |                          |                            |
| Solar Security Fixtures                                                                                                                                                                                                                                                                                                                            | 478                       | 92.6                       | 478                      | 92.6                       |
| Dimmer Switches                                                                                                                                                                                                                                                                                                                                    | 17.0                      | 3.42                       | 17.0                     | 3.42                       |
| Indoor Motion Sensors                                                                                                                                                                                                                                                                                                                              | 45.8                      | 9.22                       | 45.8                     | 9.22                       |
| Outdoor Motion Sensors                                                                                                                                                                                                                                                                                                                             | 159                       | 19.7                       | 159                      | 19.7                       |
| <b>Air Sealing Products</b>                                                                                                                                                                                                                                                                                                                        |                           |                            |                          |                            |
| Foam Gaskets (electric resistance heating) *                                                                                                                                                                                                                                                                                                       | 90.0                      | 9.00                       | 90.0                     | 9.00                       |
| Foam Gaskets (heat pump heating) *                                                                                                                                                                                                                                                                                                                 | 40.9                      | 5.00                       | 40.9                     | 5.00                       |
| Door Sweeps (heat pump heating)                                                                                                                                                                                                                                                                                                                    | 78.6                      | 96.1                       | 78.6                     | 96.1                       |
| Window Air Sealing (electric resistance heating) *                                                                                                                                                                                                                                                                                                 | 149                       | 9.90                       | 149                      | 9.90                       |
| Window Air Sealing (heat pump heating) *                                                                                                                                                                                                                                                                                                           | 67.7                      | 5.50                       | 67.7                     | 5.50                       |
| Door Weather Stripping (electric resistance heating) *                                                                                                                                                                                                                                                                                             | 196                       | 11.5                       | 196                      | 11.5                       |
| Door Weather Stripping (heat pump heating) *                                                                                                                                                                                                                                                                                                       | 89.1                      | 6.39                       | 89.1                     | 6.39                       |
| Window Film Kits (electric resistance heating)                                                                                                                                                                                                                                                                                                     | 333                       | 334                        | 333                      | 334                        |
| Window Film Kits (heat pump heating)                                                                                                                                                                                                                                                                                                               | 151                       | 185                        | 151                      | 185                        |
| <b>Smart and Advanced Learning Thermostats</b>                                                                                                                                                                                                                                                                                                     |                           |                            |                          |                            |
| Smart Thermostats (for MSHPs)                                                                                                                                                                                                                                                                                                                      | 514                       | 564                        | 411                      | 535                        |
| Smart Thermostats (for electric baseboards)                                                                                                                                                                                                                                                                                                        | 348                       | 312                        | 278                      | 241                        |
| Smart Thermostats (for electric in-floor heating)                                                                                                                                                                                                                                                                                                  | 348                       | 312                        | 278                      | 241                        |
| Advanced Learning Thermostats (for central electric heating without a heat pump)                                                                                                                                                                                                                                                                   | 831                       | 2,030                      | -                        | -                          |
| Advanced Learning Thermostats (for central electric heating with a heat pump)                                                                                                                                                                                                                                                                      | 831                       | 1,128                      | -                        | -                          |
| <b>Other Products</b>                                                                                                                                                                                                                                                                                                                              |                           |                            |                          |                            |
| Humidity Sensors                                                                                                                                                                                                                                                                                                                                   | 79                        | 143                        | 79                       | 143                        |
| * Tracked unitary savings values for foam gaskets, window air sealing and door weather stripping were respectively per pack of 10, per 15 feet and per 17 feet, while evaluated unitary savings herein are per unit or per foot. This is only to reflect true unitary savings values and does not affect total savings claimed for these products. |                           |                            |                          |                            |

### 14.2.3 Unitary Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity demand peak period in Nova Scotia is between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays.

The Evaluator established unitary peak demand savings for each product based on the peak demand-to-energy ratios presented in the 2024-2025 DSM MA. Differences between tracked and evaluated peak demand savings reflect updates made to the unitary energy savings of certain products.

Table 29 summarizes the tracked and evaluated unitary peak demand savings for each product installed through EPI and for which the unitary peak demand savings were changed in 2024.

**Table 29: 2024 EPI Updated Tracked and Evaluated Unitary Peak Demand Savings Values**

| Product                    | EPI – Single-family Homes |                          | EPI – Apartments       |                          |
|----------------------------|---------------------------|--------------------------|------------------------|--------------------------|
|                            | Tracked Savings [W/yr]    | Evaluated Savings [W/yr] | Tracked Savings [W/yr] | Evaluated Savings [W/yr] |
| <b>LED Lamps</b>           |                           |                          |                        |                          |
| 9 W Replacing 25 W         | 2.56                      | 2.46                     | 2.56                   | 2.46                     |
| 9 W Replacing 29 W         | 3.19                      | 3.08                     | 3.19                   | 3.08                     |
| 9 W Replacing 40 W         | 4.96                      | 4.76                     | 4.96                   | 4.76                     |
| 9 W Replacing 43 W         | 5.43                      | 5.23                     | 5.43                   | 5.23                     |
| 9 W Replacing 60 W         | 8.15                      | 7.84                     | 8.15                   | 7.84                     |
| 9 W Replacing 72 W         | 10.1                      | 9.69                     | 10.1                   | 9.69                     |
| 9 W Replacing 100 W        | 14.5                      | 14.0                     | 14.5                   | 14.0                     |
| 9 W Replacing 150 W        | 22.5                      | 21.7                     | 22.5                   | 21.7                     |
| 9.5 W Replacing 25 W       | 2.50                      | 2.38                     | 2.50                   | 2.38                     |
| 9.5 W Replacing 29 W       | 3.11                      | 3.00                     | 3.11                   | 3.00                     |
| 9.5 W Replacing 40 W       | 4.88                      | 4.68                     | 4.88                   | 4.68                     |
| 9.5 W Replacing 43 W       | 5.35                      | 5.15                     | 5.35                   | 5.15                     |
| 9.5 W Replacing 60 W       | 8.07                      | 7.76                     | 8.07                   | 7.76                     |
| 9.5 W Replacing 72 W       | 9.98                      | 9.61                     | 9.98                   | 9.61                     |
| 9.5 W Replacing 100 W      | 14.5                      | 13.9                     | 14.5                   | 13.9                     |
| 9.5 W Replacing 150 W      | 22.4                      | 21.5                     | 22.4                   | 21.5                     |
| 18 W Replacing 75 W        | 9.10                      | 8.76                     | 9.10                   | 8.76                     |
| 18 W Replacing 100 W       | 13.1                      | 12.6                     | 13.1                   | 12.6                     |
| PAR20 7 W Replacing 50 W   | 6.87                      | 6.61                     | 6.87                   | 6.61                     |
| PAR38 15 W Replacing 90 W  | 12.0                      | 11.5                     | 12.0                   | 11.5                     |
| PAR38 15 W Replacing 120 W | 16.7                      | 16.1                     | 16.7                   | 16.1                     |
| PAR38 15 W Replacing 150 W | 21.5                      | 20.7                     | 21.5                   | 20.7                     |
| GU10 7 W Replacing 35 W    | 4.47                      | 4.31                     | 4.47                   | 4.31                     |



| Product                                                                          | EPI – Single-family Homes |                          | EPI – Apartments       |                          |
|----------------------------------------------------------------------------------|---------------------------|--------------------------|------------------------|--------------------------|
|                                                                                  | Tracked Savings [W/yr]    | Evaluated Savings [W/yr] | Tracked Savings [W/yr] | Evaluated Savings [W/yr] |
| GU10 7 W Replacing 50 W                                                          | 6.87                      | 6.61                     | 6.87                   | 6.61                     |
| 4.5 W G25 Replacing 40 W                                                         | -                         | 5.46                     | -                      | 5.46                     |
| 5 W E12 Chandelier Replacing 40 W                                                | 5.59                      | 5.38                     | 5.59                   | 5.38                     |
| <b>Other Lighting Products</b>                                                   |                           |                          |                        |                          |
| Solar Security Fixtures                                                          | 77.4                      | 15.0                     | 77.4                   | 15.0                     |
| Dimmer Switches                                                                  | 2.75                      | 0.554                    | 2.75                   | 0.554                    |
| Indoor Motion Sensors                                                            | -                         | -                        | -                      | -                        |
| Outdoor Motion Sensors                                                           | -                         | -                        | -                      | -                        |
| <b>Air Sealing Products</b>                                                      |                           |                          |                        |                          |
| Foam Gaskets (electric resistance heating)                                       | 25.5                      | 2.55                     | 25.5                   | 2.55                     |
| Foam Gaskets (heat pump heating)                                                 | 11.6                      | 1.42                     | 11.6                   | 1.42                     |
| Door Sweeps (heat pump heating)                                                  | 22.2                      | 27.2                     | 22.2                   | 27.2                     |
| Window Air Sealing (electric resistance heating)                                 | 42.2                      | 2.80                     | 42.2                   | 2.80                     |
| Window Air Sealing (heat pump heating)                                           | 19.2                      | 1.56                     | 19.2                   | 1.56                     |
| Door Weather Stripping (electric resistance heating)                             | 55.5                      | 3.25                     | 55.5                   | 3.25                     |
| Door Weather Stripping (heat pump heating)                                       | 25.2                      | 1.81                     | 25.2                   | 1.81                     |
| Window Film Kits (electric resistance heating)                                   | 94.2                      | 94.5                     | 94.2                   | 94.5                     |
| Window Film Kits (heat pump heating)                                             | 42.7                      | 52.4                     | 42.7                   | 52.4                     |
| <b>Smart and Advanced Learning Thermostats</b>                                   |                           |                          |                        |                          |
| Advanced Learning Thermostats (for central electric heating without a heat pump) | -                         | -                        | -                      | -                        |
| Advanced Learning Thermostats (for central electric heating with a heat pump)    | -                         | -                        | -                      | -                        |
| <b>Other Products</b>                                                            |                           |                          |                        |                          |
| Humidity Sensors                                                                 | 12.8                      | 14.3                     | 12.8                   | 14.3                     |

### 14.2.4 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency products has an impact on the energy consumption of other elements such as heating and cooling. In the case of EPI, replacing lighting products with LEDs causes an increase in the heating load during winter and a decrease in the cooling load during summer. The same effects occur for hot water insulation products.

For the 2024 evaluation, the Evaluator relied on the interactive effects factors presented in the 2024-2025 DSM MA. For each entry in the EPI tracking sheet, energy and peak demand interactive effects factors were determined based on product type, location, and home type and were applied to the unitary energy and peak demand savings values.

### 14.2.5 Adjustment Ratio

As part of the 2019 evaluation, the Evaluator conducted on-site visits (n = 28) to establish an overview of the types of lamps used in homes and verify that replaced A-type lamps were properly tracked. The on-site visit results indicated that there were certain discrepancies in tracked savings.

Comparing the revised savings to tracked savings, the Evaluator determined an adjustment ratio of 96% with a margin of error of 5%. In an effort to track the wattages of replaced A-type lamps more accurately, E1 introduced new product categories to include a larger range of wattages. In 2024, 1,010 LED lamps were tracked under those new categories, which represent about 1% of LED A-type lamps installed under EPI.

No data collection aimed at updating the adjustment ratio was conducted in 2024. Therefore, given the low number of LED lamps tracked under the new categories, as was the case in the 2019 evaluation, this adjustment ratio was applied to the tracked savings for A-type incandescent lamp replacements to correct for observed discrepancies in tracked replaced lamps.

### 14.2.6 Effective Useful Life

As part of the 2024-2025 DSM MA activities, the Evaluator reviewed the EUL values used in the calculation of electrical energy savings that are expected to persist over time. Apart from lighting products, the EUL values established in the 2023 evaluation remained valid for the 2024 evaluation. For lighting products, EUL values were updated since baseline changes are anticipated during the measure lifetimes due to the rapid evolution of the LED market driven in part by government regulations. Appendix II of the 2024-2025 DSM MA details the baseline changes and the rationale for the calculation of equivalent EUL values.

Table 30 below summarizes the tracked and revised equivalent EUL values. The revised equivalent EUL values are applied to each product gross and net first-year electrical energy savings to obtain gross and net lifetime electrical energy savings. As a result, the weighted average EUL values of gross and net savings differ (see Subsections 14.2.7 and 14.3.4 below). Table 30 also presents the evaluated gross lifetime unitary savings. The measures in Table 30 are only those for which the equivalent EUL values were changed in 2024.

**Table 30: 2024 EPI Equivalent EUL and Gross Lifetime Unitary Savings Values**

| Product              | Tracked<br>Equivalent EUL<br>[years] | Evaluated<br>Equivalent EUL<br>[years] | Evaluated Gross Lifetime<br>Unitary Savings [kWh] |
|----------------------|--------------------------------------|----------------------------------------|---------------------------------------------------|
| <b>LED A19 Lamps</b> |                                      |                                        |                                                   |
| 9 W Replacing 25 W   | 2.0                                  | 1.0                                    | 15.2                                              |
| 9 W Replacing 29 W   | 2.0                                  | 1.0                                    | 19.0                                              |
| 9 W Replacing 40 W   | 1.6                                  | 1.0                                    | 29.4                                              |
| 9 W Replacing 43 W   | 2.0                                  | 1.0                                    | 32.3                                              |
| 9 W Replacing 60 W   | 1.7                                  | 1.0                                    | 48.4                                              |
| 9 W Replacing 72 W   | 2.0                                  | 1.0                                    | 59.8                                              |
| 9 W Replacing 100 W  | 1.7                                  | 1.0                                    | 86.4                                              |
| 9 W Replacing 150 W  | 1.4                                  | 1.0                                    | 134                                               |
| 9.5 W Replacing 25 W | 2.0                                  | 1.0                                    | 14.7                                              |
| 9.5 W Replacing 29 W | 2.0                                  | 1.0                                    | 18.5                                              |



| Product                                                                             | Tracked<br>Equivalent EUL<br>[years] | Evaluated<br>Equivalent EUL<br>[years] | Evaluated Gross Lifetime<br>Unitary Savings [kWh] |
|-------------------------------------------------------------------------------------|--------------------------------------|----------------------------------------|---------------------------------------------------|
| 9.5 W Replacing 40 W                                                                | 1.6                                  | 1.0                                    | 28.9                                              |
| 9.5 W Replacing 43 W                                                                | 2.0                                  | 1.0                                    | 31.8                                              |
| 9.5 W Replacing 60 W                                                                | 1.7                                  | 1.0                                    | 47.9                                              |
| 9.5 W Replacing 72 W                                                                | 2.0                                  | 1.0                                    | 59.3                                              |
| 9.5 W Replacing 100 W                                                               | 1.7                                  | 1.0                                    | 85.9                                              |
| 9.5 W Replacing 150 W                                                               | 1.4                                  | 1.0                                    | 133                                               |
| 18 W Replacing 75 W                                                                 | 2.0                                  | 1.0                                    | 54.1                                              |
| 18 W Replacing 100 W                                                                | 1.9                                  | 1.0                                    | 77.8                                              |
| <b>LED Reflector Lamps</b>                                                          |                                      |                                        |                                                   |
| PAR20 7 W Replacing 50 W                                                            | 2.0                                  | 1.0                                    | 40.8                                              |
| PAR38 15 W Replacing 90 W                                                           | 2.0                                  | 1.0                                    | 71.2                                              |
| PAR38 15 W Replacing 120 W                                                          | 2.0                                  | 1.0                                    | 99.6                                              |
| PAR38 15 W Replacing 150 W                                                          | 2.0                                  | 1.0                                    | 128                                               |
| GU10 7 W Replacing 35 W                                                             | 2.0                                  | 1.0                                    | 26.6                                              |
| GU10 7 W Replacing 50 W                                                             | 2.0                                  | 1.0                                    | 40.8                                              |
| <b>LED Decorative Lamps</b>                                                         |                                      |                                        |                                                   |
| 4.5 W G25 Replacing 40 W                                                            | 2.0                                  | 1.0                                    | 33.7                                              |
| 5 W Chandelier E12 Replacing 40 W                                                   | 2.0                                  | 1.0                                    | 33.2                                              |
| <b>Other Lighting Products</b>                                                      |                                      |                                        |                                                   |
| LED Nightlights                                                                     | 23                                   | 1.0                                    | 29.3                                              |
| Solar Security Fixtures                                                             | 2.6                                  | 2.5                                    | 232                                               |
| Dimmer Switches                                                                     | 10                                   | 10                                     | 34.2                                              |
| Indoor Motion Sensors                                                               | 10                                   | 10                                     | 92.2                                              |
| Outdoor Motion Sensors                                                              | 10                                   | 10                                     | 197                                               |
| <b>Smart and Advanced Learning Thermostats</b>                                      |                                      |                                        |                                                   |
| Advanced Learning Thermostats<br>(for central electric heating without a heat pump) | 10                                   | 10                                     | 20,300                                            |
| Advanced Learning Thermostats<br>(for central electric heating with a heat pump)    | 10                                   | 10                                     | 11,280                                            |
| <b>Other Products</b>                                                               |                                      |                                        |                                                   |
| Humidity Sensors                                                                    | 19                                   | 9.5                                    | 1,359                                             |





### 14.2.7 Evaluated Gross Savings

Table 31 and Table 32 below present the annual gross savings results per product category and dwelling for the main EPI offering, including the smart thermostat for electric baseboard pilot measure. Table 33 further below presents the breakdown of savings results for apartments, single-family homes, and EPI as a whole.

Overall, total gross energy and peak demand savings amounted to 9.093 GWh and 0.898 MW at the generator respectively, which represent 52.872 GWh in lifetime electrical energy savings. As a result, the weighted average EUL value for gross electrical energy savings was established at 5.8 years.

The gross savings at the generator were estimated using the appropriate line loss factors for each participant based on their rate code. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>38</sup>

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<sup>38</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1. For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed. If a municipal utility participant did not have a specific rate code, the average of participants for which the line loss was known was used.



**Table 31: Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes**

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LED Lamps     |        |        |        |        |        |        |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|--------|--------|--------|--------|--------|--------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 9 W Replacing |        |        |        |        |        |        |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 25 W          | 29 W   | 40 W   | 43 W   | 60 W   | 72 W   | 100 W  | 150 W  |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |        |        |        |        |        |        |        |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1,293         | 364    | 16,217 | 432    | 47,911 | 183    | 3,173  | 4      |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 94%           | 94%    | 94%    | 94%    | 94%    | 94%    | 94%    | 94%    |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1,215         | 342    | 15,244 | 406    | 45,036 | 172    | 2,983  | 4      |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |        |        |        |        |        |        |        |
| Unitary Energy Savings (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                             | 15.2          | 19.0   | 29.4   | 32.3   | 48.4   | 59.8   | 86.4   | 134    |
| Energy Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                       | -18.6%        | -17.7% | -19.6% | -16.8% | -19.3% | -17.6% | -17.3% | -5.5%  |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960         | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.014         | 0.005  | 0.346  | 0.010  | 1.689  | 0.008  | 0.205  | 0.000  |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947        | 1.0947 | 1.0947 | 1.0947 | 1.0947 | 1.0947 | 1.0947 | 1.0947 |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.016         | 0.006  | 0.378  | 0.011  | 1.849  | 0.009  | 0.224  | 0.000  |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.0           | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.016         | 0.006  | 0.378  | 0.011  | 1.849  | 0.009  | 0.224  | 0.000  |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |        |        |        |        |        |        |        |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2.46          | 3.08   | 4.76   | 5.23   | 7.84   | 9.69   | 14.0   | 21.7   |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -46.4%        | -46.8% | -49.1% | -45.9% | -50.4% | -46.8% | -42.2% | -21.8% |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960         | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.002         | 0.001  | 0.035  | 0.001  | 0.168  | 0.001  | 0.023  | 0.000  |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466        | 1.1466 | 1.1466 | 1.1466 | 1.1465 | 1.1466 | 1.1466 | 1.1466 |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.002         | 0.001  | 0.041  | 0.001  | 0.193  | 0.001  | 0.027  | 0.000  |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |               |        |        |        |        |        |        |        |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LED Lamps            |                          |                           |                            |                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------|---------------------------|----------------------------|----------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 18 W Replacing 100 W | PAR20 7 W Replacing 50 W | PAR38 15 W Replacing 90 W | PAR38 15 W Replacing 120 W | PAR38 15 W Replacing 150 W |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                      |                          |                           |                            |                            |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1,031                | 4,260                    | 362                       | 98                         | 1,286                      |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 94%                  | 94%                      | 94%                       | 94%                        | 94%                        |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 969                  | 4,004                    | 340                       | 92                         | 1,209                      |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |                          |                           |                            |                            |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 77.8                 | 40.8                     | 71.2                      | 99.6                       | 128                        |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -21.1%               | -21.3%                   | -                         | -                          | -                          |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960                | 1.000                    | 1.000                     | 1.000                      | 1.000                      |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.057                | 0.129                    | 0.024                     | 0.009                      | 0.155                      |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947               | 1.0947                   | 1.0947                    | 1.0947                     | 1.0947                     |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.062                | 0.141                    | 0.027                     | 0.010                      | 0.169                      |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.0                  | 1.0                      | 1.0                       | 1.0                        | 1.0                        |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.062                | 0.141                    | 0.027                     | 0.010                      | 0.169                      |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      |                          |                           |                            |                            |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 12.6                 | 6.61                     | 11.5                      | 16.1                       | 20.7                       |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -55.9%               | -59.2%                   | -                         | -                          | -                          |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960                | 1.000                    | 1.000                     | 1.000                      | 1.000                      |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.005                | 0.011                    | 0.004                     | 0.001                      | 0.025                      |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466               | 1.1466                   | 1.1466                    | 1.1466                     | 1.1466                     |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.006                | 0.012                    | 0.004                     | 0.002                      | 0.029                      |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                      |                          |                           |                            |                            |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LED Lamps   |                            |                            |                             |                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------|----------------------------|-----------------------------|-----------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nightlights | GU10 7 W<br>Replacing 35 W | GU10 7 W<br>Replacing 50 W | G25 4.5 W<br>Replacing 40 W | E12 5 W<br>Chandelier<br>Replacing 40 W |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                            |                            |                             |                                         |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 11,093      | 720                        | 3,430                      | 3,399                       | 11,146                                  |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 94%         | 94%                        | 94%                        | 94%                         | 94%                                     |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10,427      | 677                        | 3,224                      | 3,195                       | 10,477                                  |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                            |                            |                             |                                         |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 29.3        | 26.6                       | 40.8                       | 33.7                        | 33.2                                    |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -21.6%      | -23.0%                     | -22.1%                     | -22.0%                      | -20.8%                                  |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000       | 1.000                      | 1.000                      | 1.000                       | 1.000                                   |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.240       | 0.014                      | 0.103                      | 0.084                       | 0.275                                   |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947      | 1.0947                     | 1.0947                     | 1.0947                      | 1.0947                                  |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.262       | 0.015                      | 0.112                      | 0.092                       | 0.301                                   |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.0         | 1.0                        | 1.0                        | 1.0                         | 1.0                                     |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.262       | 0.015                      | 0.112                      | 0.092                       | 0.301                                   |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |                            |                             |                                         |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4.75        | 4.31                       | 6.61                       | 5.46                        | 5.38                                    |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -58.9%      | -63.9%                     | -63.4%                     | -55.8%                      | -55.8%                                  |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000       | 1.000                      | 1.000                      | 1.000                       | 1.000                                   |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.020       | 0.001                      | 0.008                      | 0.008                       | 0.025                                   |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1465      | 1.1466                     | 1.1465                     | 1.1466                      | 1.1466                                  |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.023       | 0.001                      | 0.009                      | 0.009                       | 0.029                                   |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |             |                            |                            |                             |                                         |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Faucet Aerators | Thermostatic Shower Valves 2.5 gpm | Low-flow Showerheads |                    |                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------|----------------------|--------------------|-------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                                    | 0.5 gpm Reduction    | 0.75 gpm Reduction | 1.0 gpm Reduction |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                                    |                      |                    |                   |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3,892           | 329                                | 325                  | 183                | 1,995             |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 92%             | 89%                                | 95%                  | 95%                | 95%               |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3,581           | 293                                | 309                  | 174                | 1,895             |
| Energy Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                    |                      |                    |                   |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 118             | 124                                | 197                  | 296                | 395               |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -               | -                                  | -                    | -                  | -                 |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000           | 1.000                              | 1.000                | 1.000              | 1.000             |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.423           | 0.036                              | 0.061                | 0.051              | 0.749             |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947          | 1.0947                             | 1.0947               | 1.0947             | 1.0947            |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.463           | 0.040                              | 0.067                | 0.056              | 0.820             |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10.0            | 10.0                               | 10.0                 | 10.0               | 10.0              |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 4.625           | 0.397                              | 0.666                | 0.563              | 8.195             |
| Peak Demand Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                                    |                      |                    |                   |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 19.1            | 20.1                               | 31.9                 | 48.0               | 64.0              |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -               | -                                  | -                    | -                  | -                 |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000           | 1.000                              | 1.000                | 1.000              | 1.000             |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.068           | 0.006                              | 0.010                | 0.008              | 0.121             |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1465          | 1.1466                             | 1.1465               | 1.1466             | 1.1466            |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.078           | 0.007                              | 0.011                | 0.010              | 0.139             |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                 |                                    |                      |                    |                   |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Pipe<br>Insulation<br>(per foot) | Hot Water<br>Tank Wraps | Smart<br>Thermostats<br>for Electric<br>Baseboards | Smart<br>Thermostats<br>for MSHPs | Advanced<br>Learning<br>Thermostats for<br>Central Electric<br>Heating without<br>a Heat Pump | Advanced<br>Learning<br>Thermostats for<br>Central Electric<br>Heating with a<br>Heat Pump |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------|----------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                  |                         |                                                    |                                   |                                                                                               |                                                                                            |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>10,840</b>                    | <b>1,362</b>            | <b>1,887</b>                                       | <b>3,482</b>                      | <b>16</b>                                                                                     | <b>10</b>                                                                                  |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 100%                             | 100%                    | 100%                                               | 84%                               | 100%                                                                                          | 100%                                                                                       |
| <b>Number of Units Installed</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>10,840</b>                    | <b>1,362</b>            | <b>1,887</b>                                       | <b>2,925</b>                      | <b>16</b>                                                                                     | <b>10</b>                                                                                  |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |                         |                                                    |                                   |                                                                                               |                                                                                            |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 12.7                             | 157                     | 312                                                | 564                               | 2,030                                                                                         | 1,128                                                                                      |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -11.9%                           | -13.3%                  | 0.0%                                               | 0.0%                              | 0.0%                                                                                          | 0.0%                                                                                       |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                            | 1.000                   | 1.000                                              | 1.000                             | 1.000                                                                                         | 1.000                                                                                      |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>0.121</b>                     | <b>0.185</b>            | <b>0.589</b>                                       | <b>1.650</b>                      | <b>0.032</b>                                                                                  | <b>0.011</b>                                                                               |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947                           | 1.0947                  | 1.0947                                             | 1.0947                            | 1.0947                                                                                        | 1.0947                                                                                     |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.133</b>                     | <b>0.203</b>            | <b>0.644</b>                                       | <b>1.806</b>                      | <b>0.036</b>                                                                                  | <b>0.012</b>                                                                               |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 13.0                             | 7.0                     | 10.0                                               | 10.0                              | 10.0                                                                                          | 10.0                                                                                       |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>1.727</b>                     | <b>1.421</b>            | <b>6.445</b>                                       | <b>18.059</b>                     | <b>0.356</b>                                                                                  | <b>0.123</b>                                                                               |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                  |                         |                                                    |                                   |                                                                                               |                                                                                            |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2.06                             | 25.4                    | -                                                  | -                                 | -                                                                                             | -                                                                                          |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -56.5%                           | -62.6%                  | -                                                  | -                                 | -                                                                                             | -                                                                                          |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                            | 1.000                   | 1.000                                              | 1.000                             | 1.000                                                                                         | 1.000                                                                                      |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.010</b>                     | <b>0.013</b>            | <b>-</b>                                           | <b>-</b>                          | <b>-</b>                                                                                      | <b>-</b>                                                                                   |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466                           | 1.1466                  | -                                                  | -                                 | -                                                                                             | -                                                                                          |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>0.011</b>                     | <b>0.015</b>            | <b>-</b>                                           | <b>-</b>                          | <b>-</b>                                                                                      | <b>-</b>                                                                                   |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                                  |                         |                                                    |                                   |                                                                                               |                                                                                            |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Consumer Electronics and Accessory Lighting |                       |                        |                 |                  |                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------|------------------------|-----------------|------------------|-------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Solar Security Fixtures                     | Indoor Motion Sensors | Outdoor Motion Sensors | Dimmer Switches | Humidity Sensors | Smart Power Controllers |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |                       |                        |                 |                  |                         |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>592</b>                                  | <b>631</b>            | <b>250</b>             | <b>1,646</b>    | <b>557</b>       | <b>205</b>              |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 100%                                        | 100%                  | 100%                   | 100%            | 100%             | 100%                    |
| <b>Number of Units Installed</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>592</b>                                  | <b>631</b>            | <b>250</b>             | <b>1,646</b>    | <b>557</b>       | <b>205</b>              |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                       |                        |                 |                  |                         |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 92.6                                        | 9.22                  | 19.7                   | 3.42            | 143              | 207                     |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                                           | -33.3%                | -                      | -33.2%          | -                | -                       |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                       | 1.000                 | 1.000                  | 1.000           | 1.000            | 1.000                   |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>0.055</b>                                | <b>0.004</b>          | <b>0.005</b>           | <b>0.004</b>    | <b>0.080</b>     | <b>0.042</b>            |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947                                      | 1.0947                | 1.0947                 | 1.0947          | 1.0947           | 1.0947                  |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.060</b>                                | <b>0.004</b>          | <b>0.005</b>           | <b>0.004</b>    | <b>0.087</b>     | <b>0.046</b>            |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.5                                         | 10.0                  | 10.0                   | 10.0            | 9.5              | 4.0                     |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>0.150</b>                                | <b>0.043</b>          | <b>0.054</b>           | <b>0.041</b>    | <b>0.828</b>     | <b>0.186</b>            |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                             |                       |                        |                 |                  |                         |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 15.0                                        | -                     | -                      | 0.554           | 14.3             | -                       |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                           | -                     | -                      | -76.7%          | -                | -                       |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                       | 1.000                 | 1.000                  | 1.000           | 1.000            | 1.000                   |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.009</b>                                | <b>-</b>              | <b>-</b>               | <b>0.000</b>    | <b>0.008</b>     | <b>-</b>                |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466                                      | -                     | -                      | 1.1466          | 1.1466           | -                       |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>0.010</b>                                | <b>-</b>              | <b>-</b>               | <b>0.000</b>    | <b>0.009</b>     | <b>-</b>                |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                                             |                       |                        |                 |                  |                         |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Air Sealing Products – Electric Resistance Heating |              |                                      |                     |                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--------------|--------------------------------------|---------------------|------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Foam Gaskets<br>(per pack of 10)                   | Door Sweeps  | Window Air<br>Sealing (per<br>15 ft) | Window Film<br>Kits | Door<br>Weather Stripping<br>(per 17 ft) |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                    |              |                                      |                     |                                          |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1,217                                              | 9            | 85                                   | 661                 | 126                                      |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 29%                                                | 100%         | 84%                                  | 57%                 | 84%                                      |
| <b>Number of Units Installed</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>353</b>                                         | <b>9</b>     | <b>71</b>                            | <b>377</b>          | <b>106</b>                               |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                    |              |                                      |                     |                                          |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 90.0                                               | 173          | 149                                  | 334                 | 196                                      |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                                                  | -            | -                                    | -                   | -                                        |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                              | 1.000        | 1.000                                | 1.000               | 1.000                                    |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>0.032</b>                                       | <b>0.002</b> | <b>0.011</b>                         | <b>0.126</b>        | <b>0.021</b>                             |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947                                             | 1.0947       | 1.0947                               | 1.0947              | 1.0947                                   |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.035</b>                                       | <b>0.002</b> | <b>0.012</b>                         | <b>0.138</b>        | <b>0.023</b>                             |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 15.0                                               | 15.0         | 15.0                                 | 1.0                 | 15.0                                     |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>0.522</b>                                       | <b>0.026</b> | <b>0.175</b>                         | <b>0.138</b>        | <b>0.341</b>                             |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                    |              |                                      |                     |                                          |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 25.5                                               | 49.0         | 42.2                                 | 94.5                | 55.5                                     |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                                  | -            | -                                    | -                   | -                                        |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                              | 1.000        | 1.000                                | 1.000               | 1.000                                    |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.009</b>                                       | <b>0.000</b> | <b>0.003</b>                         | <b>0.036</b>        | <b>0.006</b>                             |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466                                             | 1.1466       | 1.1466                               | 1.1466              | 1.1466                                   |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>0.010</b>                                       | <b>0.001</b> | <b>0.003</b>                         | <b>0.041</b>        | <b>0.007</b>                             |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                                                    |              |                                      |                     |                                          |



## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Single-family Homes (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Air Sealing Products – Heat Pump Heating |             |                               |                  |                                    | Total for Single-family Homes |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|-------------------------------|------------------|------------------------------------|-------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Foam Gaskets (per pack of 10)            | Door Sweeps | Window Air Sealing (per 15ft) | Window Film Kits | Door Weather Stripping (per 17 ft) |                               |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                          |             |                               |                  |                                    |                               |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4,726                                    | 63          | 229                           | 1,908            | 517                                | 144,145                       |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 29%                                      | 100%        | 84%                           | 57%              | 84%                                | 91%                           |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1,371                                    | 63          | 192                           | 1,088            | 434                                | 131,253                       |
| Energy Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |             |                               |                  |                                    |                               |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 50.0                                     | 96.1        | 82.8                          | 185              | 109                                | -                             |
| Interactive Effects Factor                                                                                                                                                                                                                                                                                                                                                                                                                                               | -                                        | -           | -                             | -                | -                                  | -                             |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                    | 1.000       | 1.000                         | 1.000            | 1.000                              | -                             |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.069                                    | 0.006       | 0.016                         | 0.201            | 0.047                              | 7.995                         |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947                                   | 1.0947      | 1.0947                        | 1.0947           | 1.0947                             | 1.0947                        |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.075                                    | 0.007       | 0.017                         | 0.220            | 0.052                              | 8.752                         |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 15.0                                     | 15.0        | 15.0                          | 1.0              | 15.0                               | 5.86                          |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 1.125                                    | 0.099       | 0.262                         | 0.220            | 0.777                              | 51.249                        |
| Peak Demand Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                          |             |                               |                  |                                    |                               |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 14.2                                     | 27.2        | 23.4                          | 52.4             | 30.8                               | -                             |
| Peak Demand Interactive Effects Factor                                                                                                                                                                                                                                                                                                                                                                                                                                   | -                                        | -           | -                             | -                | -                                  | -                             |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                    | 1.000       | 1.000                         | 1.000            | 1.000                              | -                             |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.019                                    | 0.002       | 0.005                         | 0.057            | 0.013                              | 0.743                         |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1465                                   | 1.1466      | 1.1466                        | 1.1465           | 1.1466                             | 1.1466                        |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.022                                    | 0.002       | 0.005                         | 0.065            | 0.015                              | 0.851                         |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                                          |             |                               |                  |                                    |                               |

**Table 32: Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure – Apartments**

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LED Lamps     |        |        |        |        |        |        |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|--------|--------|--------|--------|--------|-------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 9 W Replacing |        |        |        |        |        |        |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 25 W          | 29 W   | 40 W   | 43 W   | 60 W   | 72 W   | 100 W  | 150 W |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |        |        |        |        |        |        |       |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 39            | 13     | 493    | 16     | 2,799  | 2      | 52     | -     |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 94%           | 94%    | 94%    | 94%    | 94%    | 94%    | 94%    | 94%   |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 37            | 12     | 463    | 15     | 2,631  | 2      | 49     | -     |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |               |        |        |        |        |        |        |       |
| Unitary Energy Savings (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                             | 15.2          | 19.0   | 29.4   | 32.3   | 48.4   | 59.8   | 86.4   | 134   |
| Energy Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                       | -37.8%        | -16.4% | -34.0% | -19.6% | -12.5% | -40.7% | -41.4% | -     |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960         | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960 |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.000         | 0.000  | 0.009  | 0.000  | 0.107  | 0.000  | 0.002  | -     |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947        | 1.0947 | 1.0945 | 1.0947 | 1.0739 | 1.0947 | 1.0906 | -     |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.000         | 0.000  | 0.009  | 0.000  | 0.115  | 0.000  | 0.003  | -     |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.0           | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    | 1.0    | 1.0   |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.000         | 0.000  | 0.009  | 0.000  | 0.115  | 0.000  | 0.003  | -     |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |               |        |        |        |        |        |        |       |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2.46          | 3.08   | 4.76   | 5.23   | 7.84   | 9.69   | 14.0   | 21.7  |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -62.7%        | -33.6% | -61.1% | -38.2% | -24.8% | -87.3% | -72.2% | -     |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960         | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960  | 0.960 |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.000         | 0.000  | 0.001  | 0.000  | 0.015  | 0.000  | 0.000  | -     |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466        | 1.1466 | 1.1463 | 1.1466 | 1.0882 | 1.1466 | 1.1406 | -     |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.000         | 0.000  | 0.001  | 0.000  | 0.016  | 0.000  | 0.000  | -     |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |               |        |        |        |        |        |        |       |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure – Apartments (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LED Lamps            |                          |                           |                            |                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------------|---------------------------|----------------------------|----------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 18 W Replacing 100 W | PAR20 7 W Replacing 50 W | PAR38 15 W Replacing 90 W | PAR38 15 W Replacing 120 W | PAR38 15 W Replacing 150 W |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                      |                          |                           |                            |                            |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 56                   | 35                       | -                         | -                          | -                          |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 94%                  | 94%                      | 94%                       | 94%                        | 94%                        |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 53                   | 33                       | -                         | -                          | -                          |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |                          |                           |                            |                            |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 77.8                 | 40.8                     | 71.2                      | 99.6                       | 128                        |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -21.6%               | -29.5%                   | -                         | -                          | -                          |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960                | 1.000                    | 1.000                     | 1.000                      | 1.000                      |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.003                | 0.001                    | -                         | -                          | -                          |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947               | 1.0946                   | -                         | -                          | -                          |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.003                | 0.001                    | -                         | -                          | -                          |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.0                  | 1.0                      | 1.0                       | 1.0                        | 1.0                        |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.003                | 0.001                    | -                         | -                          | -                          |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                      |                          |                           |                            |                            |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 12.6                 | 6.61                     | 11.5                      | 16.1                       | 20.7                       |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -34.3%               | -51.4%                   | -                         | -                          | -                          |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.960                | 1.000                    | 1.000                     | 1.000                      | 1.000                      |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.000                | 0.000                    | -                         | -                          | -                          |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466               | 1.1463                   | -                         | -                          | -                          |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.000                | 0.000                    | -                         | -                          | -                          |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                      |                          |                           |                            |                            |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure – Apartments (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | LED Lamps   |                            |                            |                             |                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------|----------------------------|-----------------------------|--------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Nightlights | GU10 7 W<br>Replacing 35 W | GU10 7 W<br>Replacing 50 W | G25 4.5 W<br>Replacing 40 W | E12 5 W Chandelier<br>Replacing 40 W |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |             |                            |                            |                             |                                      |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1,028       | 6                          | 43                         | 485                         | 337                                  |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 94%         | 94%                        | 94%                        | 94%                         | 94%                                  |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 966         | 6                          | 40                         | 456                         | 317                                  |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |             |                            |                            |                             |                                      |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 29.3        | 26.6                       | 40.8                       | 33.7                        | 33.2                                 |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -11.3%      | -58.0%                     | -43.5%                     | -7.1%                       | -20.4%                               |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000       | 1.000                      | 1.000                      | 1.000                       | 1.000                                |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.025       | 0.000                      | 0.001                      | 0.014                       | 0.008                                |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0718      | 1.0947                     | 1.0947                     | 1.0682                      | 1.0758                               |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.027       | 0.000                      | 0.001                      | 0.015                       | 0.009                                |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.0         | 1.0                        | 1.0                        | 1.0                         | 1.0                                  |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.027       | 0.000                      | 0.001                      | 0.015                       | 0.009                                |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |             |                            |                            |                             |                                      |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4.75        | 4.31                       | 6.61                       | 5.46                        | 5.38                                 |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -21.7%      | -90.0%                     | -83.7%                     | -12.4%                      | -38.5%                               |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000       | 1.000                      | 1.000                      | 1.000                       | 1.000                                |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.004       | 0.000                      | 0.000                      | 0.002                       | 0.001                                |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0840      | 1.1466                     | 1.1466                     | 1.0784                      | 1.0875                               |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.004       | 0.000                      | 0.000                      | 0.002                       | 0.001                                |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |             |                            |                            |                             |                                      |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure – Apartments (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Faucet Aerators | Thermostatic Shower Valves 2.5 gpm | Low-flow Showerheads |                    |                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------|----------------------|--------------------|-------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                                    | 0.5 gpm Reduction    | 0.75 gpm Reduction | 1.0 gpm Reduction |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                 |                                    |                      |                    |                   |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 205             | 3                                  | 24                   | 11                 | 78                |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 92%             | 89%                                | 95%                  | 95%                | 95%               |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 189             | 3                                  | 23                   | 10                 | 74                |
| Energy Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |                                    |                      |                    |                   |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 128             | 141                                | 225                  | 338                | 450               |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -               | -                                  | -                    | -                  | -                 |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000           | 1.000                              | 1.000                | 1.000              | 1.000             |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.024           | 0.000                              | 0.005                | 0.004              | 0.033             |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0940          | 1.0947                             | 1.0947               | 1.0947             | 1.0947            |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.026           | 0.000                              | 0.006                | 0.004              | 0.037             |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10.0            | 10.0                               | 10.0                 | 10.0               | 10.0              |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.264           | 0.004                              | 0.056                | 0.039              | 0.365             |
| Peak Demand Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                 |                                    |                      |                    |                   |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 20.7            | 22.8                               | 36.5                 | 54.8               | 72.9              |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -               | -                                  | -                    | -                  | -                 |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000           | 1.000                              | 1.000                | 1.000              | 1.000             |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.004           | 0.000                              | 0.001                | 0.001              | 0.005             |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1447          | 1.1466                             | 1.1466               | 1.1466             | 1.1466            |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.004           | 0.000                              | 0.001                | 0.001              | 0.006             |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                 |                                    |                      |                    |                   |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure – Apartments (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Pipe Insulation (per foot) | Hot Water Tank Wraps | Smart Thermostats for Electric Baseboards | Smart Thermostats for MSHPs | Advanced Learning Thermostats for Central Electric Heating Without a Heat Pump | Advanced Learning Thermostats for Central Electric Heating with a Heat Pump |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----------------------|-------------------------------------------|-----------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                            |                      |                                           |                             |                                                                                |                                                                             |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>180</b>                 | <b>35</b>            | <b>131</b>                                | <b>24</b>                   | -                                                                              | -                                                                           |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 100%                       | 100%                 | 100%                                      | 84%                         | 100%                                                                           | 100%                                                                        |
| <b>Number of Units Installed</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>180</b>                 | <b>35</b>            | <b>131</b>                                | <b>20</b>                   | -                                                                              | -                                                                           |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                            |                      |                                           |                             |                                                                                |                                                                             |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 12.7                       | 117                  | 241                                       | 535                         | -                                                                              | -                                                                           |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -18.5%                     | -47.2%               | -                                         | -                           | -                                                                              | -                                                                           |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                      | 1.000                | 1.000                                     | 1.000                       | 1.000                                                                          | 1.000                                                                       |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>0.002</b>               | <b>0.002</b>         | <b>0.032</b>                              | <b>0.011</b>                | -                                                                              | -                                                                           |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947                     | 1.0946               | 1.0947                                    | 1.0945                      | -                                                                              | -                                                                           |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.002</b>               | <b>0.002</b>         | <b>0.035</b>                              | <b>0.012</b>                | -                                                                              | -                                                                           |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 13.0                       | 7.0                  | 10.0                                      | 10.0                        | 10.0                                                                           | 10.0                                                                        |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>0.027</b>               | <b>0.017</b>         | <b>0.346</b>                              | <b>0.118</b>                | -                                                                              | -                                                                           |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                            |                      |                                           |                             |                                                                                |                                                                             |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2.06                       | 19.0                 | -                                         | -                           | -                                                                              | -                                                                           |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -42.0%                     | -79.7%               | -                                         | -                           | -                                                                              | -                                                                           |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                      | 1.000                | 1.000                                     | 1.000                       | 1.000                                                                          | 1.000                                                                       |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.000</b>               | <b>0.000</b>         | -                                         | -                           | -                                                                              | -                                                                           |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466                     | 1.1459               | -                                         | -                           | -                                                                              | -                                                                           |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>0.000</b>               | <b>0.000</b>         | -                                         | -                           | -                                                                              | -                                                                           |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                            |                      |                                           |                             |                                                                                |                                                                             |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure - Apartments (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Consumer Electronics and Accessory Lighting |                       |                        |                 |                  |                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------|------------------------|-----------------|------------------|-------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Solar Security Fixtures                     | Indoor Motion Sensors | Outdoor Motion Sensors | Dimmer Switches | Humidity Sensors | Smart Power Controllers |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |                       |                        |                 |                  |                         |
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>8</b>                                    | <b>24</b>             | <b>6</b>               | <b>86</b>       | <b>25</b>        | <b>-</b>                |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 100%                                        | 100%                  | 100%                   | 100%            | 100%             | 100%                    |
| <b>Number of Units Installed</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>8</b>                                    | <b>24</b>             | <b>6</b>               | <b>86</b>       | <b>25</b>        | <b>-</b>                |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                             |                       |                        |                 |                  |                         |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 92.6                                        | 9.22                  | 19.7                   | 3.42            | 143              | 207                     |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                                           | -45.6%                | -                      | -45.5%          | -                | -                       |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                       | 1.000                 | 1.000                  | 1.000           | 1.000            | 1.000                   |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>0.001</b>                                | <b>0.000</b>          | <b>0.000</b>           | <b>0.000</b>    | <b>0.004</b>     | <b>-</b>                |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0947                                      | 1.0947                | 1.0947                 | 1.0947          | 1.0947           | -                       |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.001</b>                                | <b>0.000</b>          | <b>0.000</b>           | <b>0.000</b>    | <b>0.004</b>     | <b>-</b>                |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2.5                                         | 10.0                  | 10.0                   | 10.0            | 9.5              | 4.0                     |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>0.002</b>                                | <b>0.001</b>          | <b>0.001</b>           | <b>0.002</b>    | <b>0.037</b>     | <b>-</b>                |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                             |                       |                        |                 |                  |                         |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 15.0                                        | -                     | -                      | 0.554           | 14.3             | -                       |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                           | -                     | -                      | -77.4%          | -                | -                       |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                       | 1.000                 | 1.000                  | 1.000           | 1.000            | 1.000                   |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>0.000</b>                                | <b>-</b>              | <b>-</b>               | <b>0.000</b>    | <b>0.000</b>     | <b>-</b>                |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1466                                      | -                     | -                      | 1.1466          | 1.1466           | -                       |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>0.000</b>                                | <b>-</b>              | <b>-</b>               | <b>0.000</b>    | <b>0.000</b>     | <b>-</b>                |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                                             |                       |                        |                 |                  |                         |

## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure – Apartments (Continued)

| Product Category                                              | Air Sealing Products – Electric Resistance Heating |             |                                      |                     |                                          |
|---------------------------------------------------------------|----------------------------------------------------|-------------|--------------------------------------|---------------------|------------------------------------------|
|                                                               | Foam Gaskets<br>(per pack of 10)                   | Door Sweeps | Window<br>Air Sealing<br>(per 15 ft) | Window<br>Film Kits | Door<br>Weather Stripping<br>(per 17 ft) |
| <b>Number of Units</b>                                        |                                                    |             |                                      |                     |                                          |
| <b>Number of Units</b>                                        | <b>140</b>                                         | <b>-</b>    | <b>10</b>                            | <b>75</b>           | <b>13</b>                                |
| Installation Rate (%)                                         | 29%                                                | 100%        | 84%                                  | 57%                 | 84%                                      |
| <b>Number of Units Installed</b>                              | <b>41</b>                                          | <b>-</b>    | <b>8</b>                             | <b>43</b>           | <b>11</b>                                |
| <b>Energy Savings</b>                                         |                                                    |             |                                      |                     |                                          |
| Unitary Savings Value (kWh)                                   | 90.0                                               | 173         | 149                                  | 334                 | 196                                      |
| Interactive Effects Factor*                                   | -                                                  | -           | -                                    | -                   | -                                        |
| Adjustment Ratio                                              | 1.000                                              | 1.000       | 1.000                                | 1.000               | 1.000                                    |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>0.004</b>                                       | <b>-</b>    | <b>0.001</b>                         | <b>0.014</b>        | <b>0.002</b>                             |
| Line Loss Factor*                                             | 1.0942                                             | -           | 1.0947                               | 1.0947              | 1.0947                                   |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>0.004</b>                                       | <b>-</b>    | <b>0.001</b>                         | <b>0.016</b>        | <b>0.002</b>                             |
| Effective Useful Life (years)                                 | 15.0                                               | 15.0        | 15.0                                 | 1.0                 | 15.0                                     |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.060</b>                                       | <b>-</b>    | <b>0.021</b>                         | <b>0.016</b>        | <b>0.035</b>                             |
| <b>Peak Demand Savings</b>                                    |                                                    |             |                                      |                     |                                          |
| Unitary Peak Demand Savings (W)                               | 25.5                                               | 49.0        | 42.2                                 | 94.5                | 55.5                                     |
| Peak Demand Interactive Effects Factor*                       | -                                                  | -           | -                                    | -                   | -                                        |
| Adjustment Ratio                                              | 1.000                                              | 1.000       | 1.000                                | 1.000               | 1.000                                    |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.001</b>                                       | <b>-</b>    | <b>0.000</b>                         | <b>0.004</b>        | <b>0.001</b>                             |
| Line Loss Factor*                                             | 1.1452                                             | -           | 1.1466                               | 1.1466              | 1.1466                                   |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.001</b>                                       | <b>-</b>    | <b>0.000</b>                         | <b>0.005</b>        | <b>0.001</b>                             |

\* The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter.



## Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings per Measure – Apartments (Continued)

| Product Category                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Air Sealing Products – Heat Pump Heating |                |                                      |                     |                                          | Total for Apartments |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|----------------|--------------------------------------|---------------------|------------------------------------------|----------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Foam Gaskets<br>(per pack of 10)         | Door<br>Sweeps | Window Air<br>Sealing<br>(per 15 ft) | Window<br>Film Kits | Door<br>Weather Stripping<br>(per 17 ft) |                      |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                          |                |                                      |                     |                                          |                      |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 69                                       | -              | -                                    | 19                  | 7                                        | 6,577                |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 29%                                      | 100%           | 84%                                  | 57%                 | 84%                                      | 92%                  |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                | 20                                       | -              | -                                    | 11                  | 6                                        | 6,034                |
| Energy Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          |                |                                      |                     |                                          |                      |
| Unitary Savings Value (kWh)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 50.0                                     | 96.1           | 82.8                                 | 185                 | 109                                      | -                    |
| Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                              | -                                        | -              | -                                    | -                   | -                                        | -                    |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                    | 1.000          | 1.000                                | 1.000               | 1.000                                    | -                    |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                | 0.001                                    | -              | -                                    | 0.002               | 0.001                                    | 0.314                |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.0941                                   | -              | -                                    | 1.0947              | 1.0947                                   | 1.0840               |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.001                                    | -              | -                                    | 0.002               | 0.001                                    | 0.340                |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                                                                                                                            | 15.0                                     | 15.0           | 15.0                                 | 1.0                 | 15.0                                     | 4.76                 |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.016                                    | -              | -                                    | 0.002               | 0.011                                    | 1.618                |
| Peak Demand Savings                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                          |                |                                      |                     |                                          |                      |
| Unitary Peak Demand Savings (W)                                                                                                                                                                                                                                                                                                                                                                                                                                          | 14.2                                     | 27.2           | 23.4                                 | 52.4                | 30.8                                     | -                    |
| Peak Demand Interactive Effects Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                        | -              | -                                    | -                   | -                                        | -                    |
| Adjustment Ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.000                                    | 1.000          | 1.000                                | 1.000               | 1.000                                    | -                    |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                            | 0.000                                    | -              | -                                    | 0.001               | 0.000                                    | 0.042                |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.1406                                   | -              | -                                    | 1.1466              | 1.1466                                   | 1.1153               |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                        | 0.000                                    | -              | -                                    | 0.001               | 0.000                                    | 0.047                |
| * The interactive effects and line loss factors correspond to the average for each product weighted according to the proportion of each type of home and rate code. The interactive effects factor is obtained by dividing gross savings at the meter by the unitary savings value, installation rate, number of units, and adjustment ratio when applicable. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                                          |                |                                      |                     |                                          |                      |

Table 33 combines total EPI results for single-family homes and apartments.

**Table 33: Evaluated 2024 EPI Gross Electrical Energy and Peak Demand Savings**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Total for Single-family Homes | Total for Apartments | Grand Total |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------|-------------|
| <b>Number of Units</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                               |                      |             |
| Number of Units                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 144,145                       | 6,577                | 150,722     |
| Installation Rate (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 91%                           | 92%                  | 91%         |
| Number of Units Installed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 131,253                       | 6,034                | 137,287     |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                               |                      |             |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 7.995                         | 0.314                | 8.309       |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.0947                        | 1.0840               | 1.0943      |
| Gross Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8.752                         | 0.341                | 9.093       |
| Effective Useful Life (years)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 5.9                           | 4.8                  | 5.8         |
| Gross Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 51.249                        | 1.623                | 52.872      |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                               |                      |             |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 0.743                         | 0.042                | 0.785       |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.1466                        | 1.1153               | 1.1449      |
| Gross Peak Demand Savings – at the Generator (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.851                         | 0.047                | 0.898       |
| * The installation rates, EUL values, and line loss factors correspond to the average for each offering weighted according to the proportion of each type of product and rate code. The installation rate is obtained by dividing the installed number of units by the total number of units. The EUL value is obtained by dividing lifetime gross energy savings at the generator by gross energy savings at the generator. The line loss factor is obtained by dividing gross savings at the generator by gross savings at the meter. |                               |                      |             |

Figure 39 below compares the tracked and evaluated gross electrical energy savings at the generator, while Figure 40 further below compares the tracked and evaluated gross peak demand savings at the generator. For the most part, tracked and evaluated savings are similar, with differences being due to updates to the savings parameters in the 2024-2025 DSM MA.

**Figure 39: 2024 EPI Tracked and Evaluated Gross Electrical Energy Savings at the Generator**

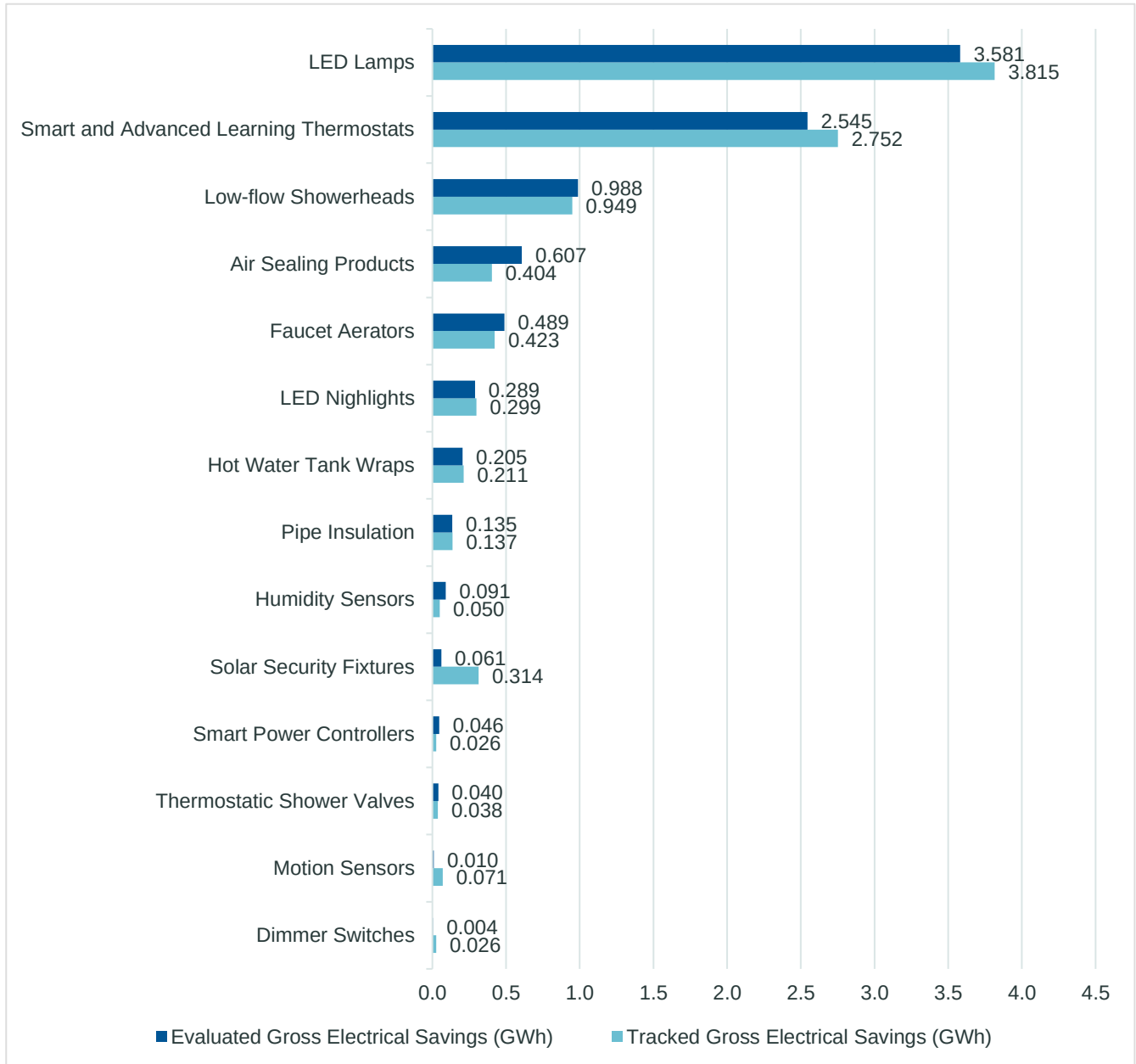
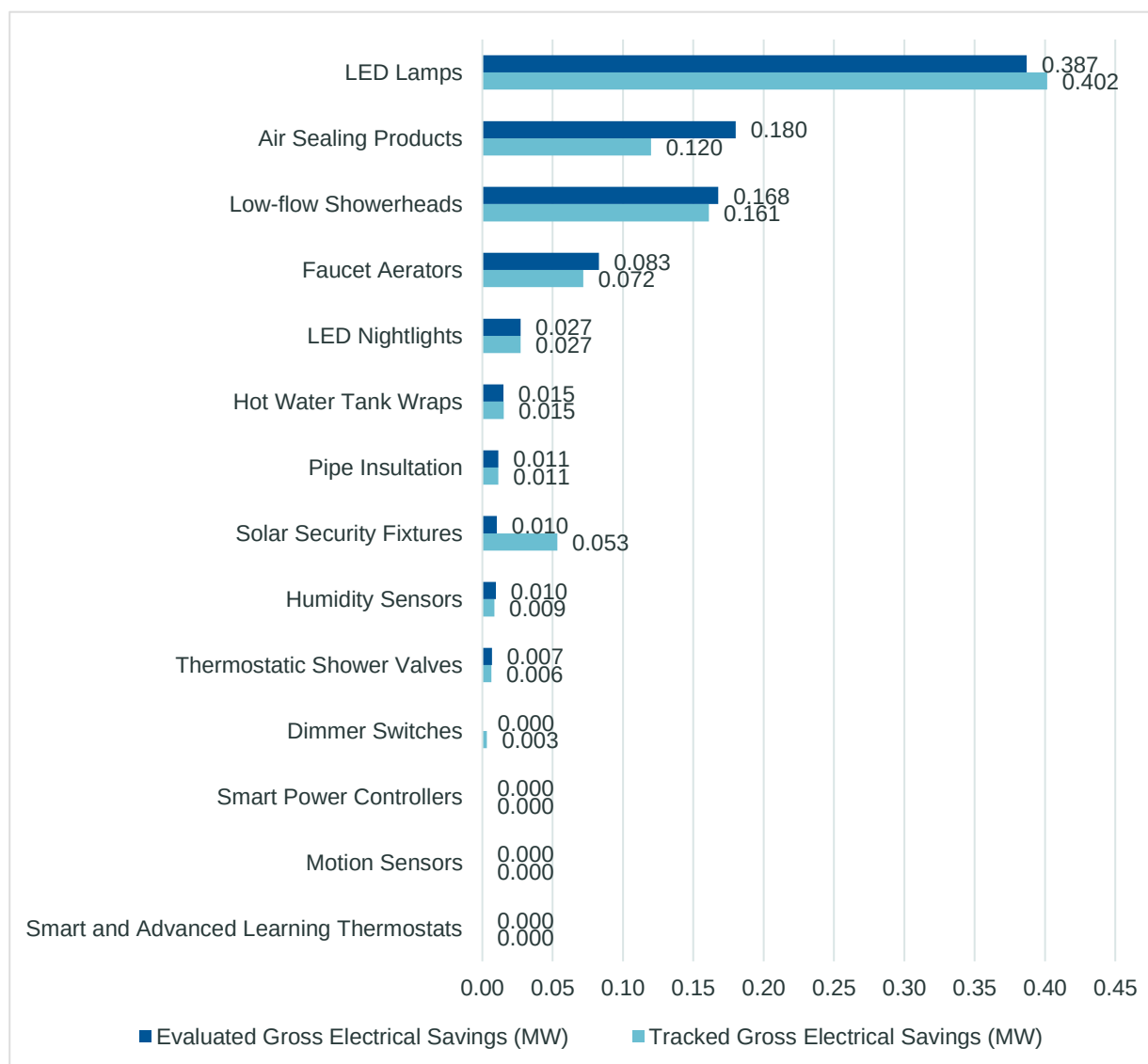


**Figure 40: 2024 EPI Tracked and Evaluated Gross Peak Demand Savings at the Generator**



GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>39</sup> for GHG emissions generated by electricity production to EPI gross savings results, the results of which are presented in Table 34.

**Table 34: Evaluated 2024 EPI Gross GHG Emission Reductions**

|                                                                                             | Total        |
|---------------------------------------------------------------------------------------------|--------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>9.093</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2        |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>4,294</b> |

<sup>39</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

## 14.3 Net Savings

The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to a program component, by estimating the NTGR. In the case of EPI, the NTGR is established considering the free-ridership and participant spillover effects that positively or negatively affect energy savings.

### 14.3.1 Free-ridership

For EPI, free-ridership occurs when participants would have installed the same energy efficient products in the absence of the program component. For low-income participants, the free-ridership level is assumed to be nil, while free-ridership for non-low-income participants was assessed during the 2024 evaluation using a self-report approach that involved asking a set of questions during a telephone survey to 100 non-low-income participants that received at least LED lamps, one smart thermostat, or any domestic hot water (DHW) measure.

To comply with the best practices highlighted in the Net-to-Gross Ratio Review<sup>40</sup> report by not assuming nil free-ridership for measures without measured free-ridership, the Evaluator relied on a literature review to select free-ridership levels to be used for air sealing products and smart power controllers. For measures added to EPI in 2024, the Evaluator assigned already established free-ridership levels for similar products, except for humidity sensors for which the Evaluator provides a rationale for the free-ridership level.

For air sealing products, free-ridership values were found in three jurisdictions<sup>41</sup> and ranged from 9% to 28%, although most programs were not fully comparable with EPI. Indeed, while EPI is a direct install program, air sealing products are mostly left behind by installers, which is not a delivery model that was found in other jurisdictions with available free-ridership levels. The Evaluator considers it more likely that more participants that had the products installed through a program would not have installed them if there was no program compared to those that had to install them themselves since they were left behind. Consequently, the Evaluator elected to use a free-ridership value closer to the lower range of those found in the literature and selected a free-ridership level of 12% from the Massachusetts 2022 Technical Reference Manual.

For smart power controllers such as those installed through EPI, only one jurisdiction was found to have a free-ridership level for this product through a direct install program; the Evaluator therefore used the level of 3% from the Westario Power Residential Direct Install 2016 evaluation.<sup>42</sup>

For measures added to EPI in 2024, free-ridership levels were not evaluated through the 2024 on-site visits because participants with these measures were not integrated into the tracking sheet at the time of sampling. The Evaluator therefore determined free-ridership levels for these measures based on similarities with measure categories for which free-ridership levels were already established. For dimmer switches, indoor motion sensors, outdoor motion sensors, and solar security fixtures, the Evaluator used the free-ridership level for LED lighting since these products are also lighting products. For advanced learning thermostats, the Evaluator used the smart thermostat free-ridership level given the similarity between both product types.

<sup>40</sup> Econoler for E1. *Net-to-Gross Ratio Review – Final Report*, November 2024.

<sup>41</sup> - Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 12.0 – Volume 3: Residential Measures*, September 22, 2023, p. 379.

- NMR Group for L. Skumatz, B. Wirtshafter, R. Prah and Evaluation Committee. *R1983 NTG Memorandum*. July 1, 2022. Retrieved from: <https://energizect.com/sites/default/files/documents/Comments%20R1983-Savings%20Weighted%20NTG%20Results%208.3.2022.docx>.

- Guidehouse. *Residential Programs Net-to-Gross Research of RCD and Select Products Measures: Results Workbook*. 2021. Retrieved from: <https://api-plus.anbetrack.com/etrm-gateway/etrm/api/v1/etrm/documents/6130ceae6933d4a3eeb9d0f/view?authToken=f20f0d437bdeaaafd3da64175dbb2ee0a1891776d21fca7d98da2350eba6ca493b93859bddd54814b92cb8e630fac359f56e61535ff4bb94ef13fb398049128721572dc3920feb>.

<sup>42</sup> NMR Group for Massachusetts Electric Program Administrators. *Residential Products Net-to-Gross Study (MA20X04-E-PRODNTG)*. June 8, 2021. Retrieved from: [https://ma-eeac.org/wp-content/uploads/MA20X04-E-PRODNTG\\_Res-Products-NTG-Report\\_FINAL\\_2021.06.08.pdf](https://ma-eeac.org/wp-content/uploads/MA20X04-E-PRODNTG_Res-Products-NTG-Report_FINAL_2021.06.08.pdf).



Finally, for humidity sensors, which do not share similarities with other EPI products with an established free-ridership level, the Evaluator assumed a free-ridership level of 0% due to the rarity of the product and complexity of the installation.

Table 35 below outlines the free-ridership levels resulting from the 2024 evaluation.

**Table 35: 2024 EPI Participant Free-ridership Levels**

|                                            | Average Free-ridership Level | Margin of Error |
|--------------------------------------------|------------------------------|-----------------|
| <b>Low-income Participants</b>             |                              |                 |
| All Products                               | 0%                           | N/A             |
| <b>Non-low-income Participants</b>         |                              |                 |
| LED Lighting and Lighting Related Products | 16%                          | 3.2%            |
| Smart and Advanced Learning Thermostats    | 9%                           | 2.9%            |
| DHW Products                               | 11%                          | 5.2%            |
| Air Sealing Products                       | 12%                          | N/A             |
| Smart Power Controllers                    | 3%                           | N/A             |
| Humidity Sensors                           | 0%                           | N/A             |

In comparison, the free-ridership level for LED lighting was 25% when it was last evaluated in 2021. Therefore, the 2024 free-ridership level of 16% represents a reduction of 9% compared to the 2021 evaluation results. This reduction is largely explained by the update made to the free-ridership algorithm, notably increasing the weight of influence since EPI and E1 influence was high, which translates into low free-ridership.

For other measures, the 2021 evaluation served to assess only low-flow showerhead free-ridership, which was established at 10%, while the 2024 evaluation encompassed all DHW measures and resulted in a free-ridership level of 11%. With the different measures included in the analysis and the changes to the algorithm, the 2021 and 2024 free-ridership levels should not be directly compared.

The smart thermostat free-ridership level was not assessed in 2021 since that measure had not yet been included in EPI.

### 14.3.2 Participant Spillover

For EPI, participant spillover occurs when participants purchase and install additional energy efficient products due to the influence of having participated in the program component without receiving any additional support from an E1 program. Similarly to free-ridership, spillover was assessed during the 2024 evaluation using a self-report approach that involved asking a set of questions during a telephone survey to 100 non-low-income participants that received at least LED lamps, one smart thermostat, or any DHW measure.

Among the 100 surveyed participants, 17 installed efficient products available or promoted through EPI after their participation in the program component and for which EPI had an influence in their decision to install the given product. The products that most generated spillover were LED lamps and fixtures as well as heat pump water heaters. A few participants also installed a new efficient appliance, a smart power bar, or faucet aerators.

Table 36 outlines the participant spillover levels established through the 2024 evaluation.

**Table 36: 2024 EPI Participant Spillover Levels**

| Average Participant Spillover Level |    | Margin of Error |
|-------------------------------------|----|-----------------|
| <b>Low-income Participants</b>      |    |                 |
| All Products                        | 0% | N/A             |
| <b>Non-low-income Participants</b>  |    |                 |
| All Products                        | 8% | 3.8%            |

In comparison, the 8% spillover level established for 2024 was similar to the 10% established through the last evaluation in 2021.

### 14.3.3 Net-to-gross Ratio Calculation

The NTGR values were calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Internal Spillover})$$

Overall NTGR values were calculated using the free-ridership and spillover levels established per participant type and product category and the proportions of savings associated with each participant type in each product category.

Table 37 outlines the overall NTGR values established through the 2024 evaluation.

**Table 37: 2024 EPI Net-to-gross Ratios by Product Category**

| Products                                       | Participant Type            | NTGR | Proportion of Product Category Gross Savings by Participant Type | Overall NTGR Values |
|------------------------------------------------|-----------------------------|------|------------------------------------------------------------------|---------------------|
| <b>LED Lamps and Lighting Related Products</b> | Non-low-income Participants | 0.92 | 32%                                                              | <b>0.97</b>         |
|                                                | Low-income Participants     | 1.00 | 68%                                                              |                     |
| <b>Smart and Advanced Learning Thermostats</b> | Non-low-income Participants | 0.99 | 49%                                                              | <b>1.00</b>         |
|                                                | Low-income Participants     | 1.00 | 51%                                                              |                     |
| <b>DHW Products</b>                            | Non-low-income Participants | 0.97 | 35%                                                              | <b>0.99</b>         |
|                                                | Low-income Participants     | 1.00 | 65%                                                              |                     |
| <b>Air Sealing Products</b>                    | Non-low-income Participants | 0.96 | 41%                                                              | <b>0.98</b>         |
|                                                | Low-income Participants     | 1.00 | 59%                                                              |                     |
| <b>Smart Power Controllers</b>                 | Non-low-income Participants | 1.05 | 38%                                                              | <b>1.02</b>         |
|                                                | Low-income Participants     | 1.00 | 62%                                                              |                     |
| <b>Humidity Sensors</b>                        | Non-low-income Participants | 1.08 | 51%                                                              | <b>1.04</b>         |
|                                                | Low-income Participants     | 1.00 | 49%                                                              |                     |

### 14.3.4 Evaluated Net Savings

Net savings are defined as the energy use reductions that are specifically attributable to EPI. Net savings were estimated by applying the overall NTGR to gross savings as exemplified in the following equation.

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR}$$

This equation was used to calculate both electrical energy savings and peak demand savings.

The detailed results per measure are presented in Table 38 below. The net energy savings resulted in 4,225 tonnes of CO2 eq in net annual GHG emission reductions.

**Table 38: Evaluated 2024 EPI Net Electrical Energy and Peak Demand Savings per Measure**

| Product Category                                                                                                                                                                                                            | LED Lamps     |              |              |              |              |              |              |              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|                                                                                                                                                                                                                             | 9 W Replacing |              |              |              |              |              |              |              |
|                                                                                                                                                                                                                             | 25 W          | 29 W         | 40 W         | 43 W         | 60 W         | 72 W         | 100 W        | 150 W        |
| <b>Energy Savings</b>                                                                                                                                                                                                       |               |              |              |              |              |              |              |              |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                            | <b>0.015</b>  | <b>0.005</b> | <b>0.354</b> | <b>0.011</b> | <b>1.796</b> | <b>0.008</b> | <b>0.207</b> | <b>0.000</b> |
| NTGR                                                                                                                                                                                                                        | 0.97          | 0.97         | 0.97         | 0.97         | 0.97         | 0.97         | 0.97         | 0.97         |
| <b>Net Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                              | <b>0.014</b>  | <b>0.005</b> | <b>0.344</b> | <b>0.011</b> | <b>1.742</b> | <b>0.008</b> | <b>0.201</b> | <b>0.000</b> |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0947        | 1.0947       | 1.0947       | 1.0947       | 1.0935       | 1.0947       | 1.0946       | 1.0947       |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                          | <b>0.016</b>  | <b>0.006</b> | <b>0.376</b> | <b>0.012</b> | <b>1.905</b> | <b>0.009</b> | <b>0.220</b> | <b>0.000</b> |
| Effective Useful Life (years)                                                                                                                                                                                               | 1.0           | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          | 1.0          |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                 | <b>0.016</b>  | <b>0.006</b> | <b>0.376</b> | <b>0.012</b> | <b>1.905</b> | <b>0.009</b> | <b>0.220</b> | <b>0.000</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                  |               |              |              |              |              |              |              |              |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                        | <b>0.002</b>  | <b>0.001</b> | <b>0.036</b> | <b>0.001</b> | <b>0.183</b> | <b>0.001</b> | <b>0.023</b> | <b>0.000</b> |
| NTGR                                                                                                                                                                                                                        | 0.97          | 0.97         | 0.97         | 0.97         | 0.97         | 0.97         | 0.97         | 0.97         |
| <b>Net Peak Demand Savings –at the Meter (MW)</b>                                                                                                                                                                           | <b>0.002</b>  | <b>0.001</b> | <b>0.035</b> | <b>0.001</b> | <b>0.178</b> | <b>0.001</b> | <b>0.023</b> | <b>0.000</b> |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1466        | 1.1466       | 1.1466       | 1.1466       | 1.1418       | 1.1466       | 1.1465       | 1.1466       |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                      | <b>0.002</b>  | <b>0.001</b> | <b>0.040</b> | <b>0.001</b> | <b>0.203</b> | <b>0.001</b> | <b>0.026</b> | <b>0.000</b> |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |               |              |              |              |              |              |              |              |





## Evaluated 2024 EPI Net Electrical Energy and Peak Demand Savings per Measure (Continued)

| Product Category                                                                                                                                                                                                            | LED Lamps                  |                                |                                 |                                  |                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------------------|---------------------------------|----------------------------------|----------------------------------|
|                                                                                                                                                                                                                             | 18 W<br>Replacing<br>100 W | PAR20 7 W<br>Replacing<br>50 W | PAR38 15 W<br>Replacing<br>90 W | PAR38 15 W<br>Replacing<br>120 W | PAR38 15 W<br>Replacing<br>150 W |
| <b>Energy Savings</b>                                                                                                                                                                                                       |                            |                                |                                 |                                  |                                  |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                            | <b>0.060</b>               | <b>0.129</b>                   | <b>0.024</b>                    | <b>0.009</b>                     | <b>0.155</b>                     |
| NTGR                                                                                                                                                                                                                        | 0.97                       | 0.97                           | 0.97                            | 0.97                             | 0.97                             |
| <b>Net Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                              | <b>0.058</b>               | <b>0.126</b>                   | <b>0.024</b>                    | <b>0.009</b>                     | <b>0.150</b>                     |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0947                     | 1.0947                         | 1.0947                          | 1.0947                           | 1.0947                           |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                          | <b>0.064</b>               | <b>0.137</b>                   | <b>0.026</b>                    | <b>0.010</b>                     | <b>0.164</b>                     |
| Effective Useful Life (years)                                                                                                                                                                                               | 1.0                        | 1.0                            | 1.0                             | 1.0                              | 1.0                              |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                 | <b>0.064</b>               | <b>0.137</b>                   | <b>0.026</b>                    | <b>0.010</b>                     | <b>0.164</b>                     |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                  |                            |                                |                                 |                                  |                                  |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                        | <b>0.006</b>               | <b>0.011</b>                   | <b>0.004</b>                    | <b>0.001</b>                     | <b>0.025</b>                     |
| NTGR                                                                                                                                                                                                                        | 0.97                       | 0.97                           | 0.97                            | 0.97                             | 0.97                             |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                          | <b>0.005</b>               | <b>0.011</b>                   | <b>0.004</b>                    | <b>0.001</b>                     | <b>0.024</b>                     |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1466                     | 1.1466                         | 1.1466                          | 1.1466                           | 1.1466                           |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                      | <b>0.006</b>               | <b>0.012</b>                   | <b>0.004</b>                    | <b>0.002</b>                     | <b>0.028</b>                     |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |                            |                                |                                 |                                  |                                  |

## Evaluated 2024 EPI Net Electrical Energy and Peak Demand Savings per Measure (Continued)

| Product Category                                                                                                                                                                                                            | LED Lamps    |                               |                               |                                |                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------------|-------------------------------|--------------------------------|-----------------------------------------|
|                                                                                                                                                                                                                             | Nightlights  | GU10 7 W<br>Replacing<br>35 W | GU10 7 W<br>Replacing<br>50 W | G25 4.5 W<br>Replacing<br>40 W | E12 5 W<br>Chandelier<br>Replacing 40 W |
| <b>Energy Savings</b>                                                                                                                                                                                                       |              |                               |                               |                                |                                         |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                            | <b>0.265</b> | <b>0.014</b>                  | <b>0.103</b>                  | <b>0.098</b>                   | <b>0.284</b>                            |
| NTGR                                                                                                                                                                                                                        | 0.97         | 0.97                          | 0.97                          | 0.97                           | 0.97                                    |
| <b>Net Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                              | <b>0.257</b> | <b>0.014</b>                  | <b>0.100</b>                  | <b>0.095</b>                   | <b>0.275</b>                            |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0925       | 1.0947                        | 1.0947                        | 1.0908                         | 1.0941                                  |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                          | <b>0.280</b> | <b>0.015</b>                  | <b>0.110</b>                  | <b>0.104</b>                   | <b>0.301</b>                            |
| Effective Useful Life (years)                                                                                                                                                                                               | 1.0          | 1.0                           | 1.0                           | 1.0                            | 1.0                                     |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                 | <b>0.280</b> | <b>0.015</b>                  | <b>0.110</b>                  | <b>0.104</b>                   | <b>0.301</b>                            |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                  |              |                               |                               |                                |                                         |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                        | <b>0.024</b> | <b>0.001</b>                  | <b>0.008</b>                  | <b>0.010</b>                   | <b>0.026</b>                            |
| NTGR                                                                                                                                                                                                                        | 0.97         | 0.97                          | 0.97                          | 0.97                           | 0.97                                    |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                          | <b>0.023</b> | <b>0.001</b>                  | <b>0.008</b>                  | <b>0.010</b>                   | <b>0.025</b>                            |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1371       | 1.1466                        | 1.1465                        | 1.1315                         | 1.1442                                  |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                      | <b>0.026</b> | <b>0.001</b>                  | <b>0.009</b>                  | <b>0.011</b>                   | <b>0.029</b>                            |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |              |                               |                               |                                |                                         |



## Evaluated 2024 EPI Net Electrical Energy and Peak Demand Savings per Measure (Continued)

| Product Category                                                                                                                                                                                                            | Faucet Aerators | Thermostatic Shower Valves 2.5 gpm | Low-flow Showerheads |                    |                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------------------------|----------------------|--------------------|-------------------|
|                                                                                                                                                                                                                             |                 |                                    | 0.5 gpm Reduction    | 0.75 gpm Reduction | 1.0 gpm Reduction |
| Energy Savings                                                                                                                                                                                                              |                 |                                    |                      |                    |                   |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                   | 0.447           | 0.037                              | 0.066                | 0.055              | 0.782             |
| NTGR                                                                                                                                                                                                                        | 0.99            | 0.99                               | 0.99                 | 0.99               | 0.99              |
| Net Energy Savings – at the Meter (GWh)                                                                                                                                                                                     | 0.442           | 0.036                              | 0.065                | 0.054              | 0.774             |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0947          | 1.0947                             | 1.0947               | 1.0947             | 1.0947            |
| Net Energy Savings – at the Generator (GWh)                                                                                                                                                                                 | 0.484           | 0.040                              | 0.071                | 0.060              | 0.847             |
| Effective Useful Life (years)                                                                                                                                                                                               | 10.0            | 10.0                               | 10.0                 | 10.0               | 10.0              |
| Net Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                        | 4.840           | 0.398                              | 0.715                | 0.596              | 8.475             |
| Peak Demand Savings                                                                                                                                                                                                         |                 |                                    |                      |                    |                   |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                               | 0.072           | 0.006                              | 0.011                | 0.009              | 0.127             |
| NTGR                                                                                                                                                                                                                        | 0.99            | 0.99                               | 0.99                 | 0.99               | 0.99              |
| Net Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                 | 0.072           | 0.006                              | 0.011                | 0.009              | 0.125             |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1464          | 1.1466                             | 1.1465               | 1.1466             | 1.1466            |
| Net Peak Demand Savings – at the Generator (MW)                                                                                                                                                                             | 0.082           | 0.007                              | 0.012                | 0.010              | 0.144             |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |                 |                                    |                      |                    |                   |

## Evaluated 2024 EPI Net Electrical Energy and Peak Demand Savings per Measure (Continued)

| Product Category                                                                                                                                                                                                            | Pipe Insulation | Hot Water Tank Wraps | Smart Thermostats for Electric Baseboards | Smart Thermostats for MSHPs | Advanced Learning Thermostats for Central Electric Heating Without a Heat Pump | Advanced Learning Thermostats for Central Electric Heating with a Heat Pump |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|-------------------------------------------|-----------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <b>Energy Savings</b>                                                                                                                                                                                                       |                 |                      |                                           |                             |                                                                                |                                                                             |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                            | <b>0.123</b>    | <b>0.188</b>         | <b>0.620</b>                              | <b>1.660</b>                | <b>0.032</b>                                                                   | <b>0.011</b>                                                                |
| NTGR                                                                                                                                                                                                                        | 0.99            | 0.99                 | 1.00                                      | 1.00                        | 1.00                                                                           | 1.00                                                                        |
| <b>Net Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                              | <b>0.122</b>    | <b>0.186</b>         | <b>0.620</b>                              | <b>1.660</b>                | <b>0.032</b>                                                                   | <b>0.011</b>                                                                |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0947          | 1.0947               | 1.0947                                    | 1.0947                      | 1.0947                                                                         | 1.0947                                                                      |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                          | <b>0.134</b>    | <b>0.203</b>         | <b>0.679</b>                              | <b>1.818</b>                | <b>0.036</b>                                                                   | <b>0.012</b>                                                                |
| Effective Useful Life (years)                                                                                                                                                                                               | 13.0            | 7.0                  | 10.0                                      | 10.0                        | 10.0                                                                           | 10.0                                                                        |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                 | <b>1.736</b>    | <b>1.423</b>         | <b>6.791</b>                              | <b>18.177</b>               | <b>0.356</b>                                                                   | <b>0.123</b>                                                                |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                  |                 |                      |                                           |                             |                                                                                |                                                                             |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                        | <b>0.010</b>    | <b>0.013</b>         | -                                         | -                           | -                                                                              | -                                                                           |
| NTGR                                                                                                                                                                                                                        | 0.99            | 0.99                 | 1.00                                      | 1.00                        | 1.00                                                                           | 1.00                                                                        |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                          | <b>0.010</b>    | <b>0.013</b>         | -                                         | -                           | -                                                                              | -                                                                           |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1466          | 1.1466               | -                                         | -                           | -                                                                              | -                                                                           |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                      | <b>0.011</b>    | <b>0.015</b>         | -                                         | -                           | -                                                                              | -                                                                           |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |                 |                      |                                           |                             |                                                                                |                                                                             |



## Evaluated 2024 EPI Net Electrical Energy and Peak Demand Savings per Measure (Continued)

| Product Category                                                                                                                                                                                                            | Consumer Electronics and Accessory Lighting |                       |                        |                 |                  |                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------|------------------------|-----------------|------------------|-------------------------|
|                                                                                                                                                                                                                             | Solar Security Fixtures                     | Indoor Motion Sensors | Outdoor Motion Sensors | Dimmer Switches | Humidity Sensors | Smart Power Controllers |
| <b>Energy Savings</b>                                                                                                                                                                                                       |                                             |                       |                        |                 |                  |                         |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                            | <b>0.056</b>                                | <b>0.004</b>          | <b>0.005</b>           | <b>0.004</b>    | <b>0.083</b>     | <b>0.042</b>            |
| NTGR                                                                                                                                                                                                                        | 0.97                                        | 0.97                  | 0.97                   | 0.97            | 1.04             | 1.02                    |
| <b>Net Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                              | <b>0.054</b>                                | <b>0.004</b>          | <b>0.005</b>           | <b>0.004</b>    | <b>0.087</b>     | <b>0.043</b>            |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0947                                      | 1.0947                | 1.0947                 | 1.0947          | 1.0947           | 1.0947                  |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                          | <b>0.059</b>                                | <b>0.004</b>          | <b>0.005</b>           | <b>0.004</b>    | <b>0.095</b>     | <b>0.047</b>            |
| Effective Useful Life (years)                                                                                                                                                                                               | 2.5                                         | 10.0                  | 10.0                   | 10.0            | 9.5              | 4.0                     |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                 | <b>0.147</b>                                | <b>0.043</b>          | <b>0.054</b>           | <b>0.042</b>    | <b>0.900</b>     | <b>0.190</b>            |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                  |                                             |                       |                        |                 |                  |                         |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                        | <b>0.009</b>                                | -                     | -                      | <b>0.000</b>    | <b>0.008</b>     | -                       |
| NTGR                                                                                                                                                                                                                        | 0.97                                        | 0.97                  | 0.97                   | 0.97            | 1.04             | 1.02                    |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                          | <b>0.009</b>                                | -                     | -                      | <b>0.000</b>    | <b>0.009</b>     | -                       |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1466                                      | -                     | -                      | 1.1466          | 1.1466           | -                       |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                      | <b>0.010</b>                                | -                     | -                      | <b>0.000</b>    | <b>0.010</b>     | -                       |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |                                             |                       |                        |                 |                  |                         |

## Evaluated 2024 EPI Net Energy and Peak Demand Savings per Measure (Continued)

| Product Category                                                                                                                                                                                                            | Air Sealing Products – Electric Resistance Heating |              |                    |                  |                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--------------|--------------------|------------------|------------------------|
|                                                                                                                                                                                                                             | Foam Gaskets                                       | Door Sweeps  | Window Air Sealing | Window Film Kits | Door Weather Stripping |
| <b>Energy Savings</b>                                                                                                                                                                                                       |                                                    |              |                    |                  |                        |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                            | <b>0.035</b>                                       | <b>0.002</b> | <b>0.012</b>       | <b>0.140</b>     | <b>0.023</b>           |
| NTGR                                                                                                                                                                                                                        | 0.98                                               | 0.98         | 0.98               | 0.98             | 0.98                   |
| <b>Net Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                              | <b>0.035</b>                                       | <b>0.002</b> | <b>0.012</b>       | <b>0.137</b>     | <b>0.022</b>           |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0946                                             | 1.0947       | 1.0947             | 1.0947           | 1.0947                 |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                          | <b>0.038</b>                                       | <b>0.002</b> | <b>0.013</b>       | <b>0.150</b>     | <b>0.025</b>           |
| Effective Useful Life (years)                                                                                                                                                                                               | 15.0                                               | 15.0         | 15.0               | 1.0              | 15.0                   |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                 | <b>0.570</b>                                       | <b>0.025</b> | <b>0.191</b>       | <b>0.150</b>     | <b>0.368</b>           |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                  |                                                    |              |                    |                  |                        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                        | <b>0.010</b>                                       | <b>0.000</b> | <b>0.003</b>       | <b>0.040</b>     | <b>0.006</b>           |
| NTGR                                                                                                                                                                                                                        | 0.98                                               | 0.98         | 0.98               | 0.98             | 0.98                   |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                          | <b>0.010</b>                                       | <b>0.000</b> | <b>0.003</b>       | <b>0.039</b>     | <b>0.006</b>           |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1464                                             | 1.1466       | 1.1466             | 1.1466           | 1.1466                 |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                      | <b>0.011</b>                                       | <b>0.000</b> | <b>0.004</b>       | <b>0.045</b>     | <b>0.007</b>           |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |                                                    |              |                    |                  |                        |

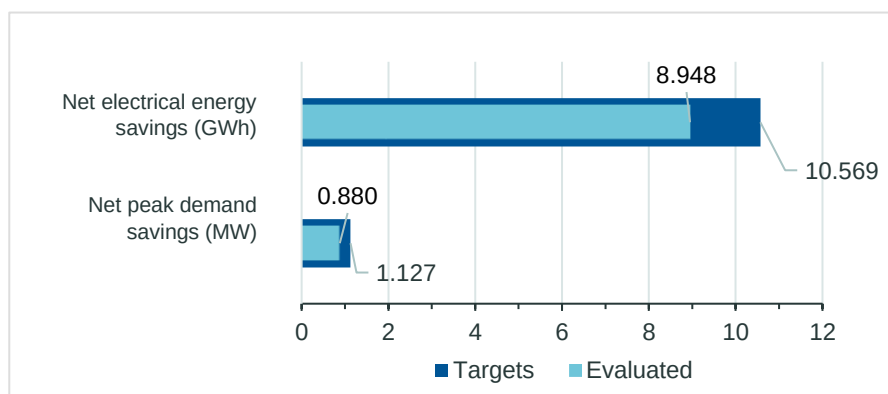
## Evaluated 2024 EPI Net Energy and Peak Demand Savings per Measure (Continued)

| Product Category                                                                                                                                                                                                            | Air Sealing Products – Heat Pump Heating |             |                    |                  |                        | Grand Total |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------|--------------------|------------------|------------------------|-------------|
|                                                                                                                                                                                                                             | Foam Gaskets                             | Door Sweeps | Window Air Sealing | Window Film Kits | Door Weather Stripping |             |
| Energy Savings                                                                                                                                                                                                              |                                          |             |                    |                  |                        |             |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                   | 0.070                                    | 0.006       | 0.016              | 0.203            | 0.048                  | 8.309       |
| NTGR                                                                                                                                                                                                                        | 0.98                                     | 0.98        | 0.98               | 0.98             | 0.98                   | -           |
| Net Energy Savings – at the Meter (GWh)                                                                                                                                                                                     | 0.068                                    | 0.006       | 0.016              | 0.199            | 0.047                  | 8.177       |
| Line Loss Factor*                                                                                                                                                                                                           | 1.0947                                   | 1.0947      | 1.0947             | 1.0947           | 1.0947                 | 1.0943      |
| Net Energy Savings – at the Generator (GWh)                                                                                                                                                                                 | 0.075                                    | 0.006       | 0.017              | 0.218            | 0.051                  | 8.948       |
| Effective Useful Life (years)                                                                                                                                                                                               | 15.0                                     | 15.0        | 15.0               | 1.0              | 15.0                   | 5.9         |
| Net Lifetime Energy Savings – at the Generator (GWh)                                                                                                                                                                        | 1.119                                    | 0.097       | 0.256              | 0.218            | 0.772                  | 52.525      |
| Peak Demand Savings                                                                                                                                                                                                         |                                          |             |                    |                  |                        |             |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                               | 0.020                                    | 0.002       | 0.005              | 0.058            | 0.014                  | 0.785       |
| NTGR                                                                                                                                                                                                                        | 0.98                                     | 0.98        | 0.98               | 0.98             | 0.98                   | -           |
| Net Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                 | 0.019                                    | 0.002       | 0.004              | 0.056            | 0.013                  | 0.768       |
| Line Loss Factor*                                                                                                                                                                                                           | 1.1464                                   | 1.1466      | 1.1466             | 1.1465           | 1.1466                 | 1.1449      |
| Net Peak Demand Savings – at the Generator (MW)                                                                                                                                                                             | 0.022                                    | 0.002       | 0.005              | 0.065            | 0.015                  | 0.880       |
| * The line loss factors correspond to the average for each product weighted according to the proportion of each rate code. These factors are obtained by dividing net savings at the generator by net savings at the meter. |                                          |             |                    |                  |                        |             |



As outlined in Figure 41, EPI fell short of its electrical energy and peak demand savings targets by 15% and 22% respectively.

**Figure 41: 2024 EPI Targets and Net Evaluated Savings**



## 14.4 Realization Rate

Table 39 below compares the energy and peak demand savings established through the 2024 evaluation to those tracked in the 2024 tracking sheet. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 39: Comparison of 2024 EPI Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                  | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate Value |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------------|
|                                                                                                                                                                  | Value         | Unit | Value | Value       | Unit |                        |
| Energy Savings                                                                                                                                                   |               |      |       |             |      |                        |
| Tracked Savings by E1                                                                                                                                            | 9.516         | GWh  | 1.00  | 9.519       | GWh  | 94%                    |
| Evaluation Results                                                                                                                                               | 9.093         | GWh  | 0.98  | 8.948       | GWh  |                        |
| Peak Demand Savings                                                                                                                                              |               |      |       |             |      |                        |
| Tracked Savings by E1                                                                                                                                            | 0.879         | MW   | 0.99  | 0.872       | MW   | 101%                   |
| Evaluation Results                                                                                                                                               | 0.898         | MW   | 0.98  | 0.880       | MW   |                        |
| *NTGRs varied for each product category. The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings. |               |      |       |             |      |                        |

Tracked gross energy and peak demand savings were 6% lower and 1% higher than the tracked savings respectively. These differences were due to the update to the 2024-2025 DSM MA. LED lamps, which generated approximately 43% of EPI energy savings in 2024, had their hours of use reduced from 2.7 to 2.6, which reduced unitary savings values by around 4%. Moreover, the introduction of the 84% installation rate for smart thermostats for MSHPs, which was 100% before the update, also explains why evaluated electrical energy savings were lower than tracked electrical energy savings. Even so, smart thermostats for MSHPs had no peak demand savings so this downward impact did not carry over to peak demand savings. Finally, the overall NTGR values established for 2024 were slightly lower than the values used for 2023, which was due to the decreased NTGR value for smart thermostats for MSHPs being counter-balanced by the increased NTGR value for LED lamps.



## 15 EPI Market Evaluation

### 15.1 Jurisdictional Scan

This section outlines the findings of the jurisdictional scan conducted to identify opportunities for electrician-installed measures.

In 2023, E1 introduced some electrician-installed measures to the EPI offering and additional electrician-installed measures were added in 2024; those measures include smart thermostats, lighting controls, and humidity sensors. Therefore, the Evaluator performed a scan across various jurisdictions throughout Canada and the United States (US) to identify other measures that could be installed by electricians under EPI. The Evaluator first focused on direct install programs and then extended the scan to instant rebate programs since potential electrician-installed measures might be found in such programs. For direct install programs, five Canadian and four US jurisdictions were reviewed, for a total of nine reviewed jurisdictions. For instant rebate programs, five jurisdictions were reviewed in each country, for a total of 10.

For direct install programs, most jurisdictions include some measures beyond lighting, airtightness, and hot water products. However, most such additional measures were either already included in the new EPI electrician-installed measures (e.g. smart thermostats) or outside the scope of electrician-installed measures (e.g. insulation, appliances, window air conditioning, heat pumps, heat recovery ventilation, as well as attic or whole-house fans). Similarly, almost all products included through instant rebate programs were either already included in EPI or outside the category of electrician-installed measures (e.g. appliances).

Globally, the scan revealed only a few measures to be considered for the EPI electrician-installed offer as follows:

- › **Advanced heat recovery ventilator (HRV) controls** are typically used in intermittent mode, such as 20 minutes ON and 40 minutes OFF, which corresponds to 67% fewer runtime hours and, consequently, 67% less consumed energy. Such controls can be installed by an electrician if they have access to the HRV and if that HRV only has timer or manual controls.
- › **Bathroom fans** that could be replaced by more recent and efficient models represent an opportunity, although installing a bathroom fan where there was none would increase energy consumption and therefore be seen more as a health and safety measure. If used three hours per day every day, an efficient bathroom fan can save approximately 4.4 kWh per year and up to 35.4 kWh per year if used continuously.<sup>43</sup>
- › **Block heater timers** are currently included through the E1 Instant Savings offering, yet EPI participants that have a block heater and no timer represent a good opportunity to add a timer to save energy. In the 2024-2025 DSM MA, this product has a unitary savings value of 122 kWh/year.
- › **Heat reflector panels or rolls** are thin reflective materials installed behind radiators to reduce heat loss by reflecting heat back into the room instead of allowing it to escape through external walls. This product is mostly useful in hydronically (hot water) heated homes, which are mostly non-electrically heated homes. Approximately 143 m<sup>3</sup> of natural gas per year are expected to be saved with this product.<sup>44</sup>

Other potential measures include smart connected outlets and switches, yet more studies are required to assess the energy and peak demand savings potential of these products since there is high uncertainty around their potential due to the behaviour aspect of how they can generate savings. Some potential also resides with heating and cooling system tune-ups, although EPI electricians would need to be certified refrigeration and air-conditioning mechanics to deliver such a service. Since such certification was not currently required for EPI electrician installers, the Evaluator did not include air-conditioning and heat pump tune-ups in the list above.

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<sup>43</sup> Shelter Analytics. *Mid-Atlantic Technical Reference Manual Version 10*. Northeast Energy Efficiency Partnerships (NEEP), May 2020.

<sup>44</sup> Energy and Resource Solutions for the Ontario Energy Board. *Ontario Natural Gas TRM (version 7.0)*, November 2022.

Furthermore, EPI represents a good opportunity to educate participants on energy efficiency and inform them on their opportunities with other E1 programs. Therefore, EPI installers could identify energy-saving opportunities for products that cannot be replaced through an EPI visit, such as old or inefficient appliances, and offer rebates for replacing them if they are not part of another program.

Finally, some jurisdictions include measures targeted at health and safety, such as carbon monoxide detectors and dehumidifiers; however, these measures do not generate energy savings.

Appendix XIX includes a table presenting the scanned jurisdictions and the measures they offer.

| 2024 EPI Jurisdictional Scan Highlights |                                                                                                                                                                                                                                  |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ›                                       | The EPI offering includes most measures found in direct install programs that have some potential for the EPI electrician-installed offer.                                                                                       |
| ›                                       | Advanced heat recovery ventilator controls, bathroom fans, block heater timers, and heat reflector panels were the only additional measures identified as potentially suitable additions to the EPI electrician-installed offer. |
| ›                                       | Smart connected devices might represent good opportunities in the near future when the potential energy savings will be better supported by relevant studies.                                                                    |
| ›                                       | Heating and cooling system tune-ups could be a good opportunity, although installers would need certification.                                                                                                                   |





## 16 EPI Key Findings and Recommendations

As mentioned previously, the main objectives of the 2024 EPI evaluation were as follows:

- › Collect information on participant perspectives
- › Calculate gross and net EPI results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions<sup>45</sup>
- › Analyze market opportunities

This section provides the Evaluator's key findings and recommendations in relation to the above objectives.

### **2024 EPI-Finding: Participants are highly satisfied with the overall program component.**

During the 2024 participant survey, participants rated the overall program component a 9.4 out of 10 and also provided high ratings on the time taken to complete the work, the quality of work, the information received on energy efficient products, and the efficient products installed.

### **2024 EPI-Finding: EPI net electrical energy savings and peak demand savings fell short of targets.**

EPI achieved 8.948 GWh in net electrical energy savings and 0.880 MW in net peak demand savings at the generator in 2024, thus falling short of the planned net electrical energy savings of 10.569 GWh and net peak demand savings of 1.127 MW.

### **2024 EPI-Finding: Participation slightly increased in 2024, although not enough to increase savings compared to 2023.**

While participation increased by 2% in 2024, average electrical energy savings per participant decreased by 6.3%. This reduction in savings per participant was mainly due to the update to the 2024-2025 DSM MA, notably downward adjustments to smart thermostat and LED lamp unitary savings that respectively represented around 28% and 39% of EPI gross electrical energy savings in 2024.

### **2024 EPI-Finding: Installation rates for most products remained relatively stable, while those of smart thermostats for MSHPs were reduced.**

For the most part, installation rates measured during the 2024 on-site visits varied by less than 10% compared to installation rates used in 2023. One notable exception was smart thermostats for MSHPs, for which the Evaluator had assumed a 100% installation rate when the product was first introduced to EPI. An 84% installation rate was established for this product during the 2024 on-site visits, which represents a 16% reduction. This reduction is mainly due to participants disconnecting their smart thermostats because of arising issues or dissatisfaction with the product.

### **Recommendation #1: To improve the smart thermostat installation rate, explore and implement strategies to reduce the number of participants disconnecting this product due to dissatisfaction.**

For example, follow-up calls could be conducted, installers could educate more participants on this product, or additional educational material on this product could be shared with participants.

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<sup>45</sup> First-year savings are based on typical energy consumption and do not consider changes in energy consumption resulting from the COVID-19 pandemic.

**2024 EPI-Finding: The overall NTGR for EPI value remained stable although per-product NTGR values varied more significantly.**

An overall NTGR of 0.98 was established for EPI in 2024 for both the evaluated electrical energy and peak demand savings, which was similar to 2023 overall NTGR values. The overall NTGR value was stable despite variations in per-product NTGR values. Indeed, it remained stable since the NTGR value for LED lighting increased by a similar factor to the one that the NTGR value for smart thermostats for MSHPs decreased by, thereby cancelling each other out.

**2024 EPI-Finding: Evaluated net electrical energy and peak demand savings were respectively lower and slightly higher than the values tracked by E1.**

The evaluated net electrical energy savings were 6% lower than the tracked net electrical energy savings, while the evaluated net peak demand savings were 1% higher than the tracked net peak demand savings. The main reason for this difference is the impact of the new installation rate of 84% for smart thermostats for MSHPs compared to the tracked value of 100% since this product was the second largest contributor to EPI energy savings in 2024. In addition, the hours of use value for LED lamps, the largest contributor to EPI energy savings in 2024, was reduced by 4%, consequently reducing the energy savings by the same amount. Since smart thermostats for MSHPs do not generate peak demand savings, the impact of the reduced installation rate did not carry over to evaluated net peak demand savings. Finally, the overall NTGR value established in 2024 was slightly lower than the values used in 2023.

**2024 EPI-Finding: The jurisdictional scan revealed several appropriate products to be considered for the EPI electrician-installed measure offer.**

The 2024 EPI jurisdictional scan allowed the Evaluator to identify several measures that would be appropriate for the electrician-installed measures offered through EPI, namely advanced heat recovery ventilator controls, bathroom fans, block heater timers, and heat reflector panels or rolls.

# 17 Green Heat Overview

This section describes Green Heat, follows up on past evaluation recommendations, and provides an overview of participation history.

## 17.1 Green Heat Description

The Green Heat component of the Existing Residential program is aimed at encouraging the installation of energy efficient heating systems as well as heating systems for which fuel is provided from renewable resources in Nova Scotia homes. More specifically, Green Heat provides financial incentives to homeowners for high-efficiency heat pumps, biomass heating systems, solar space and water heating systems, and demand reduction measures.

E1 staff manages and administers Green Heat. Figure 42 outlines the main steps of the Green Heat participation process.

Figure 42: Green Heat Participation Process Summary

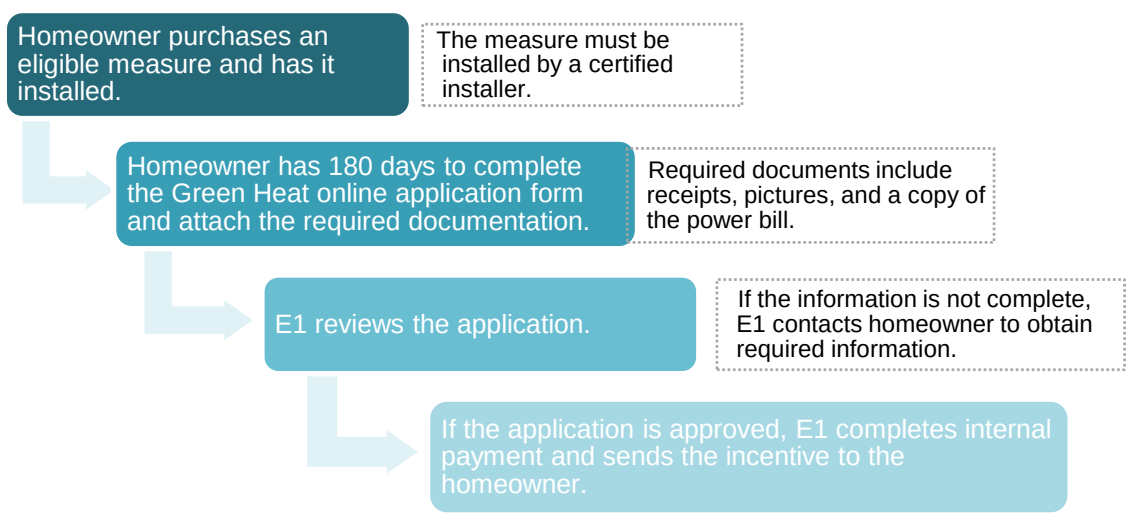


Table 40 below summarizes current Green Heat incentives for each type of eligible system. In February 2024, incentives were increased for ductless mini-split heat pumps (MSHPs), centrally ducted air-source heat pumps (CASHPs), and air-to-water heat pumps (AWHPs). In March 2024, the pilot program delivering rebates for three-element water heaters was discontinued.

**Table 40: 2024 Green Heat Incentives**

| Measure                                                                                                                       | Incentive                   |
|-------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| <b>Heat Pumps</b>                                                                                                             |                             |
| Ductless Mini-split Heat Pumps                                                                                                | \$300/refrigeration tonne   |
| Centrally Ducted Air-source Heat Pumps                                                                                        | \$500/refrigeration tonne   |
| Air-to-water Heat Pumps                                                                                                       | \$2,000/refrigeration tonne |
| Ground-source Heat Pumps                                                                                                      | \$500/refrigeration tonne   |
| <b>Biomass</b>                                                                                                                |                             |
| Wood/Pellet Stoves or Fireplace Inserts                                                                                       | \$750/unit                  |
| Wood/Pellet Boilers or Centrally Ducted Forced Air Furnaces                                                                   | \$1,000/unit                |
| <b>Solar Thermal</b>                                                                                                          |                             |
| Solar Thermal: Air Heating                                                                                                    | \$400/unit                  |
| Solar Domestic Hot Water (DHW)                                                                                                | \$1,000/unit                |
| <b>Demand Reduction</b>                                                                                                       |                             |
| Electric Thermal Storage (ETS, listed room unit)                                                                              | \$316-\$1,600/unit*         |
| Electric Thermal Storage (unlisted room unit)                                                                                 | \$40/kWh                    |
| Electric Thermal Storage (central system)                                                                                     | \$2,000/unit                |
| Three-element Water Heaters (replacing electrical DHW)                                                                        | \$400/unit**                |
| Three-element Water Heaters (replacing oil-fired DHW)                                                                         | \$650/unit**                |
| DHW Heater Timers                                                                                                             | \$20/unit                   |
| * There were nine eligible ETS room units offered through Green Heat. The incentive level varied depending on the model.      |                             |
| ** Only eligible for installations before March 31, 2024. Applications had to be completed and submitted before May 31, 2024. |                             |

Since July 2018, through the addition of funds from the federal Low Carbon Economy Fund (LCEF) and provincial Green Fund, Green Heat has offered heating system rebates for non-electrically heated homes. The rebate amounts and criteria remain unchanged whether the home is electrically or non-electrically heated except for demand reduction measures. This report presents the evaluation results for measures generating electrical savings only. The savings associated with measures that displace non-electrical energy consumption are reported in the Government-funded Evaluation report and are therefore not included herein.

Green Heat was aimed at achieving net electrical energy savings of 3.600 GWh and net peak demand savings of 2.775 MW at the generator in 2024.

## 17.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated Green Heat in previous years and issued improvement recommendations. Table 41 below provides a summary of the implementation status of past recommendations that were carried forward.

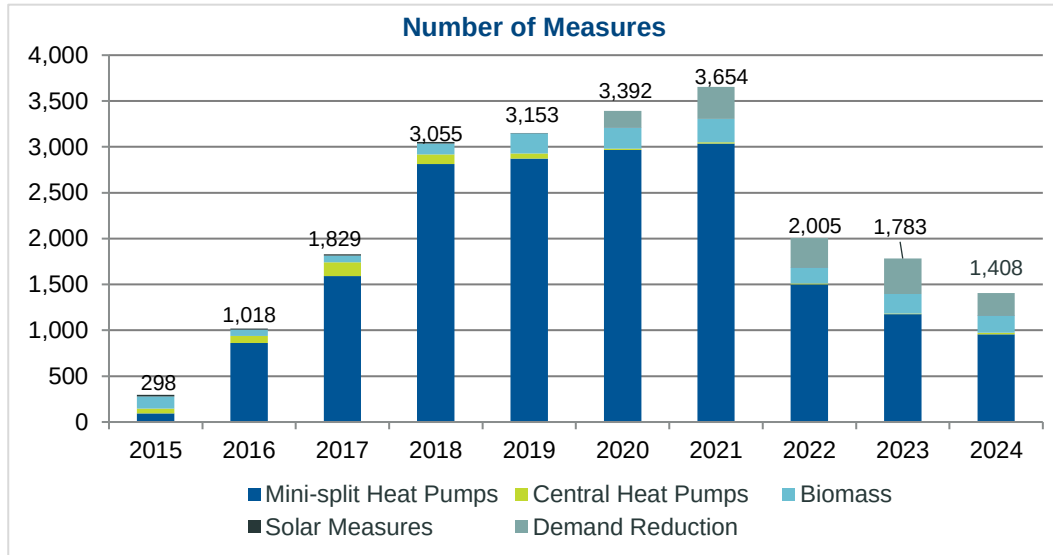
**Table 41: Implementation Status of Past Recommendations for Green Heat**

| #          | Past Recommendations                                                                                                                                                                             | Status      | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2023-GH-R1 | It would be in E1's best interest to ensure that Green Heat marketing materials are available to contractors and participants.                                                                   | In progress | In 2024, E1 worked to create new relevant marketing material. E1 also hosted a webinar in June 2024 for Efficiency Preferred Partners (EPP) to provide information on the differences in rebates for the Oil to Heat Pump Affordability program when participating in the Green Heat, HomeWarming, and Home Energy Assessment program components.                                                                                                                          |
| 2023-GH-R2 | Ensure that the Green Heat page is as user-friendly as possible by making sections, links, eligibility criteria, and eligible equipment lists clear, simple to understand, and easy to navigate. | Complete    | In 2024, E1 redesigned its website, including updates for the Green Heat page, which was completed in the fall of 2024.                                                                                                                                                                                                                                                                                                                                                    |
| 2023-GH-R3 | Investigate how communications between E1 and contractors and participants could be improved.                                                                                                    | Complete    | In 2024, E1 program staff implemented a one business day turn around for responses to contractors and participants emails to ensure timely communications. E1 Customer Services also added a queue callback option into the phone system as well as a webchat option in early 2024. To ensure ESA's have direct access to the most recent customer or participant information, Customer Services integrated their phone system with E1s Customer Information System (CIS). |
| 2023-GH-R4 | Consider offering increased incentives to low and moderate-income households and incentivizing heat pump replacements for those households.                                                      | In progress | E1's exploration of providing low and moderate-income rebates through Green Heat (in addition to market rebates) served to identify challenges with balancing administrative burden and providing a simple post-purchase offer to customers.                                                                                                                                                                                                                               |

## 17.3 Participation History

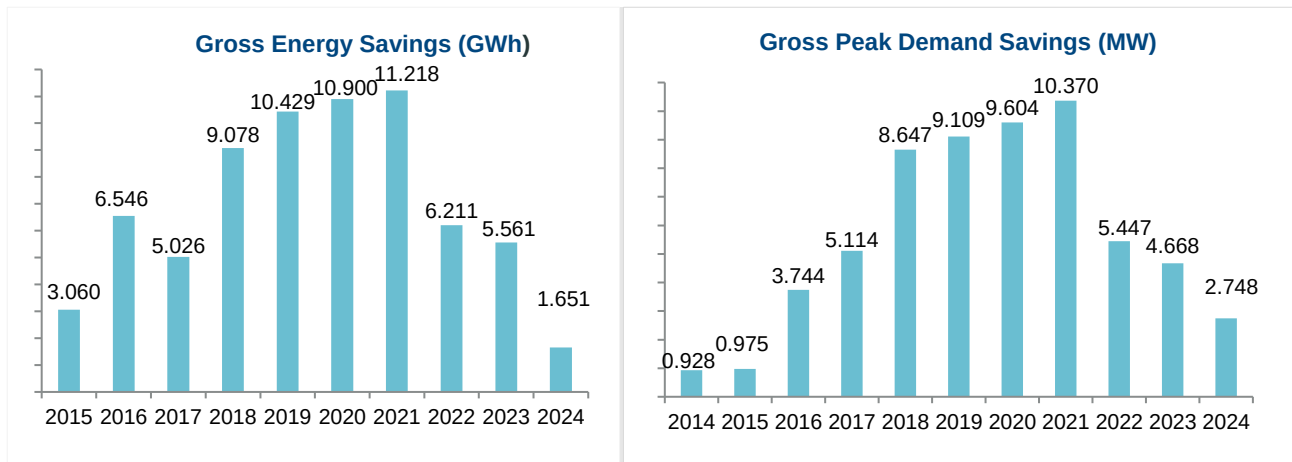
In 2024, the number of Green Heat measures installed decreased by 21% compared to 2023 levels primarily due to a 19% drop in the number of installed MSHPs and a 36% drop in the number of installed demand reduction measures, as illustrated in Figure 43 below. The decrease in installed measures has been observed for three consecutive years now and has been attributed to the launch of the Canada Greener Homes Grant (CGH Grant) by the federal government in May 2021. During those years, a portion of participants opted to enroll in HEA and the CGH Grant rather than Green Heat to access higher federal incentives. Since the CGH Grant was closed to new applicants on February 5, 2024, it is possible that Green Heat participation will increase once again in the upcoming years.

**Figure 43: Overview of Green Heat Participation, 2015-2024**



As indicated in Figure 44 below, Green Heat recorded its lowest savings levels in more than 10 years in 2024, which was 70% lower than 2023 levels. This was due to the combination of lower number of measures installed as well as significantly reduced claimed savings for MSHPs and wood-burning equipment in light of billing analysis results, as presented in Subsection 19.2.2 below.

**Figure 44: Evolution of Green Heat Gross Savings, 2014-2024**



## 18 Green Heat Evaluation Approach

The 2024 Green Heat evaluation comprised a comprehensive impact evaluation.

The main objectives of the evaluation were as follows:

- › Calculate gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

In 2024, the Evaluator identified key research questions aimed at achieving the above objectives. Table 42 outlines the evaluation objectives and maps them to the Evaluator's research questions and methods. Each method is described further below.

**Table 42: 2024 Green Heat Evaluation Approach**

| Evaluation Objectives   | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Methodology                                                                                                                                                                                                                               |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› Which participants did not add an extension to their home (in floor area or newly heated area) as part of their participation in Green Heat and whose results could be included in the sample for the billing analysis?</li><li>› What are the savings for mini-split heat pumps?</li><li>› What are the unitary savings and EUL values for all measures?</li><li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Billing analysis</li><li>› Past participant survey</li><li>› Unitary savings review</li><li>› EUL update</li><li>› Calculations using evaluation results</li></ul> |
| Calculate net results   | <ul style="list-style-type: none"><li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li><li>› What are the net GHG emission reductions in CO2 eq?</li></ul>                                                                                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"><li>› Use of 2023 NTGR results</li><li>› Calculations using evaluation results</li><li>› GHG emission reduction calculations</li></ul>                                                                  |

### Tracking Sheet Audit

Prior to performing the savings review, the Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The detailed protocol used for the tracking sheet audit and the results obtained are presented in Appendix XXIII.

### Billing Analysis

After inconclusive results in 2023, a billing analysis was again conducted for Green Heat as part of the 2024 DSM evaluation to obtain measured electrical energy savings generated through the installation of MSHPs and wood or pellet stoves or fireplace inserts. The results were used to update the unitary savings values for these measures. MSHPs are the most significant measures in Green Heat, followed by wood or pellet stoves or fireplace inserts. The 2024 billing analysis served to update the results of a 2017 billing analysis for MSHPs, while it was conducted for the first time on wood or pellet stoves or fireplace inserts since the resulting measure savings were previously estimated using energy modelling as part of the 2013 evaluation. The detailed approach used for the billing analysis is presented in Appendix XXIV.

## Past Participant Survey

A total of 240 Green Heat participants composed of 204 MHSP participants and 36 wood/pellet stove or fireplace insert participants took part in a web survey in October 2024. The past participant survey served to collect information on participants that were included in the billing analysis and provide insight to establish billing analysis results. More specifically, participants were asked about changes they had made to their homes as part of their renovation project that included the installation of a heat pump or wood stove as well as whether they had air conditioning prior to project implementation. The survey questionnaire used is presented in Appendix XXI, and complete survey results are outlined in Appendix XXII.

Table 43 presents the total number of Green Heat participants included in the analysis with the obtained sample sizes as well as the corresponding margins of error at a 90% confidence level for the 2024 web survey. For biomass measures, the achieved sample size was slightly too small to meet the 10% margin of error target.

**Table 43: 2024 Green Heat Past Participant Survey Sample Sizes and Margins of Error**

| Measure | Population Included in Billing Analysis | Sample Size | Sampling Margin of Error at 90% Confidence Level |
|---------|-----------------------------------------|-------------|--------------------------------------------------|
| MSHPs   | 1,132                                   | 204         | ±5.2%                                            |
| Biomass | 213                                     | 36          | ±12.9%                                           |

## Unitary Savings Review

A unitary savings review was conducted for all measures, excluding measures that relied on a billing analysis, as part of the major update to the 2024-2025 Demand-side Measure Assessment (DSM MA).<sup>46</sup> The unitary savings review entailed a literature review of technical reference manuals, metering studies, and program evaluations to determine if there were more appropriate<sup>47</sup> methodologies or parameters to be applied to calculate energy and peak demand unitary savings, including elements such as baseline assumptions, operation hours, efficiency levels, peak demand-to-energy ratios, and interactive effect factors.

## EUL Update

For the 2024 evaluation, the Evaluator conducted a review of all EUL values as part of the 2024-2025 DSM MA update to determine if there were more appropriate EUL estimates.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime energy and peak demand savings as per the calculation methodology presented in Section 19 below.

<sup>46</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the DSM MA includes effective useful life values for all measures offered in E1's program portfolio. For the evaluations conducted during the last two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.

<sup>47</sup> The Evaluator will judge whether new studies are more appropriate based on various factors, including but not limited to the following: The similarities between the measures implemented in the given study and E1's measures, the similarities in terms of climate or market conditions, the size of the sample studied, whether a study is recent, the quality of the study methodology, etc.





## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for Green Heat, the Evaluator multiplied net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.

### Note on Margin of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>48</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>49</sup>

As part of the 2024 Green Heat evaluation, the Evaluator calculated the margins of error for the unitary energy savings that were obtained from the billing analysis for MSHPs and wood or pellet stoves or fireplace inserts. The margins of error are listed alongside results in the applicable sections below. As it is often the case with billing analyses, there was a high variability in savings from one participant to another, and using all available participants did not allow to reach margins of error that were within the target. The Evaluator therefore kept results with higher margins of error as those represent the best available estimate; the Evaluator ensured that the results were statistically significant, meaning that the absence of savings could reasonably be excluded based on the corresponding confidence interval. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary.

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<sup>48</sup> Precision refers to how reproducible a set of measurements is. It does not take into account how close the measured values are to the true values since this would refer to accuracy.

<sup>49</sup> As part of this evaluation, confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.



## 19 Green Heat Impact Evaluation

The objectives of the 2024 Green Heat impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as effective useful life (EUL) values and associated lifetime energy savings.

### 19.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in detail in Appendix XXII. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 19.2 Gross Savings

For Green Heat, gross savings correspond to the change in energy consumption resulting from actions taken by participants regardless of their reasons for participating.<sup>50</sup> For the 2024 evaluation, the Evaluator relied on the values presented in the 2024-2025 DSM MA.

#### 19.2.1 Installation Rates

Installation rates represent the proportion of measures recorded in the tracking sheet and that remains installed in participants' homes. Installation rates for all energy efficient heating systems under Green Heat were estimated at 100% due to their relatively high cost, and this assumption was not changed as part of the 2024-2025 DSM MA update.

#### 19.2.2 Unitary Energy Savings

To establish Green Heat unitary savings, the Evaluator relied on a combination of billing analyses, energy models, engineering algorithms, and literature reviews. The 2024-2025 DSM MA provides a detailed description of inputs, references, and unitary savings calculations for all measure categories. The following subsections present the results of the billing analysis for MSHP measures and wood/pellet stoves and fireplace inserts, followed by a summary of the updates to unitary savings (including all measures reviewed based on a literature review as part of the 2024-2025 DSM MA major update).

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<sup>50</sup> Definition adapted from National Renewable Energy Laboratory, The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices, September 2014, p. 3.

## Billing Analysis

The billing analysis consisted of calculating the change in electrical energy consumption by comparing levels before and after participation in Green Heat for a group of recent participants (treatment group). To account for variations in electrical energy consumption due to factors other than Green Heat participation, the Evaluator selected a control group of Green Heat participants from previous years and deducted the change in electrical energy consumption observed for that group over the same period (difference-in-differences approach). Subtracting the change in control group electrical energy consumption (i.e. a change that is not linked to the program component) from that of the treatment group ensures that only savings attributable to Green Heat are captured and avoids capturing other effects that can have an impact on energy consumption (e.g. the COVID-19 pandemic) because both the treatment and control groups are impacted by such effects.

As stated previously, the billing analysis results were used to update unitary savings for MSHPs and wood or pellet stoves or fireplace inserts, which are presented in the remainder of this subsection and in Subsection 19.2.3 below. Past participant survey results were used to remove from the billing analysis participants who, as part of their Green Heat renovation project, also added heated floor area (i.e. by building an extension to their home or by starting to heat existing rooms that were not previously heated). The detailed approach used for the billing analysis is presented in Appendix XXIV.

## Summary of Updates to Unitary Energy Savings

Table 44 below summarizes the tracked and evaluated unitary energy savings values of each measure installed through Green Heat and for which there was an update in the 2024-2025 DSM MA.

The MSHP and wood/pellet stove and fireplace insert unitary savings were updated as per the results of the billing analysis described above. The Evaluator maintained the same unitary savings values for all other measures.

**Table 44: 2024 Green Heat Tracked and Evaluated Unitary Energy Savings**

| Measure                                                                                                                                                                                           | Tracked Savings | Evaluated Savings |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|
| <b>Heat Pumps</b>                                                                                                                                                                                 |                 |                   |
| MSHPs – Fully Electrically Heated                                                                                                                                                                 | 0.179 kWh/Btu/h | 0.0855 kWh/Btu/h* |
| MSHPs – Mainly Electrically Heated**                                                                                                                                                              | 0.060 kWh/Btu/h | 0.000 kWh/Btu/h   |
| <b>Biomass</b>                                                                                                                                                                                    |                 |                   |
| Wood Stoves with Electric Resistance Baseline                                                                                                                                                     | 10,443 kWh/year | 1,461 kWh/year    |
| Wood Stoves with Heat Pump Baseline                                                                                                                                                               | 4,747 kWh/year  | 1,461 kWh/year    |
| Pellet Stoves with Electric Resistance Baseline                                                                                                                                                   | 8,959 kWh/year  | 1,461 kWh/year    |
| Pellet Stoves with Heat Pump Baseline                                                                                                                                                             | 4,072 kWh/year  | 1,461 kWh/year    |
| Wood Fireplace Inserts with Electric Resistance Baseline                                                                                                                                          | 10,443 kWh/year | 232 kWh/year      |
| Wood Fireplace Inserts with Heat Pump Baseline                                                                                                                                                    | 4,747 kWh/year  | 232 kWh/year      |
| Pellet Fireplace Inserts with Electric Resistance Baseline                                                                                                                                        | 8,959 kWh/year  | 232 kWh/year      |
| Pellet Fireplace Inserts with Heat Pump Baseline                                                                                                                                                  | 4,072 kWh/year  | 232 kWh/year      |
| Wood Furnaces or Boilers with Heat Pump Baseline                                                                                                                                                  | 6,275 kWh/year  | 7,669 kWh/year    |
| Pellet Furnaces or Boilers with Heat Pump Baseline                                                                                                                                                | 6,257 kWh/year  | 7,647 kWh/year    |
| *Unitary savings expressed in kWh/Btu/h are applied to individual MSHPs heating capacity to obtain unitary savings specific to each MSHP. On average, this represents 1,460 kWh per MSHP in 2024. |                 |                   |
| **Mainly electrically heated refers to households with an electric primary heating system and a non-electric secondary heating system.                                                            |                 |                   |



A detailed analysis of the variation between the tracked and evaluated savings is presented in Appendix XXIV, and the Evaluator lists the key points of that analysis below.

- › The unitary savings for MSHPs decreased significantly. The reduction is partially due to changes in the methodology, such as adding a control group to the pre-post billing analysis, although savings did decrease beyond methodology changes when comparing to the 2017 billing analysis. The Evaluator compared the results obtained for MSHPs in Green Heat to those for HEA participants who only installed MSHPs and found that the results were similar. Furthermore, a literature review was conducted to compare the results of this 2024 billing analysis to other similar and recent studies in other jurisdictions, the results of which supported the validity of these new results.
- › Electrical energy savings for MSHPs in mainly electrically heated households were found to be nil. Since the billing analysis was based only on electricity consumption, it was not possible to measure non-electrical savings, which does not mean that MSHPs do not generate non-electrical savings. In fact, the Evaluator considers that the most likely reason for seeing no electrical energy savings is that the increase in electricity consumption due to transferring a portion of heating consumption from wood or oil to an electric heat pump cancels out the electricity savings achieved by replacing some electric resistance heating by the heat pump.
- › The unitary savings for wood or pellet stoves were decreased by a large margin. This change was mostly due to a change in methodology because the previous estimate of electrical energy savings was not based on a pre- and post-installation comparison of electricity consumption. Rather, it was based on a HOT2000 simulation for which only the post-installation period was calibrated to match electricity bills. This approach assumed that any consumption below the simulated consumption for 100% electric resistance space heating was fully met by the stoves and fireplace inserts,<sup>51</sup> while in fact it appeared that the space heating load was overestimated, and that the energy savings were overestimated as a result.
- › While wood or pellet fireplace inserts represented only a small portion of the biomass measures included in the billing analysis, the average savings measured for this measure were significantly lower than that of wood or pellet stoves. The Evaluator therefore separated the wood or pellet fireplace inserts from the other biomass measures in the billing analysis results. The savings obtained for this measure are not statistically significant (meaning that the margin of error on the value is larger than the savings value itself).

### 19.2.3 Unitary Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity peak demand period in Nova Scotia is defined as the coldest days (with an on-peak temperature estimated at -15°C) between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays.

For MSHPs, unitary peak demand savings are calculated individually for each system installed. Since the billing analysis resulted in nil electrical energy savings for homes mainly electrically heated with MSHPs, no peak demand savings were claimed for those installations. Peak demand savings calculations for homes fully electrically heated with MSHPs remained unchanged since the electrical energy savings results are not used to calculate peak demand savings.

For wood or pellet stoves or fireplace inserts, in light of the significant reduction in unitary energy savings resulting from the billing analysis, the Evaluator also adjusted the peak demand savings. This change was necessary because the tracked peak demand savings were based on the assumed heating load obtained from the energy simulations mentioned in Subsection 19.2.2 above, and these were no longer valid as proven by the billing analysis. Therefore, the peak demand savings were reduced by the ratio of evaluated electrical energy savings to tracked electrical energy savings.

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<sup>51</sup> Econoler, *Green Heat 2013 DSM Evaluation*, Report prepared for Efficiency Nova Scotia Corporation, February 21, 2014, p. 25.

Table 45 below summarizes the evaluated unitary peak demand savings values for each measure installed through Green Heat for which there was an update in the 2024-2025 DSM MA. The detailed rationale and calculations for these changes are presented in the 2024-2025 DSM MA.

**Table 45: 2024 Green Heat Tracked and Evaluated Unitary Peak Demand Savings**

| Measure                                                      | Tracked Peak Demand Savings [W] | Evaluated Peak Demand Savings [W] |
|--------------------------------------------------------------|---------------------------------|-----------------------------------|
| <b>Biomass</b>                                               |                                 |                                   |
| Wood Stoves with Electric Resistance Baseline                | 4,000                           | 828                               |
| Wood Stoves with Heat Pump Baseline                          | 4,000                           | 828                               |
| Pellet Stoves with Electric Resistance Baseline              | 4,000                           | 828                               |
| Pellet Stoves with Heat Pump Baseline                        | 4,000                           | 828                               |
| Wood Fireplace Inserts with Electric Resistance Baseline     | 4,000                           | 132                               |
| Wood Fireplace Inserts with Heat Pump Baseline               | 4,000                           | 132                               |
| Pellet Fireplace Inserts with Electric Resistance Baseline   | 4,000                           | 132                               |
| Pellet Fireplace Inserts with Heat Pump Baseline             | 4,000                           | 132                               |
| Pellet Furnaces or Boilers with Electric Resistance Baseline | 7,775                           | 7,750                             |
| Pellet Furnaces or Boilers with Heat Pump Baseline           | 7,775                           | 7,750                             |

### 19.2.4 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling. Since Green Heat high-efficiency heating measures directly target heating and cooling loads, the impact of those measures on heating and cooling is considered in the unitary savings. Therefore, no additional interactive effects factors were applied to the savings of all measures because the interactive effects factor for each measure is assumed to be nil. This assumption remained valid in 2024.

### 19.2.5 Effective Useful Life

As part of the 2024-2025 DSM MA activities, the Evaluator reviewed the EUL values used in the calculations of electrical energy savings that are expected to persist over time. All EUL values used in previous years remained unchanged in the 2024-2025 DSM MA.

The equivalent EUL values are applied to the gross and net first-year electrical energy savings of each measure to obtain the gross and net lifetime electrical energy savings. As a result, the weighted average EUL values for gross and net savings differ (see Subsections 19.2.6 and 19.3 below). The gross weighted average EUL value is equal to 18.0 years.

## 19.2.6 Evaluated Gross Savings

The annual gross savings for each category of measure installed through Green Heat in 2024 are listed in Table 46 below.

The gross savings at the generator were estimated by using a line loss factors associated to the rate code of each participant. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>52</sup>

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<sup>52</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1. For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed. If a municipal utility participant did not have any specific rate code, the average of participants for which the line loss was known was used.

**Table 46: Evaluated 2024 Green Heat Gross Electrical Energy and Peak Demand Savings**

| Measure                                                       | MSHPs            |                   | CASHPs       | Air-to-water Heat Pumps |
|---------------------------------------------------------------|------------------|-------------------|--------------|-------------------------|
|                                                               | Fully Electrical | Mainly Electrical |              |                         |
| Number of Units                                               | 793              | 162               | 16           | 1                       |
| <b>Energy Savings</b>                                         |                  |                   |              |                         |
| Unitary Energy Savings (kWh)                                  | 1,480            | -                 | 3,491        | 7,272                   |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>1.174</b>     | -                 | 0.056        | <b>0.007</b>            |
| Line Loss Factor                                              | 1.0947           | -                 | 1.0947       | 1.0947                  |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>1.285</b>     | -                 | 0.061        | <b>0.008</b>            |
| Effective Useful Life (years)                                 | 18               | 18                | 18           | 18                      |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>23.126</b>    | -                 | 1.101        | <b>0.143</b>            |
| <b>Peak Demand Savings</b>                                    |                  |                   |              |                         |
| Unitary Peak Demand Savings (W)                               | 2,501            | -                 | 3,988        | 3,988                   |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>1.983</b>     | -                 | <b>0.064</b> | <b>0.004</b>            |
| Line Loss Factor                                              | 1.1465           | -                 | 1.1466       | 1.1466                  |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>2.274</b>     | -                 | <b>0.073</b> | <b>0.005</b>            |

## Evaluated 2024 Green Heat Gross Electrical Energy and Peak Demand Savings (Continued)

| Measure                                                       | Wood Stoves  | Pellet Stoves | Wood Fireplace Inserts | Pellet Fireplace Inserts | Wood Furnaces/Boilers - Electric Resistance Baseline |
|---------------------------------------------------------------|--------------|---------------|------------------------|--------------------------|------------------------------------------------------|
| Number of Units                                               | 147          | 26            | 13                     | 2                        | 1                                                    |
| <b>Energy Savings</b>                                         |              |               |                        |                          |                                                      |
| Unitary Energy Savings (kWh)                                  | 1,461        | 1,461         | 232                    | 232                      | 13,804                                               |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>0.215</b> | <b>0.038</b>  | <b>0.003</b>           | <b>0.000</b>             | <b>0.014</b>                                         |
| Line Loss Factor                                              | 1.0947       | 1.0947        | 1.0947                 | 1.0947                   | 1.0947                                               |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>0.235</b> | <b>0.042</b>  | <b>0.003</b>           | <b>0.001</b>             | <b>0.015</b>                                         |
| Effective Useful Life (years)                                 | 18           | 18            | 18                     | 18                       | 18                                                   |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>4.232</b> | <b>0.748</b>  | <b>0.059</b>           | <b>0.009</b>             | <b>0.272</b>                                         |
| <b>Peak Demand Savings</b>                                    |              |               |                        |                          |                                                      |
| Unitary Peak Demand Savings (W)                               | 828          | 828           | 132                    | 132                      | 7,660                                                |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.122</b> | <b>0.022</b>  | <b>0.002</b>           | <b>0.000</b>             | <b>0.008</b>                                         |
| Line Loss Factor                                              | 1.1466       | 1.1466        | 1.1466                 | 1.1466                   | 1.1466                                               |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.140</b> | <b>0.025</b>  | <b>0.002</b>           | <b>0.000</b>             | <b>0.009</b>                                         |



## Evaluated 2024 Green Heat Gross Electrical Energy and Peak Demand Savings (Continued)

| Measure                                                       | Solar DHW    | ETS          | Three-element Water Heaters | DHW Heater Timers | Total         |
|---------------------------------------------------------------|--------------|--------------|-----------------------------|-------------------|---------------|
| <b>Number of Units</b>                                        | <b>1</b>     | <b>133</b>   | <b>71</b>                   | <b>42</b>         | <b>1408</b>   |
| <b>Energy Savings</b>                                         |              |              |                             |                   |               |
| Unitary Energy Savings (kWh)                                  | 1,546        | -            | -                           | -                 | -             |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>0.002</b> | <b>-</b>     | <b>-</b>                    | <b>-</b>          | <b>1.508</b>  |
| Line Loss Factor                                              | 1.0947       | -            | -                           | -                 | -             |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>0.002</b> | <b>-</b>     | <b>-</b>                    | <b>-</b>          | <b>1.651</b>  |
| Effective Useful Life (years)                                 | 20           | 18           | 12                          | 15                | -             |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.034</b> | <b>-</b>     | <b>-</b>                    | <b>-</b>          | <b>29.724</b> |
| <b>Peak Demand Savings</b>                                    |              |              |                             |                   |               |
| Unitary Peak Demand Savings (W)                               | -            | 1,187        | 200                         | 500               | -             |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>-</b>     | <b>0.158</b> | <b>0.014</b>                | <b>0.021</b>      | <b>2.397</b>  |
| Line Loss Factor                                              | -            | 1.1466       | 1.1466                      | 1.1466            | -             |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>-</b>     | <b>0.181</b> | <b>0.016</b>                | <b>0.024</b>      | <b>2.748</b>  |

Figure 45 below compares tracked gross electrical energy savings to evaluated gross electrical energy savings at the generator. As outlined in the figure, tracked and evaluated electrical energy savings are the same for solar measures, demand response measures, as well as CASHPs and AWHPs, but evaluated electrical energy savings were significantly lower for the two measures that generate the most savings, namely biomass measures and MSHPs for which the unitary savings were updated as part of the 2024-2025 DSM MA.

**Figure 45: 2024 Green Heat Tracked and Evaluated Gross Electrical Energy Savings at the Generator (GWh)**

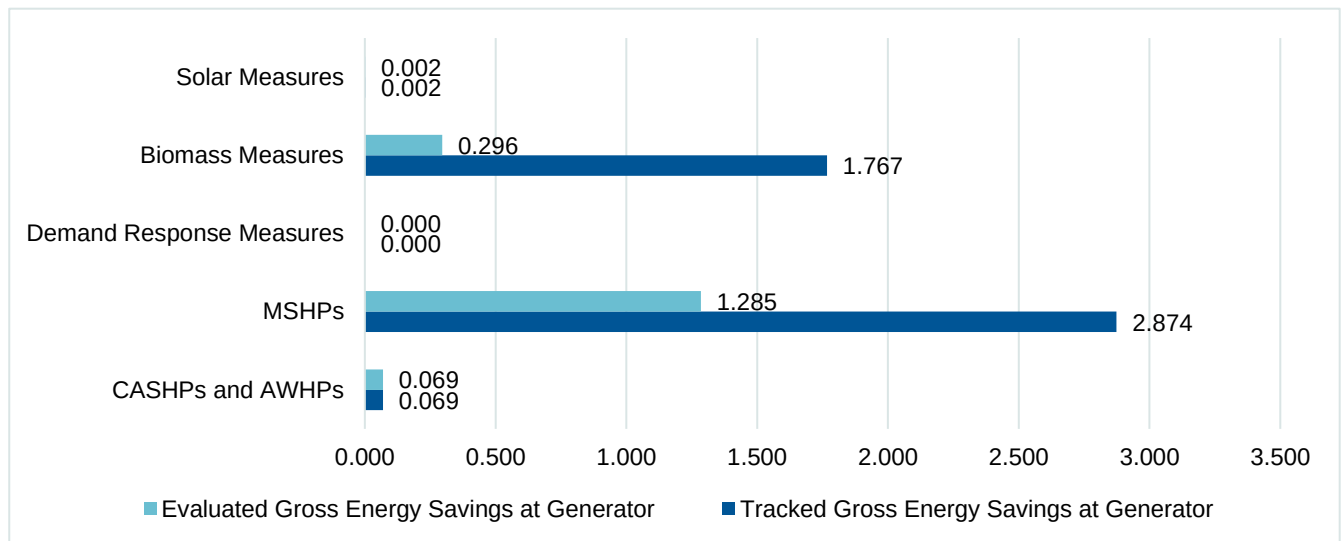
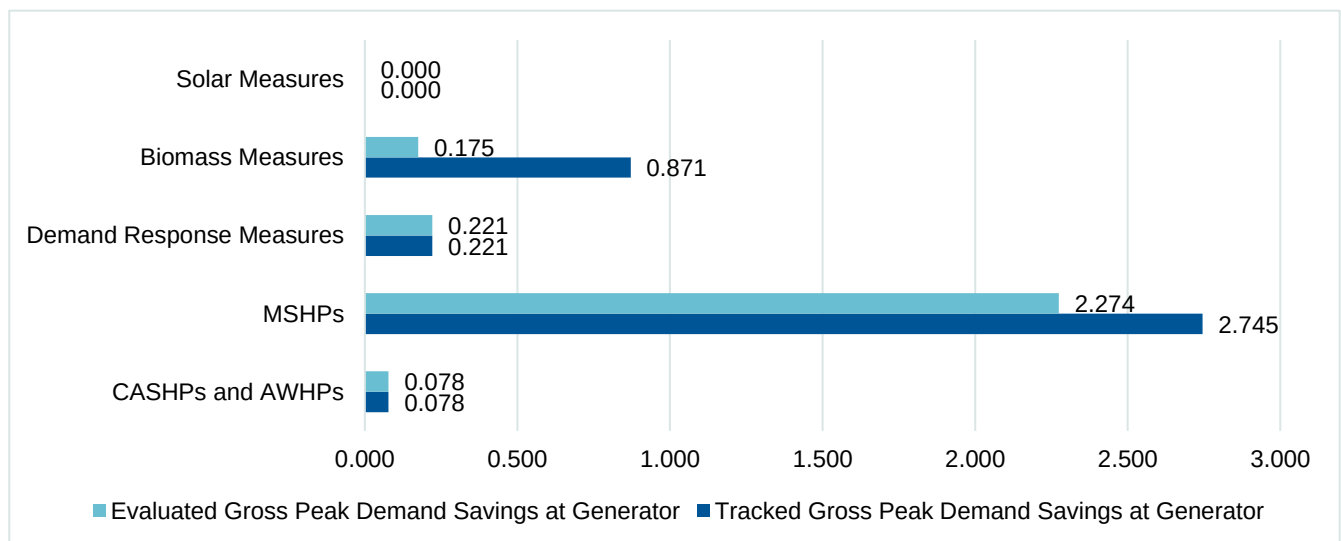


Figure 46 below compares tracked gross peak demand savings to evaluated gross peak demand savings at the generator. A similar trend as for electrical energy savings is illustrated in this figure.; for biomass measures and MSHPs, the reduction in unitary savings led to significantly lower evaluated peak demand savings than tracked peak demand savings.

**Figure 46: 2024 Green Heat Tracked and Evaluated Gross Peak Demand Savings at the Generator (MW)**



As presented in Table 47, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>53</sup> for GHG emissions generated by electricity production to Green Heat gross electrical energy savings.

**Table 47: Evaluated 2024 Green Heat GHG Gross Emission Reductions**

|                                                                                             | Total        |
|---------------------------------------------------------------------------------------------|--------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>1.651</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2        |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>780</b>   |

## 19.3 Net Savings

The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to a program component, by estimating the NTGR. More precisely, the NTGR includes effects such as free-ridership and spillover that positively or negatively affect both the energy savings and peak demand savings generated by a program component. In the case of Green Heat, only free-ridership is considered.

### 19.3.1 Free-ridership

For Green Heat, free-ridership occurs when participants would have still installed a new, more efficient heating system in the absence of the program component.

Free-ridership was assessed during the 2023 evaluation using a self-reporting approach with participants. Since no data-collection activities aimed at updating the free-ridership levels were conducted for 2024, the 2023 levels were used for the 2024 evaluation for all measures.

Table 48 outlines the free-ridership levels used for 2024 along with 2023 survey parameters.

**Table 48: 2024 Green Heat Average Free-ridership Levels**

| Measure                                                                                                                                                                                                                                                      | Average Free-ridership Level | Sample Size | Population Size | Margin of Error |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------|-----------------|-----------------|
| MSHPs                                                                                                                                                                                                                                                        | 48%                          | 90          | 1,132           | 5.5%            |
| Biomass Measures                                                                                                                                                                                                                                             | 47%                          | 29          | 213             | 8.2%            |
| Demand Reduction Measures                                                                                                                                                                                                                                    | 9%                           | 5           | 314             | 13.4%           |
| CASHPs and AWHPs*                                                                                                                                                                                                                                            | 33%                          | 30          | 54              | 7.6%            |
| *CASHPs and AWHPs free-ridership levels were not measured in 2023 due to the very low number of participants that installed this measure. The free-ridership results presented above for these two measures were established as part of the 2021 evaluation. |                              |             |                 |                 |

<sup>53</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

### 19.3.2 Net-to-gross Ratio Calculation

The NTGR was calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership})$$

Using the free-ridership level established for each measure category, the Evaluator calculated the NTGR values presented in Table 49.

**Table 49: 2024 Green Heat NTGRs**

| Measure                    | Free-ridership | NTGR |
|----------------------------|----------------|------|
| MSHPs                      | 48%            | 0.52 |
| Biomass and Solar Measures | 47%            | 0.53 |
| Demand Reduction Measures  | 9%             | 0.91 |
| CASHPs and AWHPs           | 33%            | 0.67 |

### 19.3.3 Evaluated Net Savings

Net savings are defined as the energy use reductions specifically attributable to Green Heat. Net savings were estimated by applying the NTGRs listed above to the evaluated gross savings using the following equation.

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR}$$

This equation was used to calculate both electrical energy savings and peak demand savings.

The detailed results are presented in Table 50 below. The net electrical energy savings resulted in 412 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions.

**Table 50: Evaluated 2024 Green Heat Net Electrical Energy and Peak Demand Savings**

| Measure                                              | MSHPs            |                   | CASHPs | AWHPs  |
|------------------------------------------------------|------------------|-------------------|--------|--------|
|                                                      | Fully Electrical | Mainly Electrical |        |        |
| Energy Savings                                       |                  |                   |        |        |
| Gross Energy Savings – at the Meter (GWh)            | 1.174            | -                 | 0.056  | 0.007  |
| NTGR                                                 | 0.52             | 0.52              | 0.67   | 0.67   |
| Net Energy Savings – at the Meter (GWh)              | 0.610            | -                 | 0.037  | 0.005  |
| Line Loss Factor                                     | 1.0947           | -                 | 1.0947 | 1.0947 |
| Net Energy Savings – at the Generator (GWh)          | 0.668            | -                 | 0.041  | 0.005  |
| Effective Useful Life (years)                        | 18               | 18                | 18     | 18     |
| Net Lifetime Energy Savings – at the Generator (GWh) | 12.025           | -                 | 0.737  | 0.096  |
| Peak Demand Savings                                  |                  |                   |        |        |
| Gross Peak Demand Savings – at the Meter (MW)        | 1.983            | -                 | 0.064  | 0.004  |
| NTGR                                                 | 0.52             | 0.52              | 0.67   | 0.67   |
| Net Peak Demand Savings – at the Meter (MW)          | 1.031            | -                 | 0.043  | 0.003  |
| Line Loss Factor                                     | 1.1465           | 1.1466            | 1.1466 | 1.1466 |
| Net Peak Demand Savings – at the Generator (MW)      | 1.182            | -                 | 0.049  | 0.003  |

Evaluated 2024 Green Heat Net Electrical Energy and Peak Demand Savings (Continued)

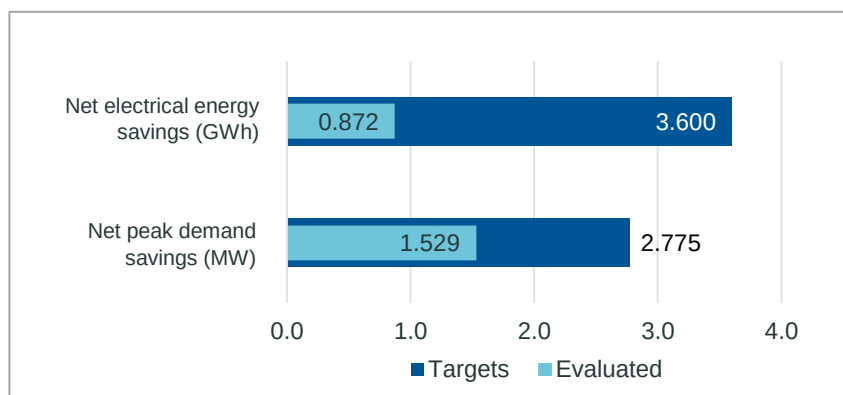
| Measure                                                     | Wood Stoves  | Pellet Stoves | Wood Fireplace Inserts | Pellet Fireplace Inserts | Wood Furnaces/Boilers - Electric Resistance Baseline |
|-------------------------------------------------------------|--------------|---------------|------------------------|--------------------------|------------------------------------------------------|
| <b>Energy Savings</b>                                       |              |               |                        |                          |                                                      |
| Gross Energy Savings – at the Meter (GWh)                   | 0.215        | 0.038         | 0.003                  | 0.000                    | 0.014                                                |
| NTGR                                                        | 0.53         | 0.53          | 0.53                   | 0.53                     | 0.53                                                 |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>0.114</b> | <b>0.020</b>  | <b>0.002</b>           | <b>0.000</b>             | <b>0.007</b>                                         |
| Line Loss Factor                                            | 1.0947       | 1.0947        | 1.0947                 | 1.0947                   | 1.0947                                               |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>0.125</b> | <b>0.022</b>  | <b>0.002</b>           | <b>0.000</b>             | <b>0.008</b>                                         |
| Effective Useful Life (years)                               | 18           | 18            | 18                     | 18                       | 18                                                   |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>2.243</b> | <b>0.397</b>  | <b>0.031</b>           | <b>0.005</b>             | <b>0.144</b>                                         |
| <b>Peak Demand Savings</b>                                  |              |               |                        |                          |                                                      |
| Gross Peak Demand Savings – at the Meter (MW)               | 0.122        | 0.022         | 0.002                  | 0.000                    | 0.008                                                |
| NTGR                                                        | 0.53         | 0.53          | 0.53                   | 0.53                     | 0.53                                                 |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>0.065</b> | <b>0.011</b>  | <b>0.001</b>           | <b>0.000</b>             | <b>0.004</b>                                         |
| Line Loss Factor                                            | 1.1466       | 1.1466        | 1.1466                 | 1.1466                   | 1.1466                                               |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>0.074</b> | <b>0.013</b>  | <b>0.001</b>           | <b>0.000</b>             | <b>0.005</b>                                         |

Evaluated 2024 Green Heat Net Electrical Energy and Peak Demand Savings (Continued)

| Measure                                                     | Solar DHW    | Electric Thermal Storage | Three-element Water Heaters | DHW Heater Timers | Total         |
|-------------------------------------------------------------|--------------|--------------------------|-----------------------------|-------------------|---------------|
| <b>Energy Savings</b>                                       |              |                          |                             |                   |               |
| Gross Energy Savings – at the Meter (GWh)                   | 0.002        | -                        | -                           | -                 | 1.508         |
| NTGR                                                        | 0.53         | 0.91                     | 0.91                        | 0.91              | -             |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>0.001</b> | <b>-</b>                 | <b>-</b>                    | <b>-</b>          | <b>0.797</b>  |
| Line Loss Factor                                            | 1.0947       | -                        | -                           | -                 | -             |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>0.001</b> | <b>-</b>                 | <b>-</b>                    | <b>-</b>          | <b>0.872</b>  |
| Effective Useful Life (years)                               | 20           | 18                       | 12                          | 15                | -             |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.018</b> | <b>-</b>                 | <b>-</b>                    | <b>-</b>          | <b>15.697</b> |
| <b>Peak Demand Savings</b>                                  |              |                          |                             |                   |               |
| Gross Peak Demand Savings –at the Meter (MW)                | -            | 0.158                    | 0.014                       | 0.021             | 2.397         |
| NTGR                                                        | 0.53         | 0.91                     | 0.91                        | 0.91              | -             |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>-</b>     | <b>0.144</b>             | <b>0.013</b>                | <b>0.019</b>      | <b>1.333</b>  |
| Line Loss Factor                                            | 1.1466       | 1.1466                   | 1.1466                      | 1.1466            | -             |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>-</b>     | <b>0.165</b>             | <b>0.015</b>                | <b>0.022</b>      | <b>1.529</b>  |

As outlined in Figure 47, Green Heat fell short of both its electrical energy and peak demand savings targets by 76% and 45% respectively.

**Figure 47: 2024 Green Heat Targets and Evaluated Savings**



## 19.4 Realization Rate

Table 51 below compares the energy and peak demand savings established through the 2024 evaluation to those calculated in the 2024 tracking sheet. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 51: Comparison of 2024 Green Heat Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                  | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                  | Value         | Unit |       | Value       | Unit |                  |
| Energy Savings                                                                                                                                                   |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                            | 4.711         | GWh  | 0.53  | 2.478       | GWh  | 35%              |
| Evaluation Results                                                                                                                                               | 1.651         | GWh  | 0.53  | 0.872       | GWh  |                  |
| Peak Demand Savings                                                                                                                                              |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                            | 3.915         | MW   | 0.55  | 2.143       | MW   | 71%              |
| Evaluation Results                                                                                                                                               | 2.748         | MW   | 0.56  | 1.529       | MW   |                  |
| *NTGRs varied for each measure category. The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings. |               |      |       |             |      |                  |

The evaluated gross electrical energy and peak demand savings determined by the Evaluator were significantly lower than the initial gross savings tracked by E1. This is explained by the lower unitary savings for MSHPs and biomass measures as a result of the billing analysis. For the same reasons, net electrical energy and peak demand savings were also lower than the tracked values, although the reduction is less significant than for energy savings.





## 20 Green Heat Key Findings and Recommendations

As mentioned previously, the main objectives of the 2024 Green Heat evaluation were as follows:

- › Calculate gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

This section provides the Evaluator's key findings in relation to the above objectives.

**2024 Green Heat-Finding: Green Heat fell short of its net savings targets, achieving 24% and 55% of its electrical energy and peak demand targets respectively.**

Green Heat achieved 0.872 GWh in net electrical energy savings and 1.529 MW in net peak demand savings at the generator in 2024, thus falling short of the planned net electrical energy savings of 3.600 GWh and net peak demand savings of 2.775 MW. While lower than expected participation partially explains part of the missed targets, the primary reason is the low realization rates that were obtained through the billing analyses conducted for the 2024 evaluation, as described below.

**2024 Green Heat-Finding: Green Heat participation decreased for the third consecutive year.**

Green Heat participation levels decreased by 21% compared to 2023 levels, particularly for MSHPs (19% reduction) and demand reduction measures (36% reduction). The decrease in the number of installed measures has been observed for three consecutive years and has been attributed to the launch of the CGH Grant by the federal government in May 2021. During those years, a portion of participants opted to enroll in HEA and the CGH Grant rather than Green Heat to access higher federal incentives. Since the CGH Grant was closed to new applicants on February 5, 2024, it is possible that Green Heat participation will increase once again in the upcoming years.

**2024 Green Heat-Finding: Both the evaluated gross electrical energy and peak demand savings were significantly lower than the savings tracked by E1.**

Green Heat underwent a comprehensive impact evaluation in 2024. Following the billing analysis results, significant changes were made by the Evaluator to gross electrical energy and peak demand savings parameters and calculations, which resulted in low realization rates of 35% and 71% for net electrical energy savings and net peak demand savings respectively. These significant reductions between tracked and evaluated savings are explained by the lower unitary savings for MSHPs and biomass measures. Most notably, unitary energy savings for MSHPs in fully electrically heated households were reduced by half, those in mainly electrically heated households were found to be nil, and those for wood stoves, pellet stoves, and fireplace inserts were reduced by 83% on average.

**Recommendation #1: Consider removing wood fireplace inserts and pellet fireplace inserts from the Green Heat offer.** In light of the very low savings with no statistical significance and considering the low uptake of these measures, the Evaluator recommends re-evaluating the program component offering for wood fireplace inserts and pellet fireplace inserts

**2024 Green Heat-Finding:** The nil electrical energy savings found for mainly electrically heated households as part of the billing analysis now suggests that the increase in electricity consumption due to transferring a portion of the heating consumption from wood or oil to an electric heat pump cancels out the electricity savings achieved by replacing some electric resistance heating by a heat pump. While DSM savings only consider electrical savings, there are most likely other fuel savings occurring for these participants.

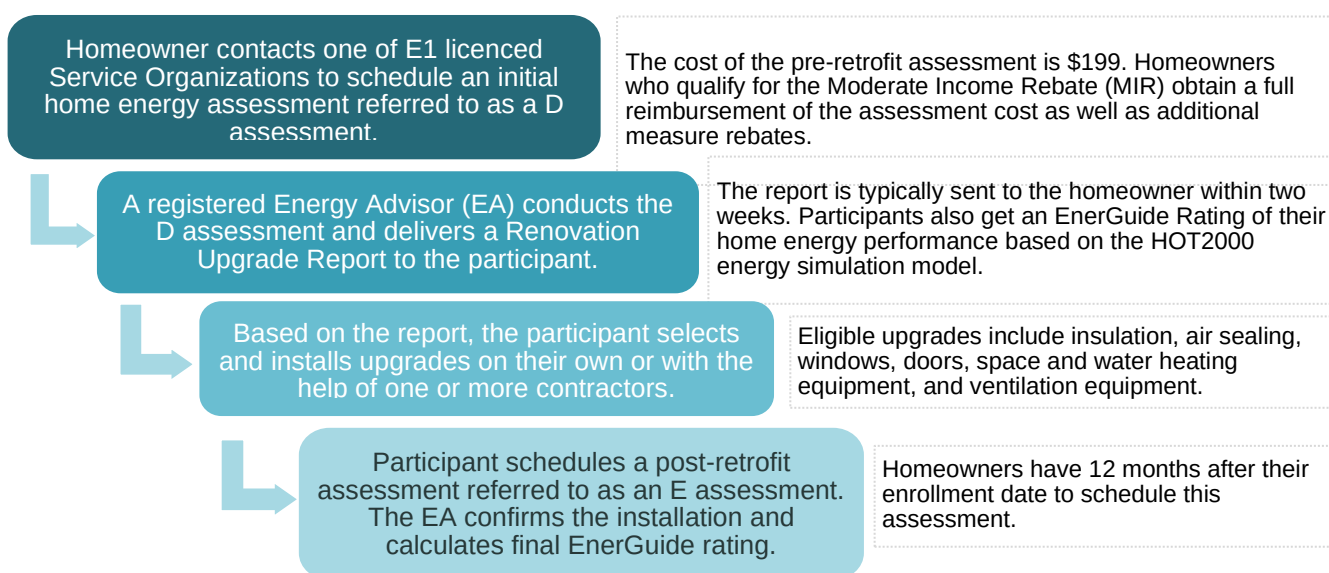
## 21 HEA Overview

This section describes Home Energy Assessment (HEA), follows up on past evaluation recommendations, and provides an overview of participation history.

### 21.1 HEA Description

HEA is a home energy evaluation-based program component that encourages homeowners to improve the energy efficiency and comfort of their homes by providing them with related information and financial incentives in the form of rebates. HEA uses the EnerGuide home evaluation framework and is administered in collaboration with Natural Resources Canada (NRCan). Figure 48 illustrates the participation process along with details about the program component.

**Figure 48: HEA Participation Process Summary**



Since 2018, HEA offers the same services to non-electrically heated homes. This report presents the evaluation results for electrical measures only.

In May 2021, the federal government announced the launch of the Canada Greener Homes (CGH) Grant. The initiative offered grants of up to \$5,000 to help homeowners implement energy efficiency retrofits in their primary residences. In Nova Scotia, the CGH Grant was co-delivered by E1 through HEA. On 5 February 2024, the CGH Grant was closed to new applications, which means that measures solely funded by the CGH Grant, namely resiliency measures (batteries for solar PV, roofing membranes, foundation water proofing, and moisture proofing), solar PV, and smart thermostats, are no longer available for applicants after this date.

At the end of 2022, low uptake measures (air-to-water heat pumps, solar air equipment, and drain water heat recovery) as well as demand reduction measures (electric thermal storage [ETS] units, three-element water heaters, domestic hot water [DHW] heater timers) were removed from the offering. Rebates for those measures are honoured for customers who enrolled prior to these changes taking effect.

HEA was aimed at achieving 19.012 GWh in net electrical energy savings and 4.799 MW in net peak demand savings at the generator in 2024.

## 21.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated HEA in previous years and issued improvement recommendations. Table 52 below provides a summary of the implementation status of past recommendations that were carried forward. The Evaluator notes that all remaining recommendations were completed in 2024.

**Table 52: Implementation Status of Past Recommendations for HEA**

| #               | Past Recommendations                                                                                                                                                                                                                              | Status   | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2018<br>HEA-R1  | Conduct a billing analysis to review overestimation ratios (ORs) when a sufficient participant sample becomes available.                                                                                                                          | Complete | A billing analysis has been planned for 2022 to reassess the overestimation ratio. The billing analysis was deferred in 2022 due to the number of participants with sufficient billing data being too low to establish reliable overestimation ratio values for subcategories of participants. In 2022, the Evaluator researched potential changes to the billing analysis approach and the savings calculation methodology to produce more robust savings values in future evaluations and simplify savings calculations. The proposed new billing analysis approach was described in the 2023 Existing Residential evaluation report. The Evaluator performed a billing analysis using the abovementioned new approach in 2023, although the results thereof were inconclusive. The Evaluator and E1 further explored the results of the 2023 billing analysis to adjust the billing analysis approach for the 2024 evaluation, which made it possible to review the ORs and replace them with adjustment ratios (ARs). |
| 2020<br>HEA-R1  | Update the unconverted D assessment spillover calculation assumptions to reflect the current participation mix and obtain more representative results.                                                                                            | Complete | In 2022, the Evaluator analyzed the evolution of the average savings per electrical participant to determine if an adjustment to the savings value per unconverted D assessment should be applied to align with changes in HEA since the unconverted D assessment spillover study was conducted. The analysis revealed that no adjustment was needed, although the Evaluator still recommended that new activities be conducted to reassess all parameters used to calculate unconverted D assessment spillover savings. The Evaluator updated these parameters in the 2024 evaluation and the results are presented in this report.                                                                                                                                                                                                                                                                                                                                                                                      |
| 2023-<br>HEA-R1 | Continue exploring the factors potentially responsible for the inconclusive billing analysis results, one being related to billing data interpretation, and work with the Evaluator to define the impact evaluation approach to be taken in 2024. | Complete | E1 and the Evaluator worked to define a new impact evaluation approach for the 2024 evaluation, which consisted of using AMI data for the billing analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## 21.3 Participation History

As presented in Figure 49 below, HEA participation levels<sup>54</sup> have constantly and significantly increased since 2022, which is likely due to the introduction of the CGH Grant. In 2024, HEA participation increased by 31% compared to the 2023 level to once again reach a new record.

Average gross energy savings per participant remained stable for 2024 and were among the highest levels in program history. Between 2021 and 2022, an increase of 26% was observed. Between 2022 and 2023, the increase was of 57%, and for 2024, only a slight decrease of 3% was observed compared with 2023. The increases in recent years are mainly explained by solar PV measures installed through HEA as a result of the CGH Grant offered since May 2021. The CGH Grant was closed to new applicants on 5 February 2024. Hence, solar PV measures will no longer be offered through HEA, which should result in substantial participation and gross energy savings decreases in the upcoming years. In 2024, solar PV measures represented 74% of gross energy savings. It should be noted that, prior to July 2018, HEA was only offered to electrically heated homes and thus generated more electrical energy savings per participant. This explains why average gross energy savings per participant were higher in previous years, then decreased and started increasing again with the introduction of solar PV measures.

**Figure 49: Overview of HEA Participation, 2015-2024**

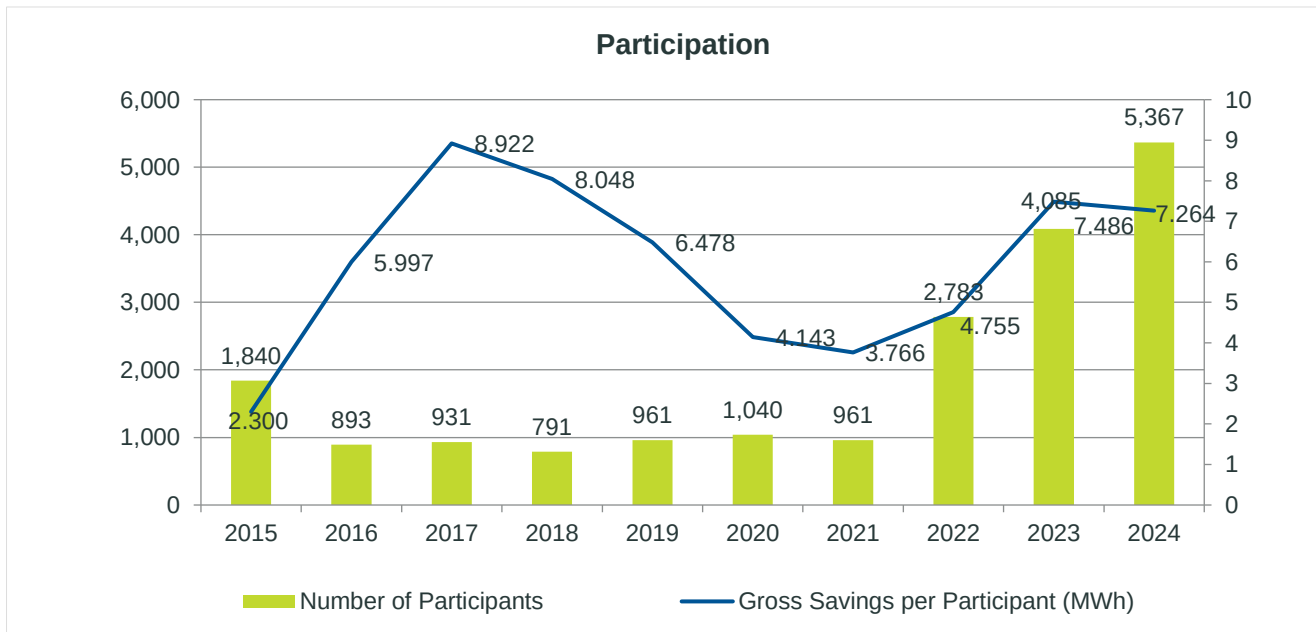
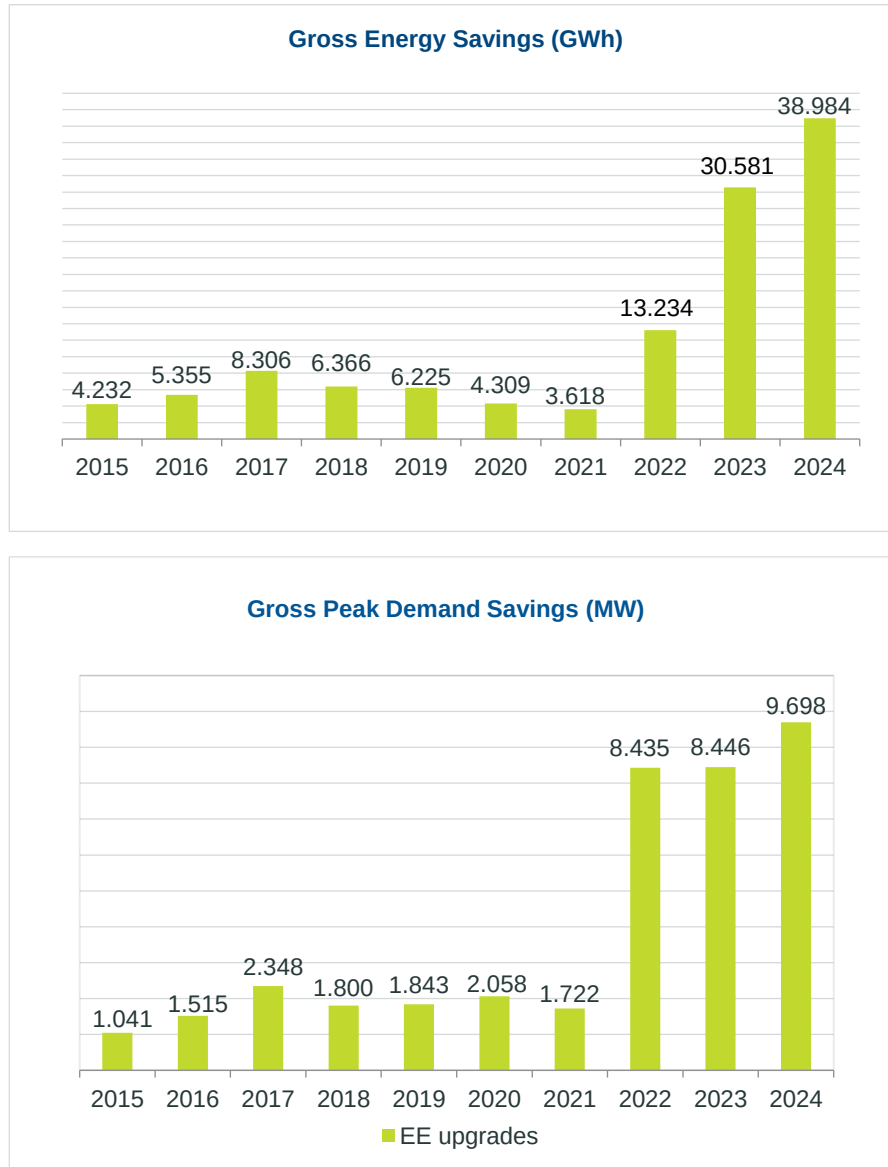


Figure 50 below provides an overview of the evolution of HEA gross energy and peak demand savings from 2015 to 2024. In 2024, an increase of 27% in gross energy savings was observed compared to 2023, a year in which record savings were achieved. Finally, peak demand savings increased by 15% compared to 2023, thereby also achieving record levels.

<sup>54</sup> In this DSM evaluation report, the number of participants refers to those participants whose projects generated electrical savings regardless of whether their homes are primarily electrically heated.

Figure 50: Evolution of HEA Gross Savings, 2015-2024



## 22 HEA Evaluation Approach

The 2024 HEA evaluation comprised a comprehensive impact evaluation.

The main objectives of the 2024 HEA evaluation were to:

- › Calculate gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

The Evaluator identified key research questions aimed at achieving the above objectives. Table 53 outlines the evaluation objectives and maps them to the Evaluator's research questions, methods, and sample sizes (n). Each method is described further below.

**Table 53: 2024 HEA Evaluation Approach**

| Evaluation Objectives   | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Methodology                                                                                                                                                                                                                                      |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results | <ul style="list-style-type: none"> <li>› Are the data in the tracking sheet complete, accurate, and consistent?</li> <li>› Which participants did not add an extension as part of their participation in the program component and should be included in the sample for billing analysis?</li> <li>› What is the adjustment ratio applicable to modelled energy savings according to the heating type in place and other factors that might have significant impact on savings?</li> <li>› How can non-modelled measures be treated separately from the adjustment ratio and what is the appropriate unitary savings value for these measures?</li> <li>› What are the appropriate EUL values for the measures implemented?</li> <li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li> </ul> | <ul style="list-style-type: none"> <li>› Tracking sheet audit</li> <li>› Past participant survey</li> <li>› Billing analysis</li> <li>› Unitary savings review</li> <li>› EUL update</li> <li>› Calculations using evaluation results</li> </ul> |
| Calculate net results   | <ul style="list-style-type: none"> <li>› What percentage of unconverted D assessment (expired) participants implement at least one measure in their house?</li> <li>› What is the level of E1 influence on their decision to implement measures?</li> <li>› What is the average modelled electrical energy savings of unconverted D assessment participants who implement at least one measure in their house?</li> <li>› What is the level of unconverted D assessment spillover?</li> <li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li> <li>› What are the net GHG emission reductions in CO<sub>2</sub> eq?</li> </ul>                                                                                                                                                                  | <ul style="list-style-type: none"> <li>› Survey with expired participants</li> <li>› Site visits</li> <li>› Use 2023 NTGR results</li> <li>› Calculations using evaluation results</li> <li>› GHG emission reduction calculations</li> </ul>     |

### Tracking Sheet Audit

Prior to conducting the savings calculation review, the Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The detailed protocol used for the tracking sheet audit and the results obtained are presented in Appendix XXX.



## Past Participant Survey

In the fall of 2024, Narrative Research conducted an online survey with a total of 483 past HEA participants. The objective was to collect information prior to conducting the billing analysis on these participants. The average length of the survey was 3.0 minutes. The questionnaire used is presented in Appendix XXVI, while complete survey results are outlined in Appendix XXVII. Drawing a random sample of 483 from a population of 1,963 yields a margin of error of +/- 3.3 percentage points at a 90% confidence level.

## Billing Analysis

A billing analysis was conducted to establish adjustment ratios to be directly applied to the savings estimates obtained from HOT2000. A lot of work was done prior to performing the billing analysis, notably to understand the information available in NRCan data to identify households with square footage changed between the D and E assessments, availability of AMI data for the treatment and control groups, as well as if anything from the literature could be applied to inform the billing analysis approach.

## Unitary Savings Review

Savings for some HEA measures are determined through a prescriptive approach based on unitary savings values. In 2024, the Evaluator did a complete review and update of unitary savings values and produced the 2024-2025 Demand-side Management Measure Assessment (DSM MA).<sup>55</sup> The unitary savings review entailed a literature review of technical reference manuals, metering studies, and program evaluations to determine if there are more appropriate methodologies or parameters to be applied to calculate energy and peak demand unitary savings, including elements such as baseline assumptions, operating hours, efficiency levels, peak demand-to-energy ratios, and interactive effect factors.

## EUL Update

For the 2024 evaluation, the Evaluator conducted a review of all EUL values as part of the 2024-2025 DSM MA update to determine if there were more appropriate EUL estimates.

## Expired Participant Survey

To reassess unconverted D assessment savings parameters, Narrative Research conducted a telephone survey with a total of 76 expired participants, i.e. participants who did not complete a final home energy assessment after the 12-month period following their initial D assessment. The survey was conducted in the fall of 2024 and its average length was 7.1 minutes. The questionnaire is presented in Appendix XXVIII, while complete survey results are outlined in Appendix XXIX. Drawing a random sample of 76 from a population of 2,542 yields a margin of error of  $\pm 9.3\%$  at a 90% confidence level.

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<sup>55</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the MA includes effective useful life values for all measures offered in E1's program portfolio. For the remainder of the evaluations to be conducted during the 2023-2025 DSM cycle, the Evaluator will refer to the values presented in the 2024-2025 DSM MA.



## Site Visits

A total of 19 site visits were completed by EAs among surveyed expired participants who declared not having completed a final home energy assessment but still had some recommended measures installed. The site visits consisted of performing a final home energy assessment, confirm the installation of measures, and calculate the final energy simulation results with HOT2000.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime electrical energy and peak demand savings as per the calculation methodology presented in Section 23 below.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for HEA, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data<sup>56</sup>.

### Note on Margin of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>57</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>58</sup>

As part of the 2024 HEA evaluation, the Evaluator calculated the margins of error for adjustment ratios obtained from the billing analysis. The margins of error are listed alongside results in the applicable sections below. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary.

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<sup>56</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO<sub>2</sub> eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

<sup>57</sup> Precision refers to how reproducible a set of measurements is. It does not take into account how close the measured values are to the true values since this would refer to accuracy.

<sup>58</sup> As part of this evaluation, confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.





## 23 HEA Impact Evaluation

The objectives of the 2024 HEA impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as EUL values and associated lifetime energy savings.

### 23.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in detail in Appendix XXX. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

The HEA tracking sheet is very complex. The new savings calculation approach developed as part of this evaluation will help simplify the number and length of calculation steps for HEA. Moreover, HEA is transitioning into E1's Customer Information System (CIS), which should considerably facilitate data tracking. An example of data tracking that should be simplified is the heat pump parameters that are required for the peak demand savings calculation. Currently, the Evaluator validates these parameters by manually cross-referencing them with the Northeast Energy Efficiency Partnerships' (NEEP) ccASHP Specification and Product List, a process that has proven to be difficult with the current tracking sheet. Integration into the CIS should allow for easier validation of all heat pump parameters with their AHRI model number.

### 23.2 Gross Savings

For HEA, gross savings correspond to the change in energy consumption resulting from measures implemented by HEA participants regardless of their reasons for participating.<sup>59</sup> The following subsections describe how HEA gross savings are calculated and how each parameter of the methodology was determined.

#### 23.2.1 Installation Rates

Installation rates represent the proportion of products recorded in the tracking sheet and that remain installed in participant homes. Based on the 2024-2025 DSM MA, installation rates for all HEA measures were estimated at 100% because they are confirmed by EAs at the time of the E assessment.

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<sup>59</sup> Definition adapted from: National Renewable Energy Laboratory, *The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices*, September 2014, p. 3.

### 23.2.2 Energy Savings

HEA energy savings are calculated based on HOT2000 simulation results adjusted with billing analysis results and unitary savings values for prescriptive measures, as shown in the equation below.

$$\begin{aligned} \text{Gross Energy Savings (kWh)} = \\ (Total Elec_D(kWh) - Total Elec_E(kWh) - HPWH(kWh)) \times AR \\ + Savings for Prescriptive Measures (kWh) \end{aligned}$$

Where:

- › *Total Elec<sub>D</sub>* and *Total Elec<sub>E</sub>* correspond to the modelled electrical energy consumption levels respectively obtained in HOT2000 during the D and E assessments.
- › *HPWH (kWh)* correspond to the unitary savings value established for heat pump water heaters (HPWHs).
- › *AR* correspond to the adjustment ratio established through a billing analysis and used to adjust the savings obtained from the difference between the modelled electrical energy consumption during the D and E assessments. Adjustment ratios vary according to different space heating system scenarios.
- › *Savings for Prescriptive Measures* are obtained by multiplying the prescriptive measures installed through HEA by their respective unitary electrical energy savings value.

### Measures Modelled in HOT2000

After the D and E home energy assessments, EAs model the house in the HOT2000 energy simulation software to obtain the initial and final EnerGuide ratings of the given house. Energy consumption levels obtained from HOT2000 simulation results are used to determine the electrical energy savings for modelled measures. They correspond to the reduction in consumption level between the D and E assessments.

The methodology currently used to calculate tracked savings compares electrical space heating consumption levels for the two assessments, both of which are adjusted with an overestimation ratio (OR). The ORs were drawn from the results of billing analyses conducted during the 2015 and 2018 HEA evaluations. The 2018 evaluation established distinct ORs depending on the space heating system in place.

As part of the 2024 evaluation, the Evaluator made some changes to the current savings calculation methodology to make it more robust and simpler and conducted a new billing analysis. The Evaluator used the savings values obtained through the billing data to develop adjustment ratios that can be directly applied to the modelled savings estimates obtained from HOT2000 using whole home consumption (not only space heating).

The billing analysis consisted of calculating the change in electrical energy consumption by comparing levels before and after participation in HEA for a group of recent participants (treatment group). To account for variations in electrical energy consumption due to factors other than HEA participation, the Evaluator selected a control group and deducted the change in electrical energy consumption observed for that group over the same period. Subtracting the change in control group electrical energy consumption (i.e. a change that is not linked to the program component) from that of the treatment group ensures that only savings attributable to HEA are captured and avoids capturing other effects that can have an impact on energy consumption (e.g. the COVID-19 pandemic) because both the treatment and control groups are impacted by such effects.

Since the adjustment ratio is to be applied to the modelled savings values obtained from HOT2000, the billing analysis was conducted on participants who only implemented modelled measures. Hence, participants who installed wood burning equipment or solar photovoltaic (PV) measures through their participation in HEA were removed from the analysis.

The complete billing analysis methodology and results are presented in Appendix XXXI.

The adjustment ratios (ARs) obtained through the billing analysis performed as part of this evaluation are presented in Table 54 below. They were determined separately for three heat pump scenarios, as it was the case for ORs. The tracked ORs are also presented in the table for comparison. The values in brackets represent the values obtained when calculating the factor  $(1 - OR)$  that was multiplied with the D and E space heating consumption values. It is worth reminding that the ARs are directly applied to the savings values obtained from the difference between the total consumption values.

**Table 54: 2024 HEA Adjustment Ratios**

| Scenario                                                                            | Tracked                    |                            | Evaluated |
|-------------------------------------------------------------------------------------|----------------------------|----------------------------|-----------|
|                                                                                     | OR <sub>D</sub> Assessment | OR <sub>E</sub> Assessment | AR        |
| A participant who registered <b>with</b> a heat pump                                | 0% (1.00)                  | 0% (1.00)                  | 1.24      |
| A participant who registered <b>without</b> a heat pump and who did not install one | 19% (0.81)                 | 19% (0.81)                 | 0.58      |
| A participant who registered <b>without</b> a heat pump and then had one installed  | 19% (0.81)                 | 0% (1.00)                  | 0.43      |

## Prescriptive Measures

For some measures installed under HEA, instead of using a performance approach based on energy simulation results, energy savings are calculated using a prescriptive approach based on unitary energy savings values. This is the case for:

- › Wood burning equipment
- › Smart thermostats
- › Solar PV systems
- › HPWHs

Wood burning equipment, smart thermostats, and solar PV systems are not modelled in HOT2000, which is why unitary savings are used. It should be noted that, for smart thermostats introduced in HEA through the Canada Greener Homes (CGH) Grant, the unitary savings value for HEA is assumed to be nil considering the relatively high risk of double counting with Instant Savings given smart thermostats are also incented year-round through that program component.

For HPWHs, even if modelled in HOT2000, savings from this measure are deducted from the modelled savings (according to their unitary savings value) before applying the AR to the remaining modelled savings. HPWH savings are then added up as a prescriptive measure, again according to their unitary savings value. This approach avoids applying the AR on HPWH savings considering this measure was not captured in the billing analysis due to its low number of installations and will facilitate future savings accounting in conjunction with E1's HPWH market transformation pilot.

The detailed descriptions of inputs, references, and unitary savings calculations for all prescriptive measures are presented in the 2024-2025 DSM MA. Table 55 summarizes the tracked and evaluated unitary energy savings values of each measure for which there was an update in the 2024-2025 DSM MA.

**Table 55: 2024 HEA Tracked and Evaluated Unitary Energy Savings for Prescriptive Measures**

| Measure                                                                                                                                                                                                                                               | Tracked Savings<br>[kWh/year]  | Evaluated Savings<br>[kWh/year] |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------|
| Wood Stoves or Fireplace Inserts with Electric Resistance Baseline                                                                                                                                                                                    | 10,443                         | 1,461**                         |
| Wood Stoves or Fireplace Inserts with Heat Pump Baseline                                                                                                                                                                                              | 10,443 / Annual Heat Pump COP* |                                 |
| Pellet Stoves or Fireplace Inserts with Electric Resistance Baseline                                                                                                                                                                                  | 8,959                          |                                 |
| Pellet Stoves or Fireplace Inserts with Heat Pump Baseline                                                                                                                                                                                            | 8,959 / Annual Heat Pump COP*  |                                 |
| *COP = coefficient of performance                                                                                                                                                                                                                     |                                |                                 |
| **Since the HEA tracking sheet does not track stove and fireplace insert measures separately, the Evaluator applied the unitary energy savings value for stoves drawn from the Green Heat billing analysis to all stove and fireplace inserts in HEA. |                                |                                 |

The new evaluated savings values for wood burning equipment, updated as part of a billing analysis activity performed for Green Heat, are no longer dependent on the type of wood burning or the heating system baseline (heat pump or electric resistance). Furthermore, evaluated energy savings values for stoves and fireplace inserts are now different in Green Heat. Since the HEA tracking sheet does not track these measures separately, it is not possible to allocate different unitary savings values for these products. Considering the small number of wood burning equipment installations in HEA (90 installations out of 7,264 participants), the Evaluator applied the unitary energy savings value for stoves to all stoves or fireplace inserts in HEA. As recommended in Green Heat moving forward, E1 should consider removing fireplace inserts from its offer considering the low savings associated with this measure.

## Reporting Requirements

HEA incentives originate from three sources of funding: Nova Scotia Power ratepayers for DSM, the Province of Nova Scotia, and the Government of Canada (CGH Grant). The incorporation of the CGH Grant, as a co-funder of the energy assessments and measures for both DSM and Province of Nova Scotia funding, has not changed anything in E1's evaluation reporting structure. Therefore, HEA savings are reported to two different parties, the Nova Scotia Utility and Review Board (NSUARB) and the Province of Nova Scotia respectively via the DSM evaluation reports and the government-funded evaluation reports.

The DSM evaluation is focused on reporting electrical savings achieved with electrical DSM investments, while the government-funded evaluation reporting requirements for HEA are focused on participation and GHG emission reductions achieved with government funding regardless of the type of fuel. To avoid double counting and determine the most appropriate way to report associated savings, equations for each possible scenario were developed. The equations and their rationales are presented in Appendix XXXII.

As for the solar PV measures introduced through HEA with the CGH Grant, since solar PV generation offsets electricity use and results in savings to the electric grid, solar PV measure savings are included in the DSM evaluation report for HEA regardless of participant heating source.

### 23.2.3 Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity demand peak period in Nova Scotia is defined as the coldest days (with an on-peak temperature estimated at -15 °C) between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays.

For HEA, peak demand savings are calculated using a different approach for measures modelled in HOT2000 and prescriptive measures.

## Measures Modelled in HOT2000

For measures modelled in HOT2000, peak demand savings are calculated by applying a peak demand-to-energy ratio of 0.283 MW/GWh after having removed the energy savings associated with mini-split heat pumps. The energy savings value currently tracked for mini-split heat pumps is based on Green Heat. The value was updated as part of this evaluation based on the billing analysis conducted for HEA. Treatment participants who only installed a mini-split heat pump through their participation in HEA were isolated to calculate an average energy savings value per capacity installed of 0.0760 kWh/Btu/h. Peak demand savings are then calculated separately for mini-split heat pumps using the following equation.

$$MSHP \text{ Peak Demand Savings } (W) = \frac{1,000}{3.412} \times HC_{min} \times \left( \frac{1}{COP_{base\_min}} - \frac{1}{COP_{ee\_min}} \right)$$

The parameters used in this equation are outlined in Table 56 below.

**Table 56: Unitary Peak Demand Savings Values for Mini-split Heat Pumps**

| Variable                                                                                             | Symbol            | Value                                        |
|------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------|
| Rated heating capacity of the new heat pump at outdoor air temperature of -15 °C [kBTU/h]            | $HC_{min}$        | Specification data for each installed system |
| Coefficient of performance of the assumed baseline equipment (electric resistance) at -15 °C [kW/kW] | $COP_{base\_min}$ | 1                                            |
| Coefficient of performance of the new heat pump at -15 °C [kW/kW]                                    | $COP_{ee\_min}$   | Specification data for each installed system |
| Conversion factor [BTU/W·h]                                                                          | -                 | 3.412                                        |
| Conversion factor [W/kW]                                                                             | -                 | 1,000                                        |

As for the peak demand-to-energy ratio of 0.283 MW/GWh applied to the remaining energy savings modelled in HOT2000, the details are presented in the 2024-2025 DSM MA.

## Prescriptive Measures

For prescriptive measures, specific unitary peak demand savings values are used. The detailed calculations are presented in the 2024-2025 DSM MA, and the values of each measure for which there was an update are presented in Table 57. Again, for stoves and fireplace inserts, the Evaluator applied the unitary peak demand savings value for stoves from Green Heat since HEA does not track stoves and fireplace inserts separately.

**Table 57: 2024 HEA Tracked and Evaluated Unitary Peak Demand Savings for Prescriptive Measures**

| Measure                                                                                   | Tracked Savings [W] | Evaluated Savings [W] |
|-------------------------------------------------------------------------------------------|---------------------|-----------------------|
| Wood or pellet stoves or fireplace inserts with electric resistance or heat pump baseline | 4,000               | 828                   |

## Demand Reduction Measures

In the past, HEA offered incentives for demand reduction measures, namely electric thermal storage (ETS) units, three-element water heaters, and domestic hot water (DHW) heater timers. For these measures installed prior to the removal of those incentives from HEA, unitary peak demand savings values were established and remain unchanged.

### 23.2.4 Supplemental File Adjustments

Supplemental files refer to participants that have multiple files (or lines) in the tracking sheet. Supplemental files occur for multiple reasons that may or may not result in incremental energy savings. For example, a supplemental file can stem from administrative issues around incentive payments, which have no effect on energy savings. On the other hand, supplemental files can stem from the need to remodel a home, which would impact the savings for the given participant. For 2024, E1 performed the analysis and compiled the incremental savings from all supplemental files (i.e. the difference between what was claimed in the original file and what should have been claimed according to the updated supplemental file). The Evaluator considers that the approach adopted by E1 is thorough and allows for identifying most savings from supplemental files, especially considering the order of magnitude of such savings relative to total program savings.

Table 58 below summarizes the supplemental file adjustments for 2024. They result in a positive adjustment made to gross savings.

**Table 58: 2024 HEA Supplemental File Adjustments**

| Category                                                                                            | Values |
|-----------------------------------------------------------------------------------------------------|--------|
| Incremental gross energy savings at the meter for energy efficiency measures (GWh) <sup>1</sup>     | 0.044  |
| Incremental gross energy savings at the meter for solar PV measures (GWh)                           | 0.011  |
| Incremental gross peak demand savings at the meter for energy efficiency measures (MW) <sup>1</sup> | 0.023  |
| Incremental gross peak demand savings at the meter for solar PV measures (MW)                       | 0      |
| <sup>1</sup> Energy efficiency measures refer to all HEA measures except solar PV.                  |        |

### 23.2.5 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling. Since the vast majority of HEA measure savings are obtained from simulation results that already consider interactions between the heating and cooling systems, no additional interactive effects need to be accounted for. For wood burning equipment, since it directly targets heating loads, the impact of these prescriptive measures on heating is already considered in the unitary savings calculations. As for solar PV systems, savings are not impacted by interactive effects.

### 23.2.6 Effective Useful Life

As part of 2024-2025 DSM MA activities, the Evaluator reviewed the EUL values used in the calculation of electrical energy savings that are expected to persist over time. For the electrical energy savings that come from measures modelled in HOT2000, an average EUL value was established by calculating the weighted average of EUL values associated with the main building envelope measures and space heating equipment installed under HEA in 2024. For the prescriptive measures, the EUL values are directly applied to the unitary savings value.

The EUL values that were updated in the 2024-2025 DSM MA are presented in Table 59.

**Table 59: 2024 HEA Tracked and Evaluated Effective Useful Life Values**

| Measure                                                                       | Tracked EUL<br>[years] | Evaluated EUL<br>[years] |
|-------------------------------------------------------------------------------|------------------------|--------------------------|
| Measures Modelled in HOT2000 (i.e. Heat Pumps and Building Envelope Measures) | 20.8                   | 20.5                     |
| Heat Pump Water Heaters                                                       | 10.0                   | 15.0                     |
| Solar PV                                                                      | 25.0                   | 30.0                     |

The equivalent EUL values are applied to the gross and net first-year electrical energy savings of each measure category to obtain the gross and net lifetime electrical energy savings. As a result, the weighted average EUL values of gross and net savings differ (see Subsections 23.2.7 and 23.3.6 below). The gross weighted average EUL value is equal to 27.5 years.

### 23.2.7 Evaluated Gross Savings

The annual gross savings for each category of measures installed through HEA in 2024 are listed in Table 60 below.

The gross savings at the generator were estimated by using residential line loss factors of 1.0947 and 1.146601 for energy and peak demand savings respectively. The residential line loss factors correspond to the values submitted to the NSUARB as part of the 2014 Cost of Service Study Progress Update.<sup>60</sup> Residential line loss factors were used for all participants since municipal rate codes only represent a very small portion of participants (less than 1%).

<sup>60</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.



**Table 60: Evaluated 2024 HEA Gross Energy and Peak Demand Savings**

| Measure Category                                                                                                                                                                                                                                                      | HOT2000 Modelled Measures* | Wood Burning Equipment | HPWHs  | Electrical Thermal Storage | Energy Efficiency Measure Subtotal | Solar PV Measures | Total     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------|--------|----------------------------|------------------------------------|-------------------|-----------|
| Number of Participants**                                                                                                                                                                                                                                              | 4,417                      | 90                     | 53     | 1                          | -                                  | 2,276             | 5,367     |
| Total Installed Capacity (kW)                                                                                                                                                                                                                                         | -                          | -                      | -      | -                          | -                                  | 24,117            |           |
| <b>Evaluated Energy Savings</b>                                                                                                                                                                                                                                       |                            |                        |        |                            |                                    |                   |           |
| Unitary Energy Savings (kWh per KW installed)                                                                                                                                                                                                                         | -                          | -                      | -      | -                          | -                                  | 1,086             | -         |
| Gross Energy Savings Without Adjustment Ratio (AR) – at the Meter (GWh)                                                                                                                                                                                               | 14.062                     | 0.097                  | 0.068  | -                          | -                                  | 26.191            | 40.419    |
| 2024 Supplemental File Energy Savings (kWh)                                                                                                                                                                                                                           | -                          | -                      | -      | -                          | 0.044                              | 0.011             | 0.055     |
| <b>Gross Energy Savings with AR – at the Meter (GWh)</b>                                                                                                                                                                                                              | 9.200                      | 0.097                  | 0.068  | -                          | 9.409                              | 26.202            | 35.611    |
| Line Loss Factor                                                                                                                                                                                                                                                      | 1.0947                     | 1.0947                 | 1.0947 | -                          | 1.0947                             | 1.0947            | 1.0947    |
| <b>Gross Energy Savings with AR – at the Generator (GWh)</b>                                                                                                                                                                                                          | 10.071                     | 0.107                  | 0.074  | -                          | 10.300                             | 28.684            | 38.984    |
| Effective Useful Life (years)                                                                                                                                                                                                                                         | 20.5                       | 18.0                   | 15.0   | -                          | -                                  | 30.0              | 27.5      |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                         | 206.455                    | 1.919                  | 1.112  | -                          | 210.479                            | 860.509           | 1,070.988 |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                            |                            |                        |        |                            |                                    |                   |           |
| Unitary Peak Demand Savings Value (W)                                                                                                                                                                                                                                 | -                          | -                      | -      | 2.600                      | -                                  | -                 | -         |
| 2024 Supplemental File Peak Demand Savings (MW)                                                                                                                                                                                                                       |                            |                        |        |                            | 0.023                              |                   |           |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                  | 8.365                      | 0.055                  | 0.011  | 0.003                      | 8.458                              | -                 | 8.458     |
| Line Loss Factor                                                                                                                                                                                                                                                      | 1.1466                     | 1.1466                 | 1.1466 | 1.1466                     | 1.1466                             | -                 | 1.1466    |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                              | 9.592                      | 0.063                  | 0.013  | 0.003                      | 9.698                              | -                 | 9.698     |
| * HOT2000 modelled measures include all heat pumps and building envelope measures.                                                                                                                                                                                    |                            |                        |        |                            |                                    |                   |           |
| **The number of participants who install measures modelled in HOT2000 and the number of prescriptive measures are not mutually exclusive. Number of participants for Solar PV measures corresponds to the number of participants who generated savings from solar PV. |                            |                        |        |                            |                                    |                   |           |
| ***Unitary savings for wood burning equipment and HPWHs vary according to the type of equipment (wood stove, wood furnace, etc.) and baseline.                                                                                                                        |                            |                        |        |                            |                                    |                   |           |



As presented in Table 61, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>61</sup> for GHG emissions generated by electricity production to HEA net savings.

**Table 61: Evaluated 2024 HEA Gross GHG Emission Reductions**

|                                                                                             | Total         |
|---------------------------------------------------------------------------------------------|---------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>38,984</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2         |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>18,408</b> |

## 23.3 Net Savings

The Evaluator determined net energy and peak demand savings, that is the electrical energy and peak demand savings that can be reliably attributed to a program component, by estimating the net-to-gross ratio (NTGR). In the case of HEA, the NTGR is established considering the effects, namely free-ridership and participant spillover, which positively or negatively affect energy savings.

In addition to the NTGR, unconverted D assessment spillover savings as well as savings deductions for participation in other residential programs are also accounted for in the net savings calculation.

### 23.3.1 Free-ridership

For HEA, free-ridership occurs when participants would have implemented energy efficiency measures and/or solar PV systems in the absence of the program component.

Free-ridership was assessed in 2023 through a participant survey with HEA participants. Since no data-collection activities aimed at updating the free-ridership levels were conducted in 2024, the 2023 levels were used for the 2024 evaluation.

Table 62 outlines the free-ridership levels used for HEA for 2024 along with the survey parameters.

**Table 62: 2024 HEA Free-ridership Levels**

| Measure                    | Average Free-ridership Level | Sample Size | Population Size | Margin of Error |
|----------------------------|------------------------------|-------------|-----------------|-----------------|
| Energy Efficiency Measures | 17%                          | 77          | 3,995           | 4.20%           |
| Solar PV Measures          | 26%                          | 29          | 1,520           | 6.50%           |

<sup>61</sup> At the time of writing, 2023 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2022 total system emissions data (5,770,500 CO2 eq tonnes) and total electricity generation (10,456 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed December 1, 2023), Emera inc., Management's Discussion & Analysis, as at February 23, 2023 [https://s25.q4cdn.com/978989322/files/doc\\_financials/2022/q4/Emera-Q4-2022-MD-A-FINAL-Feb-22%2723.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2022/q4/Emera-Q4-2022-MD-A-FINAL-Feb-22%2723.pdf) (last accessed December 1, 2023).

### 23.3.2 Participant Spillover

For HEA, participant spillover occurs when participants implement additional measures recommended in their initial energy assessments after their participation in the program component, that is after having completed the final energy assessment and due to the influence of having participated in the program component without receiving any additional support from the program component.

Similarly to free-ridership, no data collection aimed at updating the 2023 participant spillover level was conducted in 2024. Therefore, the 2023 spillover level was used as part of the 2024 evaluation for all measures.

Table 63 outlines the participant spillover level measured for HEA.

**Table 63: 2024 HEA Participant Spillover Level**

| Measure      | Number of Participants Generating Spillover | Average Participant Spillover Level |
|--------------|---------------------------------------------|-------------------------------------|
| All Measures | 11                                          | 1%                                  |

### 23.3.3 Net-to gross Ratio Calculation

The NTGR is calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Participant Spillover})$$

The NTGR values calculated with the free-ridership and spillover levels established for HEA are presented in Table 64.

**Table 64: 2024 HEA NTGR Values**

| Measure                    | Free-ridership | Participant Spillover | NTGR |
|----------------------------|----------------|-----------------------|------|
| Energy Efficiency Measures | 17%            | 1%                    | 0.84 |
| Solar PV Measures          | 26%            |                       | 0.75 |

### 23.3.4 Unconverted Assessment Spillover

The unconverted D assessment savings spillover effect corresponds to the savings associated with those measures implemented by electrical participants who did not complete an E assessment by the end of the allocated 12-month period (referred to as expired participants or unconverted D assessment participants). It should be noted that only expired participants who use electricity as their primary heating source are considered in the analysis.

As part of the 2024 HEA evaluation, the Evaluator conducted a survey with expired participants and site visits to reassess unconverted D assessment savings parameters. The parameters used for tracked savings were based on data-collection activities conducted by E1 in 2014 and 2015. A similar approach was used by the Evaluator for the reassessment.

- › The proportion of participants who implemented at least one upgrade, measured through the expired participant survey results, remained the same as the tracked value, i.e. 54%. Of the 338 survey respondents, 183 declared having implemented at least one upgrade recommended in their home energy report.
- › The average savings value influenced by E1 was established at 2,097 kWh based on the results of 19 on-site visits. Site visits were conducted among expired survey respondents who declared having installed at least one measure. EAs went to their house to perform an E assessment and complete the final HOT2000 simulation model. Using the simulation models, the Evaluator calculated the savings for the 19 expired participants and multiplied the value with the E1 influence level declared by those participants during the survey. The tracked value was of 2,283 kWh. It should be noted that the new savings calculation methodology was used to establish the 2,097 kWh value. If the former methodology had been used, the average savings value would have been very close to the tracked value, i.e. 2,123 kWh.

Table 65 below outlines the tracked and evaluated parameters used to establish the unconverted D assessment spillover level for 2024. A total of 1,868 unconverted D assessment participants who use electricity as their primary heating source were included in the 2024 tracking sheet. Total unconverted D assessment spillover savings were calculated by multiplying the number of unconverted D assessment participants by both the proportion of participants who completed at least one upgrade and the associated savings.

**Table 65: 2024 HEA Unconverted D Assessment Spillover Savings**

| Parameters                                                                                        | Tracked Values | Evaluated Values |
|---------------------------------------------------------------------------------------------------|----------------|------------------|
| <b>Total Number of Unconverted D Assessment Participants</b>                                      | <b>1,868</b>   |                  |
| Ratio of Unconverted D Assessment Participants Who Implemented at Least One Measure               | 54%            | 54%              |
| <b>Total Number of Unconverted D Assessment Participants Who Implemented At Least One Measure</b> | <b>1,009</b>   | <b>1,009</b>     |
| Average Electrical Savings per Participant in kWh (with influence from E1)                        | 2,283          | 2,097            |
| <b>Total Unconverted D Assessment Spillover Energy Savings – at the Meter (GWh)</b>               | <b>2.303</b>   | <b>2.115</b>     |
| Demand-to-energy Ratio (MW/GWh)                                                                   | 0.283          |                  |
| <b>Total Unconverted D Assessment Spillover Peak Demand Savings – at the Meter (MW)</b>           | <b>0.652</b>   | <b>0.599</b>     |

Unconverted D assessment spillover reversals are expired participants from previous years and for which savings had been claimed and who ended up participating in HEA by completing their E assessment after the allocated 12-month period. To avoid double counting savings, the savings that were attributed to them as unconverted D assessment spillover in previous years are reversed, meaning they are deducted from total net savings.

In previous evaluations, these savings were deducted by simply subtracting the number of participants who ended participation in HEA from the number of unconverted D assessment spillover participants. Starting in 2024, reversals are calculated separately considering the change in savings parameters.

A total of 337 unconverted D assessment spillover reversal participants were identified in the tracking sheet for 2024. Their associated deductions are calculated in Table 66 based on the savings parameters used when they were initially claimed.

**Table 66: 2024 HEA Unconverted D Assessment Spillover Reversals**

| Parameters                                                                                                                                                                                           | Values         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Total Number of Unconverted D Assessment Spillover Reversals</b>                                                                                                                                  | <b>337</b>     |
| Ratio of Unconverted D Assessment Participants Who Implemented at Least One Measure                                                                                                                  | 54%            |
| Average Electrical Savings per Participant in kWh (with influence from E1)                                                                                                                           | (2,283)*       |
| <b>Total Unconverted D Assessment Spillover Reversal Energy Savings – at the Meter (GWh)</b>                                                                                                         | <b>(0.415)</b> |
| Demand-to-energy Ratio (MW/GWh)                                                                                                                                                                      | 0.283          |
| <b>Total Unconverted D Assessment Spillover Reversal Peak Demand Savings – at the Meter (MW)</b>                                                                                                     | <b>(0.118)</b> |
| *To determine the savings to be deducted for reversals, the parameters need to correspond to those used in previous years when they were claimed as unconverted D assessment spillover participants. |                |

Unconverted D assessment spillover savings are presented in energy units rather than as a percentage of annual gross savings. They are added to gross savings minus the reversal savings to be deducted.

### 23.3.5 Savings Deductions for Participation in Other Residential Programs

Several measures are offered under both HEA and Green Heat. In addition, Efficient Product Installation (EPI) introduced air sealing measures in 2019, and Solar Homes offers solar PV. To ensure that energy savings are not claimed twice for the same upgrade, the net electrical savings that were already claimed under Green Heat or EPI are deducted from HEA net electrical savings for those participants who participated in HEA and Green Heat or EPI during the same period. In addition, when approving HEA project files, E1 removes solar PV savings that were already claimed in Solar Homes during the same period.

Customer IDs are not used uniformly in the different tracking sheets to easily identify participation overlaps. To identify participants who participated in HEA and Green Heat or EPI during the same period, E1 created a tool that uses various customer information fields to find matches in the relevant tracking sheets. The Evaluator considers that the tool developed by E1 allows identifying most overlaps, which are rare since delays with Natural Resources Canada (NRCAN) are resolved and E1 is able to intercept overlaps between HEA and Green Heat prior to finalizing the participation process in Green Heat.

**Table 67: 2024 Savings Overlap to Deduct from HEA**

| Overlap                 | Net Energy Savings at Generator (GWh) | Net Peak Demand Savings at Generator (MW) |
|-------------------------|---------------------------------------|-------------------------------------------|
| Overlap with Green Heat | (0.013)                               | (0.007)                                   |
| Overlap with EPI        | (0.051)                               | (0.009)                                   |
| <b>Total</b>            | <b>(0.064)</b>                        | <b>(0.017)</b>                            |

### 23.3.6 Evaluated Net Savings

Net savings are defined as the energy use reductions specifically attributable to HEA. Net savings were calculated by applying the NTGR value, adding unconverted D assessment spillover savings, and subtracting Green Heat and EPI savings, as illustrated in the following equation.

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR} + \text{Unconverted D Assessment Spillover Savings} - \text{Green Heat Net Savings Deductions} - \text{EPI Net Savings Deductions}$$

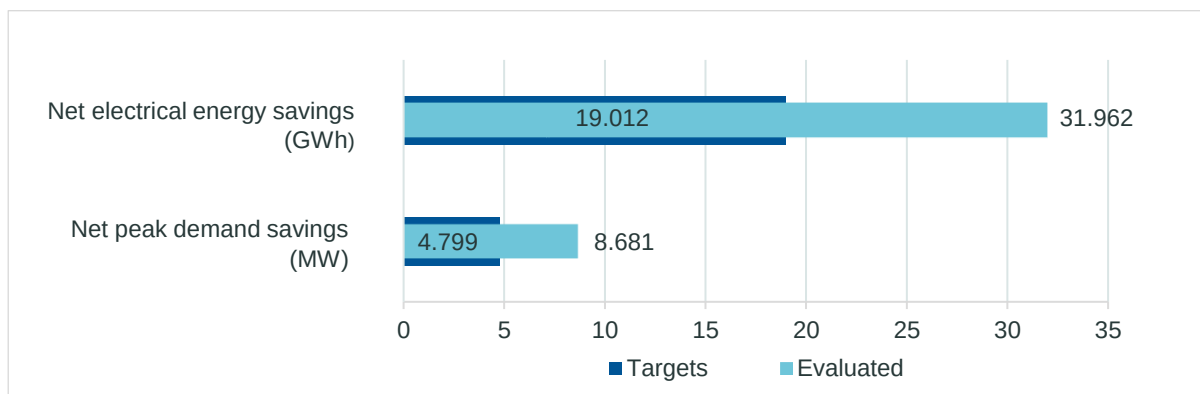
The detailed net savings results are presented in Table 68 below. The net electrical energy savings resulted in 15,093 tonnes of CO2 eq in net annual GHG emission reductions.

**Table 68: Evaluated 2024 HEA Net Energy and Peak Demand Savings**

|                                                                                   | Energy Efficiency Measures | Solar PV Measures | Total   |
|-----------------------------------------------------------------------------------|----------------------------|-------------------|---------|
| <b>Energy Savings</b>                                                             |                            |                   |         |
| Gross Energy Savings – at the Meter (GWh)                                         | 9.409                      | 26.202            | 35.611  |
| Unconverted D Assessment Spillover Energy Savings (GWh)                           | 2.115                      | -                 | -       |
| Unconverted D Assessment Spillover Reversal Energy Savings (GWh)                  | (0.415)                    | -                 | -       |
| NTGR                                                                              | 0.84                       | 0.75              | -       |
| <b>Net Energy Savings Without Savings Deductions – at the Meter (GWh)</b>         | 9.603                      | 19.652            | 29.255  |
| Line Loss Factor                                                                  | 1.0947                     | 1.0947            | 1.0947  |
| Green Heat and EPI Net Energy Savings Deductions (GWh)                            | (0.064)                    | -                 | -       |
| <b>Net Energy Savings with Savings Deductions – at the Generator (GWh)</b>        | 10.449                     | 21.513            | 31.962  |
| Effective Useful Life (years)                                                     | 20.5                       | 30.0              | 26.9    |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                       | 214.213                    | 645.381           | 859.594 |
| <b>Peak Demand Savings</b>                                                        |                            |                   |         |
| Gross Peak Demand Savings – at the Meter (MW)                                     | 8.458                      | -                 | 8.458   |
| NTGR                                                                              | 0.84                       | -                 | -       |
| Unconverted D Assessment Spillover Peak Demand Savings (MW)                       | 0.599                      | -                 | 0.599   |
| Unconverted D Assessment Spillover Reversal Peak Demand Savings (MW)              | (0.118)                    | -                 | (0.118) |
| <b>Net Peak Demand Savings Without Savings Deductions – at the Meter (MW)</b>     | 7.585                      | -                 | 7.585   |
| Line Loss Factor                                                                  | 1.1466                     | -                 | -       |
| <b>Net Peak Demand Savings Without Savings Deductions – at the Generator (MW)</b> | 8.697                      | -                 | 8.697   |
| Green Heat and EPI Net Peak Demand Savings Deductions (MW)                        | (0.017)                    | -                 | (0.017) |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                            | 8.681                      | -                 | 8.681   |

As outlined in Figure 51 below, HEA surpassed its targets by 68% and 81% for energy and peak demand savings respectively.

Figure 51: 2024 HEA Targets and Evaluated Savings



## 23.4 Realization Rate

Table 69 below compares the electrical energy and peak demand savings established through this evaluation to those calculated in the 2024 tracking sheet. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

Table 69: Comparison of 2024 HEA Tracked and Evaluated Savings at the Generator

|                                                                                                                                                                                                                                                                                                                                                                     | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                                                                                                                                                                                                                     | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings                                                                                                                                                                                                                                                                                                                                                      |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                                                                                                                                                                                                                               | 41.992        | GWh  | 0.70  | 29.552      | GWh  | 108%             |
| Evaluation Results                                                                                                                                                                                                                                                                                                                                                  | 38.984        | GWh  | 0.82  | 31.962      | GWh  |                  |
| Peak Demand Savings                                                                                                                                                                                                                                                                                                                                                 |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                                                                                                                                                                                                                               | 10.518        | MW   | 0.51  | 5.367       | MW   | 162%             |
| Evaluation Results                                                                                                                                                                                                                                                                                                                                                  | 9.698         | MW   | 0.90  | 8.681       | MW   |                  |
| *NTGR values in this table include the impacts of unconverted D assessment spillover savings as well as Green Heat and EPI savings deductions. The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings, which explains why the NTGR values are different from those presented in the above sections. |               |      |       |             |      |                  |

The net evaluated electrical energy and peak demand savings determined by the Evaluator were higher than the net results tracked by E1. The differences between the tracked and evaluated savings are due to the change in the savings calculation methodology and the new adjustment ratios. In their tracked savings, E1 applied an anticipated billing analysis adjustment ratio of 0.54 in addition to the overestimation ratio. These two ratios combined reduce the savings more than the adjustment ratios established with the billing analysis as part of this evaluation. This explains the realization rates above 100%. Moreover, because peak demand savings are calculated separately for mini-split heat pumps and not impacted by the adjustment ratios, and E1 applied their 0.54 ratio to all peak demand savings, the realization rate for peak demand savings is much higher. It should be noted that solar PV, which accounts for 74% of HEA savings, has the same tracked and evaluated savings.



## 24 HEA Key Findings and Recommendations

As mentioned previously, the main objectives of the 2024 HEA evaluation were as follows:

- › Calculate gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

This section provides the Evaluator's key findings in relation to the above objectives.

### **2024 HEA-Finding: Both HEA net electrical energy and demand savings exceeded targets.**

HEA achieved 31.962 GWh in net electrical energy savings and 8.681 MW in net peak demand savings at the generator in 2024, thus exceeding the planned net electrical energy savings of 19.012 GWh and the planned net peak demand savings of 4.799 MW.

### **2024 HEA-Finding: The increase in participation and sustained average gross savings per home observed since the introduction of the CGH Grant continued in 2024.**

With 5,367 projects, the 2024 participation level was the highest observed for HEA since the program component was launched. The average gross energy savings per home was 7,264 kWh, a slight decrease of 3% compared to 2023, which was the highest observed for HEA since the program component has been offered to both electrically and non-electrically heated homes. The integration of the CGH Grant into HEA contributed to the historically high participation rate and gross savings per participant seen in recent years. More specifically, one of the main contributors was the solar PV measures in the HEA offering, which constituted 74% of gross energy savings for 2024. Since the CGH Grant was closed to new applicants in the beginning of 2024, the Evaluator expects a decrease in HEA participation and gross savings in upcoming years.

### **2024 HEA-Finding: The evaluated energy and peak demand savings were higher than the savings tracked by E1.**

A new billing analysis was conducted as part of this evaluation and changes were made to the savings calculation approach to make it more robust. In anticipation of these changes, E1 applied an adjustment ratio of 0.54 to their tracked savings in addition to the overestimation ratios already applied to the modelled energy consumption values used to determine savings. This anticipated billing analysis adjustment ratio allowed E1 to track energy savings close to the evaluation results with a realization rate of 108%. As for peak demand savings, considering the billing analysis results did not impact the peak demand savings calculation for mini-split heat pumps, the realization rate is much higher, at 162%.

Unitary electrical energy and peak demand savings for wood and pellet stoves and fireplace inserts were also updated based on the Green Heat billing analysis results. Distinct unitary savings values were determined for stoves and fireplaces, with fireplaces having very low savings.

**Recommendation #1:** Consider removing wood fireplace inserts and pellet fireplace inserts from the HEA offer.

**2024 HEA-Finding: Parameters used to calculate unconverted D assessment spillover were reassessed and remain relatively stable.**

As part of the 2024 evaluation, the Evaluator compiled the results of 19 site visits completed by EAs among surveyed expired participants. The results were used to reassess the savings allocated to unconverted D assessment spillovers. The expired participant survey was also used to review the proportion of expired participants who implemented measures after their initial assessment. Even if the number of site visits completed is fairly low and did not meet the initial target (n=30), the Evaluator considers the results obtained consistent and sufficient for spillover assessment needs. If E1 desires a higher level of precision, they may consider conducting additional site visits as part of the 2025 evaluation process.



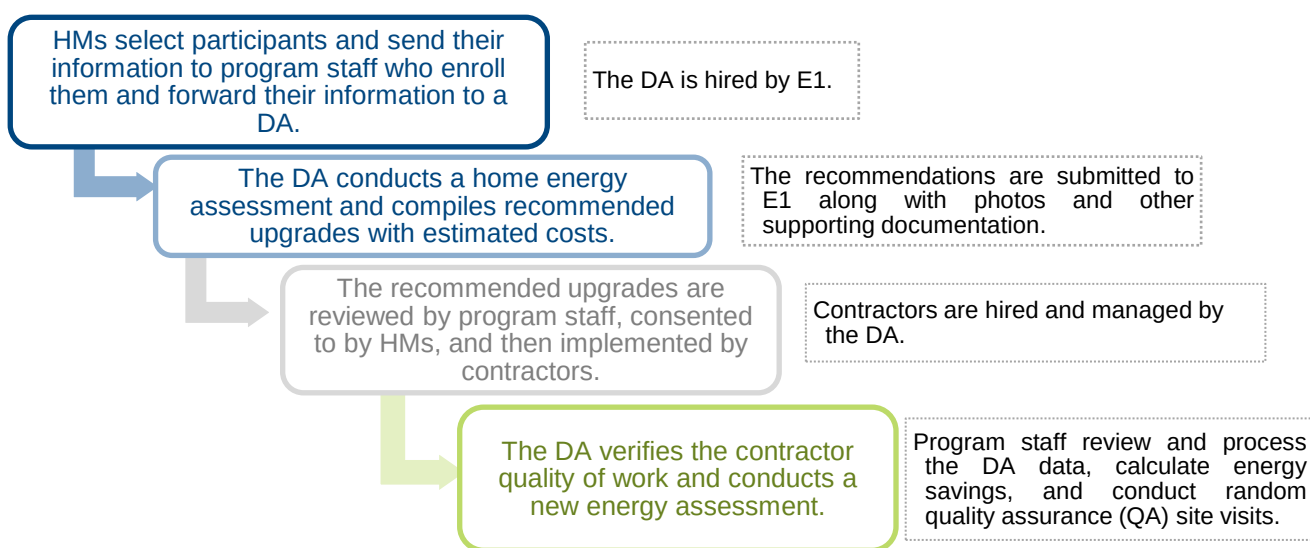
## 25 MHEEP Overview

This section describes the Mi'kmaw Home Energy Efficiency Project (MHEEP or the Project) program component, follows up on past evaluation recommendations, and provides an overview of MHEEP participation history.

### 25.1 MHEEP Description

MHEEP provides energy efficiency upgrades to homes in Mi'kmaw communities at no cost to participants or communities. E1 works with community housing managers (HMs), two delivery agents (DAs), and Mi'kmaw-preferred contractors to deliver the Project across all 13 Mi'kmaw communities in Nova Scotia. Figure 52 illustrates the participation process along with details about the program component.

**Figure 52: MHEEP Participation Process Summary**



MHEEP consists of conducting home energy assessments using the EnerGuide home evaluation framework, and each participating home receives an EnerGuide rating upon completion. The Project also provides building envelope upgrades such as draft-proofing and insulation as well as upgrades for space heating equipment, programmable and smart thermostats, and water heating equipment. Moisture management measures such as bathroom fans and heat recovery ventilators along with other measures such as carbon monoxide detectors may also be provided.

MHEEP also serves to identify opportunities to replace old appliances (dehumidifiers, refrigerators, and freezers) with energy efficient models and facilitates those replacements internally through the E1 Appliance Retirement program component. These measures are herein referred to as appliance replacements. Appliance Replacement was newly integrated into MHEEP reporting as of 2023, previously being included in Appliance Retirement reporting.

HMs identify and enroll participants and assist with program component requirements. DAs conduct pre-retrofit assessments (D assessments), recommend energy-saving measures, assign the work to contractors, and perform post-retrofit assessments (E assessments) to ensure that measures are implemented according to industry standards and that residents understand how to operate any new equipment.

MHEEP was launched in June 2018 as the First Nations Home Energy Efficiency Pilot. After the pilot stage in early 2019, MHEEP began work in participating homes in June 2019 and communications materials were developed to better inform HMs and participants. As of early 2024, privately owned homes are also eligible under amended eligibility criteria.

MHEEP funding comes from two sources: (1) Electricity ratepayer DSM funding is used for standard upgrades that reduce electricity consumption; and (2) funding from the Province of Nova Scotia (PNS) is used for upgrades that reduce non-electrical fuel consumption as well as a portion of upgrades that reduce electricity consumption. In 2023, a third type of allocation called non-standard was introduced; it is considered non-standard because all savings (electrical and non-electrical) from this type of participant are attributed entirely to PNS funding. This report presents all electrical savings achieved by MHEEP, including standard allocation, and attributed to DSM funding.

MHEEP was aimed at achieving 0.618 GWh in net electrical energy savings and 0.167 MW in net peak demand savings at the generator in 2024.

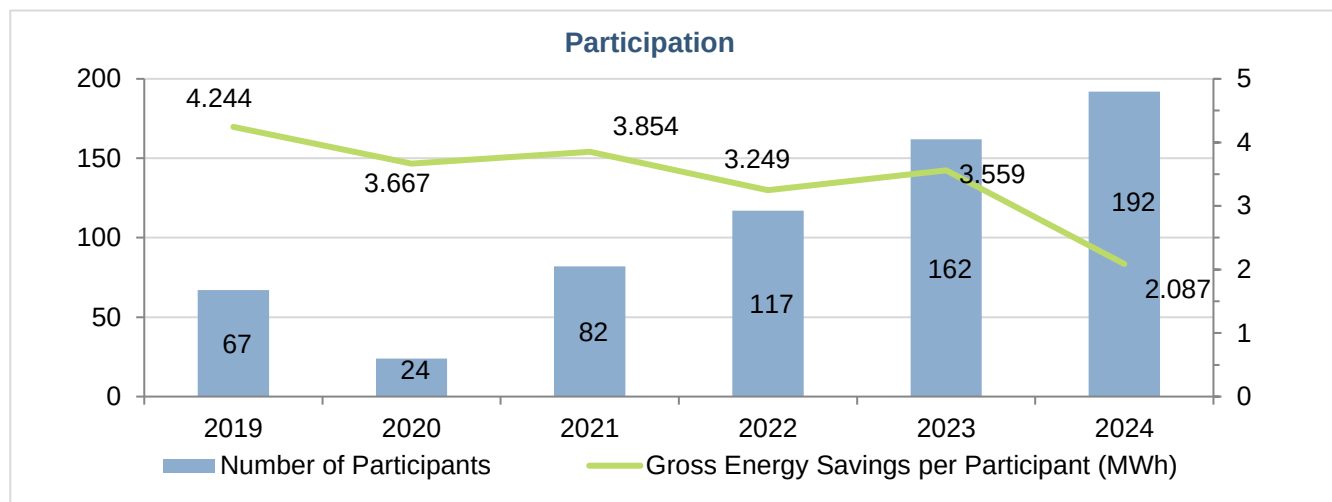
## 25.2 Follow-up on Past Evaluation Report Recommendations

No recommendations were made for MHEEP in the 2023 evaluation.

## 25.3 Participation History

As presented in Figure 16 below, 192 participants completed projects and achieved electrical energy savings under MHEEP in 2024, representing a 19% increase in participation compared to 2023 and the highest participation level since MHEEP inception. The figure also illustrates a 41% decrease in average gross energy savings per participant compared to 2023, which was mainly due to the updated adjustment ratios for modelled savings that resulted from the HEA billing analysis.

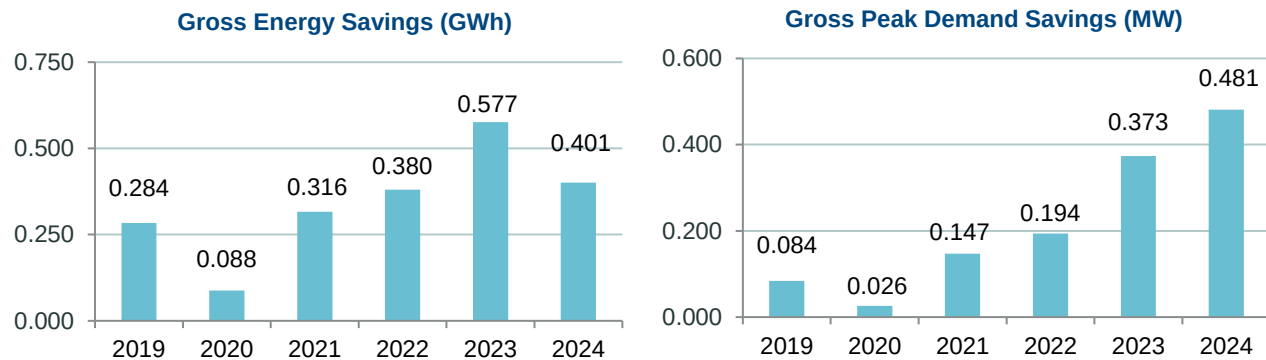
**Figure 53: Overview of MHEEP Participation, 2019-2024**



In addition to home retrofit projects completed through MHEEP, four old appliances (1 refrigerator, 2 freezers, and 1 dehumidifier) were replaced in 2024 through the program component.

Figure 54 below provides an overview of the evolution of MHEEP gross electrical energy and peak demand savings from 2019 to 2024. Total 2024 MHEEP gross energy savings were lower than in 2023 mainly due to the lower adjustment ratios. Since the new adjustment ratios had only a limited impact on peak demand savings, MHEEP total 2024 gross peak demand savings were higher than in 2023 because of the higher participation level and an updated unitary savings value.

**Figure 54: Evolution of MHEEP Gross Savings, 2019-2024**



## 26 MHEEP Evaluation Approach

The 2024 MHEEP evaluation comprised a condensed impact evaluation. The main objectives of the 2024 MHEEP evaluation were as follows:

- › Calculate gross and net MHEEP results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions.

Table 70 outlines the evaluation objectives and maps them to the research questions and methods established by the Evaluator. Each method is described further below.

**Table 70: 2024 MHEEP Evaluation Approach**

| Evaluation Objectives   | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Methodology                                                                                                                                                                             |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› What are the savings for heating and building envelope measures calculated with HOT2000, and what are the adjustment ratios from the Home Energy Assessment (HEA) program component?</li><li>› What are the unitary savings for non-modelled measures?</li><li>› What are the effective useful life (EUL) values for MHEEP measures?</li><li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Unitary savings review</li><li>› EUL update</li><li>› Calculations using evaluation results</li></ul>            |
| Calculate net results   | <ul style="list-style-type: none"><li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li><li>› What are the net greenhouse gas (GHG) emission reductions in CO<sub>2</sub> eq?</li></ul>                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"><li>› Use of a net-to-gross ratio (NTGR) of 1</li><li>› Calculations using evaluation results</li><li>› GHG emission reduction calculations</li></ul> |

### Tracking Sheet Audit

Prior to performing the savings review, the Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The detailed protocol used for the tracking sheet audit and the results obtained are presented in Appendix XXXIV.

### Unitary Savings Review

A unitary savings review was conducted for all measures (excluding the savings estimates obtained from HOT2000 and for MSHPs whose savings relied on the billing analysis) as part of a major update to the 2024-2025 Demand-Side Management Measure Assessment (DSM MA).<sup>62</sup> The unitary savings review entailed a literature review of technical reference manuals, metering studies, and program evaluations to determine if there were more appropriate<sup>63</sup> methodologies or parameters to be applied to calculate energy and peak demand unitary savings, including elements such as baseline assumptions, operating hours, efficiency levels, peak demand-to-energy ratios, and interactive effect factors.

<sup>62</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the evaluations conducted during the last two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.

<sup>63</sup> The Evaluator will judge whether new studies are more appropriate based on various factors, including but not limited by the following: The similarities between the measures implemented in a given study and E1's measures, the similarities in terms of climate or market conditions, the size of the sample studied, whether a study is recent, the quality of the study methodology, etc.

## EUL Update

In 2024, the Evaluator conducted a review of all EUL values as part of the 2024-2025 DSM MA update to determine if there were more appropriate EUL estimates.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime energy and peak demand savings using the equations and parameters that were determined to be valid based on the current evaluation.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for MHEEP, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.



## 27 MHEEP Impact Evaluation

The objectives of the 2024 MHEEP condensed impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as EUL values and associated lifetime energy savings. While the measures installed under MHEEP generate both electrical and non-electrical energy savings, only the standard-allocation electrical portion is covered in this report.

### 27.1 Tracking Sheet Audit

To ensure project results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The results obtained from the tracking sheet audit are presented in Appendix XXXIV. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 27.2 Gross Savings

MHEEP gross savings correspond to the change in energy consumption resulting from the measures implemented by participants regardless of why they participated.<sup>64</sup> In 2024, MHEEP participants received building envelope upgrades, space heating upgrades, and/or appliance replacements that generated electrical savings.

MHEEP gross savings are obtained through HOT2000 modelling with the exception of the following non-modelled measures for which gross savings are calculated using unitary savings values:

- › Replaced old appliances through Appliance Replacement (dehumidifiers, refrigerators, and freezers)
- › Programmable and smart thermostats
- › Drain water heat recovery systems (DWHRs)
- › Heat pump water heaters (HPWHs)

The methodologies used for evaluating gross savings are described in the following subsections.

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<sup>64</sup> Definition adapted from: National Renewable Energy Laboratory, *The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices*, September 2014, p. 3.

## 27.2.1 Electrical Energy Savings

For MHEEP, electrical energy savings are calculated based on HOT2000 simulation results adjusted with billing analysis results and unitary savings values for prescriptive measures, as shown in the equation below.

$$\begin{aligned} & \text{Gross Energy Savings (kWh)} \\ &= \left( \frac{(Total\ Energy_D(GJ) - Total\ Energy_E(GJ))}{0.0036\ GJ/kWh} \times \%_{Elec} - HPWH\ (kWh) - DWHR\ (kWh) \right) \\ & \times AR + Savings\ for\ Prescriptive\ Measures\ (kWh) \end{aligned}$$

Where:

- › *Total Energy<sub>D</sub>* and *Total Energy<sub>E</sub>* correspond to the modelled energy consumption levels respectively obtained in HOT2000 during the pre-retrofit (D) and post-retrofit (E) assessments. When modelled energy consumption levels were not available, the participant EnerGuide rating, which is a rating based on the modelled whole-home consumption, was used. Also, if the final E assessment consumption levels were not available, the projected final consumption levels were used.
- › *HPWH (kWh)* corresponds to the unitary savings value established for HPWHs.
- › *DWHR (kWh)* corresponds to the unitary savings value established for DWHRs.
- › *AR* corresponds to the adjustment ratio (AR) established through a billing analysis and used to adjust the savings obtained from the difference between the modelled electrical energy consumption during the D and E assessments. ARs vary according to different space heating system scenarios. ARs were drawn from billing analyses conducted in 2024 as part of the HEA evaluation.
- › *%<sub>Elec</sub>* corresponds to the percentage of electrical space heating estimated by the DA through the D assessment.
- › *Savings for Prescriptive Measures* are obtained by multiplying the prescriptive measures installed through MHEEP by their respective unitary electrical energy savings value.

### Measures Modelled in HOT2000

After the D and E assessments, the DAs model the house in the HOT2000 energy simulation software to obtain the initial and final EnerGuide ratings of that house. Energy consumption levels obtained from HOT2000 simulation results are used to determine the electrical energy savings for the modelled measures. They correspond to the reduction in consumption between the D and E assessments.

Since 2018, the methodology used to calculate tracked savings compares electrical space heating consumption levels, both of which being adjusted with an overestimation ratio (OR). The ORs were drawn from billing analyses conducted during the 2015 and 2018 HEA evaluations. The 2018 evaluation served to establish distinct ORs depending on the space heating system in place.

As part of the 2024 evaluation, the Evaluator made some changes to the current savings calculation methodology to simplify it and make it more robust. To do so, the Evaluator conducted a new billing analysis as part of the HEA 2024 evaluation. The Evaluator used the savings values obtained with billing data to develop adjustment ratios (ARs) that can be directly applied to the modelled savings estimates obtained from HOT2000 using whole-home consumption (not only space heating). The complete billing analysis methodology and results are presented in Appendix XXXI.

The ARs obtained through HEA billing analysis performed as part of the 2024 evaluation are presented in Table 54 below. They were determined separately for three heat pump scenarios, as was the case for ORs. The tracked ORs are also presented in the table for comparison. The values in parenthesis represent the ratios (1 – OR) that were multiplied with the D and E space heating consumption values when adjusting the consumption with the previous methodology. It is worth reminding that ARs are directly applied to the savings values obtained from the difference between the total initial and final consumption values.

**Table 71: 2024 MHEEP Adjustment Ratios**

| Scenario                                                                            | Tracked                    |                            | Evaluated |
|-------------------------------------------------------------------------------------|----------------------------|----------------------------|-----------|
|                                                                                     | OR <sub>D</sub> Assessment | OR <sub>E</sub> Assessment | AR        |
| A participant who registered <b>with</b> a heat pump                                | 0% (1.00)                  | 0% (1.00)                  | 1.24      |
| A participant who registered <b>without</b> a heat pump and who did not install one | 19% (0.81)                 | 19% (0.81)                 | 0.58      |
| A participant who registered <b>without</b> a heat pump and then had one installed  | 19% (0.81)                 | 0% (1.00)                  | 0.43      |

Participants with non-electrical space heating are eligible for the program component, meaning participants can generate both electrical and non-electrical savings. As indicated in the equation further above, the proportion of electrical savings for each participant is determined by multiplying total energy consumption by the proportion of space heating covered by electrical heating systems during the D assessment.

## Non-modelled Measures

Replaced appliances as well as programmable and smart thermostats are not modelled in HOT2000. Instead, resulting energy savings are calculated based on unitary energy savings values from the 2024-2025 DSM MA. That document provides a detailed description of inputs, references, and unitary savings calculations for non-modelled measures offered through MHEEP. Since the MA was updated in 2024, the unitary energy savings values of multiple measures were updated.

For HPWHs and DWHRs, even if modelled in HOT2000, savings from these measures are deducted from the modelled savings (according to their unitary savings value) before applying the AR to the remaining modelled savings. HPWH savings are then added up as a prescriptive measure, again, according to their unitary savings value. This approach avoids applying the AR on HPWH and DWHR savings considering these measures were not captured in the billing analysis due to their low installation rates. Also, this will facilitate future savings accounting in conjunction with E1's HPWH market transformation pilot.

Table 72 summarizes the tracked and evaluated unitary energy savings values for non-modelled MHEEP measures for which the unitary savings were changed in 2024.

**Table 72: Tracked and Evaluated 2024 MHEEP Unitary Energy Savings**

| Measure                                             | Tracked Savings [kWh/year] | Evaluated Savings [kWh/year] |
|-----------------------------------------------------|----------------------------|------------------------------|
| Smart Thermostats with Electric Resistance Baseline | 348                        | 312                          |
| Smart Thermostats with Heat Pump Baseline           | 514                        | 564                          |
| <b>Appliance Replacement</b>                        |                            |                              |
| Refrigerators                                       | 735                        | 674                          |
| Freezers                                            | 2,006                      | 1,380                        |
| Dehumidifiers                                       | 603                        | 616                          |



## 27.2.2 Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand period of the electricity system. The projected electricity peak demand period in Nova Scotia is between 5 p.m. and 7 p.m. in the months of December to February on non-holiday weekdays.

For MHEEP, modelled peak demand savings were calculated based on electrical savings using a peak demand-to-energy ratio of 0.283 MW/GWh for space heating savings (RES-Elect Space Heat & Cool), as set by Navigant in the 2016-2018 DSM Plan. This ratio was established based on the modelled system coincident peak demand savings and energy savings for a projected deployment of measures. Navigant used local data to establish the ratio. The Evaluator considered that the approach used by Navigant to establish the peak demand-to-energy ratio was still valid and therefore used it to estimate peak demand savings.

An exception was made for heat pump measures. Starting in 2021, unitary peak demand savings were calculated separately for heat pump measures. As documented in the 2024-2025 DSM MA, heat pump peak demand savings were established by multiplying an average unitary peak demand savings per capacity, which was based on the savings of the heat pump measures installed under HEA and was updated from 0.129 W/(Btu/hr) to 0.148 W/(Btu/hr) in 2024, by the capacity of each system installed under MHEEP and the percentage of electrical space heating.

Replaced appliances, programmable and smart thermostats, drain water heat recovery systems, and heat pump water heaters are not modelled in HOT2000. Instead, peak demand savings are calculated based on unitary peak demand savings values. The detailed calculations for the unitary peak demand savings of each measure installed through MHEEP are presented in the 2024-2025 DSM MA. Since the Measure Assessment was updated in 2024, the unitary peak demand savings values of some measures were updated.

Table 73 summarizes the tracked and evaluated unitary peak demand savings values of measures for which the unitary peak demand savings were changed in 2024.

**Table 73: Tracked and Evaluated 2024 MHEEP Unitary Peak Demand Savings**

| Measure                      | Tracked Savings<br>[W/year] | Evaluated Savings<br>[W/year] |
|------------------------------|-----------------------------|-------------------------------|
| <b>Appliance Replacement</b> |                             |                               |
| Refrigerators                | 101                         | 93                            |
| Freezers                     | 277                         | 190                           |
| Dehumidifiers                | 202                         | 206                           |

## 27.2.3 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling. The interactive effects of the space heating measures modelled in HOT2000 were already considered in the savings calculations since the simulation models encompass the total energy consumption of a house.

For the 2024 evaluation, programmable and smart thermostats as well as drain water heat recovery systems and replaced old appliances were measures not modelled in HOT2000. As presented in the 2024-2025 Measure Assessment, they do not have an impact on the energy consumption of other elements to be considered.

## 27.2.4 Effective Useful Life

As part of the 2024-2025 DSM MA activities, the Evaluator reviewed the EUL values used in the calculation of electrical energy savings that are expected to persist over time. The EUL values for building envelope upgrades and space heating equipment, i.e. the modelled savings, are based on the measures installed by HEA participants since HEA and MHEEP participants install similar measures. As part of the 2024-2025 DSM MA update, the EUL values were not revised for any measure categories except for heat pump water heaters and modelled measures. Table 74 presents the EUL values that were changed in 2024.

**Table 74: Tracked and Evaluated 2024 MHEEP Equivalent EUL Values**

| Measure                            | Tracked Equivalent EUL [years] | Evaluated Equivalent EUL [years] |
|------------------------------------|--------------------------------|----------------------------------|
| Heat Pump Water Heaters            | 10                             | 15                               |
| Building Envelope (Modelled)       | 20.8                           | 20.5                             |
| Space Heating Equipment (Modelled) | 20.8                           | 20.5                             |

## 27.2.5 Evaluated Gross Savings

The modelled and non-modelled measure annual gross savings at the meter are presented in Table 75 and Table 76 below respectively. Table 77 further below combines the savings of all MHEEP measures and presents total MHEEP annual gross savings.

**Table 75: Evaluated 2024 MHEEP Modelled Measure Gross Energy and Peak Demand Savings**

|                                                                                                                                                                                                                                                                                                                                                                        | Total        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Number of Participants</b>                                                                                                                                                                                                                                                                                                                                          | <b>192</b>   |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                  |              |
| Gross Energy Savings Without Adjustment Ratio (AR) – at the Meter (GWh)                                                                                                                                                                                                                                                                                                | 0.632        |
| <b>Gross Energy Savings with AR – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                               | <b>0.361</b> |
| Effective Useful Life (years)                                                                                                                                                                                                                                                                                                                                          | 20.5         |
| <b>Gross Lifetime Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                              | <b>7.407</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                             |              |
| Peak Demand-to-energy Ratio (MW/GWh)*                                                                                                                                                                                                                                                                                                                                  | 1.160        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                   | <b>0.419</b> |
| * Corresponds to the equivalent peak demand-to-energy ratio obtained by dividing gross peak demand savings by gross energy savings. This value is different from the peak demand-to-energy ratio that was formerly used (0.283 MW/GWh) because of the different calculation methodology applied for heat pumps and the addition of non-modelled prescriptive measures. |              |

**Table 76: Evaluated 2024 MHEEP Non-modelled Measure\* Gross Energy and Peak Demand Savings**

| Measure Category                                                             | Drain Water Heat Recovery Systems | Appliance Replacement - Refrigerators | Appliance Replacement - Freezers | Appliance Replacement - Dehumidifiers | Total        |
|------------------------------------------------------------------------------|-----------------------------------|---------------------------------------|----------------------------------|---------------------------------------|--------------|
| Number of Units Replaced                                                     | 1                                 | 1                                     | 2                                | 1                                     | 5            |
| <b>Energy Savings</b>                                                        |                                   |                                       |                                  |                                       |              |
| Unitary Energy Savings (kWh)                                                 | 599                               | 674                                   | 1,380                            | 616                                   | -            |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                             | <b>0.001</b>                      | <b>0.001</b>                          | <b>0.003</b>                     | <b>0.001</b>                          | <b>0.005</b> |
| Effective Useful Life (years)                                                | 20                                | 5                                     | 4                                | 5                                     | -            |
| <b>Gross Lifetime Energy Savings – at the Meter (GWh)</b>                    | <b>0.012</b>                      | <b>0.003</b>                          | <b>0.011</b>                     | <b>0.003</b>                          | <b>0.029</b> |
| <b>Peak Demand Savings</b>                                                   |                                   |                                       |                                  |                                       |              |
| Unitary Peak Demand Savings (W)                                              | 97                                | 93                                    | 190                              | 206                                   | -            |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                         | <b>0.0001</b>                     | <b>0.0001</b>                         | <b>0.0004</b>                    | <b>0.0002</b>                         | <b>0.001</b> |
| * Only measures with at least one installed unit are included in this table. |                                   |                                       |                                  |                                       |              |

As presented in Table 76 above, appliances replaced through Appliance Replacement (refrigerator, freezer, and dehumidifier replacements) resulted in gross energy savings of 0.004 GWh and gross peak demand savings of 0.0007 MW.

The gross savings at the generator were estimated by using a line loss factor of 1.0947 for energy savings and 1.1466 for peak demand savings between the meter and the generator. These line loss factors were provided by NS Power and correspond to the values used for residential consumers. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>65</sup>

With total gross energy and lifetime energy savings of 0.401 GWh and 8.141 GWh respectively, the average EUL value for MHEEP was 20.3 years in 2024.

<sup>65</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

**Table 77: Evaluated 2024 MHEEP Gross Energy and Peak Demand Savings**

| Measure Category                                                                                                                                                              | Modelled     | Non-modelled | Total        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------|
| <b>Energy Savings</b>                                                                                                                                                         |              |              |              |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                              | <b>0.361</b> | <b>0.005</b> | <b>0.366</b> |
| Line Loss Factor                                                                                                                                                              | 1.0947       | 1.0947       | -            |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                          | <b>0.396</b> | <b>0.005</b> | <b>0.401</b> |
| Effective Useful Life (years)                                                                                                                                                 | 20.5         | 6.3*         | -            |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                 | <b>8.109</b> | <b>0.032</b> | <b>8.141</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                    |              |              |              |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                          | <b>0.419</b> | <b>0.001</b> | <b>0.420</b> |
| Line Loss Factor                                                                                                                                                              | 1.1466       | 1.1466       | -            |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                      | <b>0.480</b> | <b>0.001</b> | <b>0.481</b> |
| * Corresponds to the equivalent EUL obtained from dividing the non-modelled measure lifetime energy savings at the meter by their energy savings at the meter (see Table 76). |              |              |              |

As presented in Table 78, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>66</sup> for GHG emissions generated by electricity production to MHEEP gross savings results.

**Table 78: Evaluated 2024 MHEEP Gross GHG Emission Reductions**

|                                                                                             | Total        |
|---------------------------------------------------------------------------------------------|--------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>0.401</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2        |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>189</b>   |

## 27.3 Net Savings

The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to a program component, by estimating a net-to-gross ratio (NTGR). More precisely, the NTGR represents the positive or negative impacts of spillover and free-rider effects on gross savings. A NTGR of 1.00 was used since participating homes are owned by Mi'kmaw communities that traditionally have small housing budgets spread across many competing housing priorities.

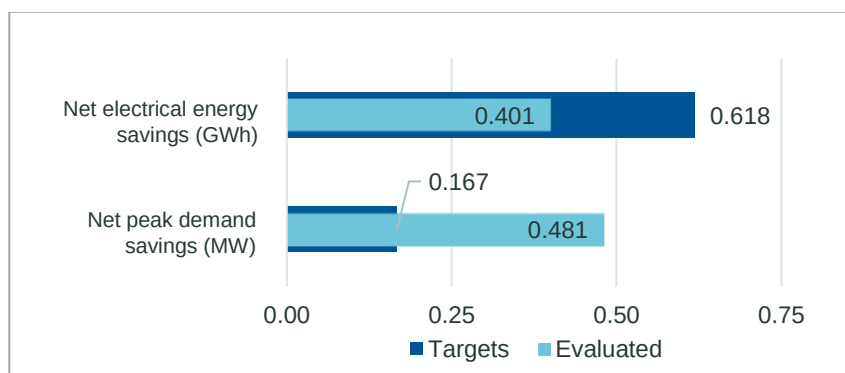
<sup>66</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

### 27.3.1 Evaluated Net Savings

Net savings are defined as the energy savings specifically attributable to MHEEP. Since spillover and free-ridership effects were considered nil, the net MHEEP impacts are equal to the gross savings generated by the program component. Overall, total net energy and peak demand savings amounted to 0.401 GWh and 0.481 MW at the generator respectively. Likewise, the net annual GHG emission reductions are equal to the gross annual GHG emission reductions.

As outlined in Figure 55, MHEEP fell short of its electrical energy savings target by 35% and exceeded its peak demand savings target by 189%.

**Figure 55: 2024 MHEEP Targets and Evaluated Savings**



### 27.4 Realization Rate

A comparison of the gross and net energy and peak demand savings values established through this evaluation and those tracked by E1 is presented in Table 79 below. The table also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 79: Comparison of Tracked and Evaluated 2024 MHEEP Savings at the Generator**

|                                                                                                                                                                  | Gross Savings |      | NTGR | Net Savings |      | Realization Rate |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|------|-------------|------|------------------|
|                                                                                                                                                                  | Value         | Unit |      | Value       | Unit |                  |
| Energy Savings                                                                                                                                                   |               |      |      |             |      |                  |
| Tracked Savings by E1                                                                                                                                            | 0.578         | GWh  | 1.00 | 0.578       | GWh  | 69%              |
| Evaluation Results                                                                                                                                               | 0.401         | GWh  | 1.00 | 0.401       | GWh  |                  |
| Peak Demand Savings                                                                                                                                              |               |      |      |             |      |                  |
| Tracked Savings by E1                                                                                                                                            | 0.420         | MW   | 1.00 | 0.420       | MW   | 115%             |
| Evaluation Results                                                                                                                                               | 0.481         | MW   | 1.00 | 0.481       | MW   |                  |
| *NTGRs varied for each product category. The NTGRs presented in this table correspond to the rounded averages obtained by dividing net savings by gross savings. |               |      |      |             |      |                  |

The evaluated net energy savings were 31% lower than the values tracked by E1 mainly due to the updated adjustment ratios. Conversely, the evaluated net peak demand savings were 15% higher than the values tracked by E1 due to the updated peak demand savings per capacity value for heat pumps.



## 28 MHEEP Key Findings and Recommendations

As mentioned previously, the main objectives of the 2024 MHEEP evaluation were as follows:

- › Calculate gross and net MHEEP results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions

This section provides the Evaluator's key findings in relation to the above objectives. The Evaluator has no specific recommendation for MHEEP.

### **2024 MHEEP-Finding: MHEEP net electrical energy savings fell short of targets while peak demand savings exceeded targets.**

MHEEP achieved 0.401 GWh in net electrical energy savings and 0.481 MW in net peak demand savings at the generator in 2024, thus not attaining the planned net electrical energy savings of 0.618 GWh while exceeding the planned net peak demand savings of 0.167 MW. MHEEP achieved 65% of the electrical energy savings target in 2024 compared to 95% in 2023. Although the participation level was higher, it was not sufficient to reach the energy savings target.

### **2024 MHEEP-Finding: While MHEEP achieved the highest participation level since its inception, the average savings per participant decreased in 2024, generating lower energy savings and higher peak demand savings in 2024 compared to 2023 levels.**

Compared to 2023 levels, participation increased by 19%, reaching the highest participation levels since the inception of the program component, and the average savings per participant decreased by 41% mainly due to the updated adjustment ratios. Overall, these changes resulted in a decrease in total electrical energy savings of 31% and in an increase in peak demand savings of 29% in 2024 compared 2023 levels, the new adjustment ratios having a limited impact on peak demand savings.

### **2024 MHEEP-Finding: The evaluated net energy and peak demand savings determined by the Evaluator were respectively lower and higher than the initial net savings tracked by E1.**

The evaluated net energy and peak demand savings were 31% lower and 15% higher than the values tracked by E1 respectively. This was mainly due to revisions to the adjustment ratios and peak demand savings per capacity value for heat pumps.



## 29 Residential Behaviour Overview

This section describes the Residential Behaviour program component, follows up on past evaluation recommendations, and provides an overview of participation history.

### 29.1 Description

The Residential Behaviour program component, publicly branded as Efficiency Insights, is designed to help Nova Scotia Power (NS Power) residential customers reduce their electricity consumption. The component provides a subset of customers with detailed usage data allowing them to compare their energy use with similar homes and includes behaviour change tips and recommendations for Efficiency Nova Scotia (ENS) programs to encourage the adoption of energy-conscious habits and practices.

E1's service provider, Bidgely, processes NS Power data using proprietary algorithms to create personalized Home Energy Reports (HERs) in both paper and electronic formats. E1 integrates its Efficiency Insights tools into NS Power's MyEnergy Insights (MEI) platform to ensure a seamless experience for customers. Customers are encouraged to use the MEI online portal to complete a survey about energy use in their home, the results of which help improve HER personalization.

To enhance customer engagement, E1 employs Energy Solutions Advisors (ESAs) who assist customers in understanding and applying insights from their HERs and the MEI platform. They also guide customers toward suitable ENS programs.

The program component is funded under E1's 2023-2025 Demand-side Management Plan. ENS previously delivered a similar initiative, known as the Home Energy Report program, from 2013 to 2015.

Energy savings are assessed annually through a billing analysis that serves to compare the energy usage of program participants with a control group not enrolled in the program. E1 treatment customers will receive up to six reports per year, aligned with NS Power's bi-monthly billing cycles. Since the program component was launched in May 2024, four reports were issued in 2024. Reports are distributed continuously in weekly batches given the variability in customers' billing cycles. Additionally, two of the annual reports are seasonally tailored to reflect the heating and cooling seasons.

### 29.2 Follow-up on Past Evaluation Report Recommendations

There are no past recommendations since this is the first evaluation of Residential Behaviour.

### 29.3 Participation History

Residential Behaviour is an opt-out program component, which means that E1 enrolls customers, and customers remain in the program until they opt out online or by contacting E1.

The targeted population for Residential Behaviour is NS Power residential customers with rate codes 02B and 03B, which include most residential customers who had an active account and sufficient billing to constitute the baseline period. Prior to program launch, the Evaluator was mandated to identify eligible customers and randomly assign them to a control or treatment group. The population was split into three waves corresponding to high, medium, and low electricity users. Table 80 below presents the number of selected participants (treatment groups) and those selected to be in the control groups when the group selection was made in March 2024 and at the time of program launch in May 2024.

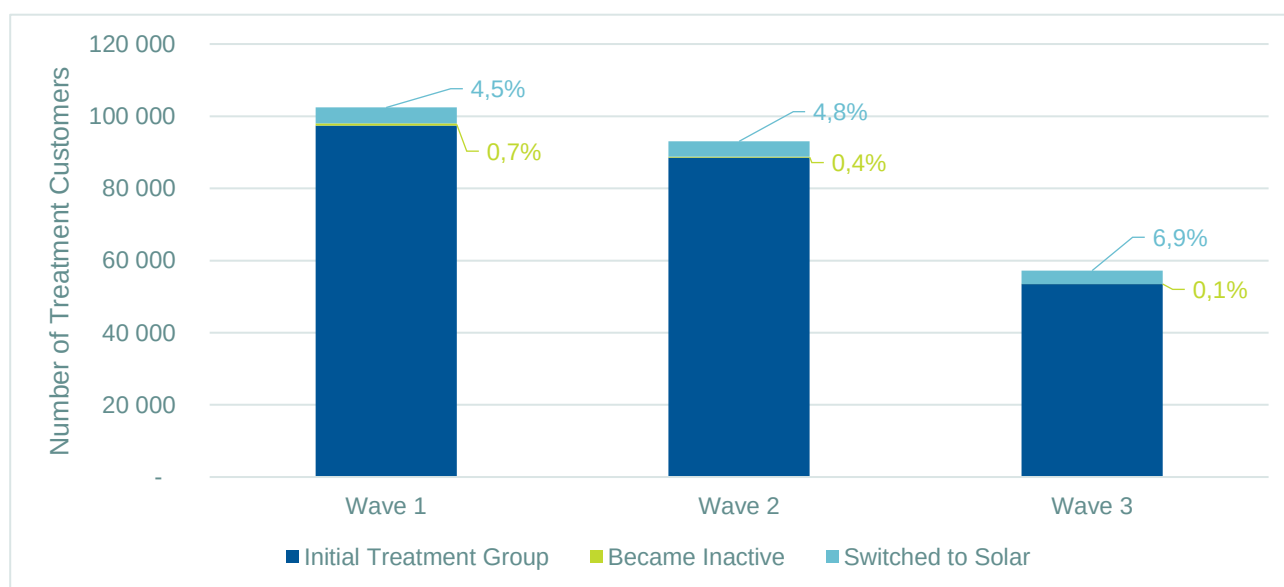
**Table 80: 2024 Treatment and Control Group Sizes**

| Wave                                             | Population Size (N) | Treatment Group Size | Control Group Size |
|--------------------------------------------------|---------------------|----------------------|--------------------|
| <b>Group Sizes at the Time of Selection</b>      |                     |                      |                    |
| 1 – High users                                   | 119,132             | 101,273              | 17,859             |
| 2 – Medium users                                 | 103,752             | 93,233               | 10,519             |
| 3 – Low users                                    | 95,403              | 66,708               | 28,695             |
| Total                                            | 318,287             | 261,214              | 57,073             |
| <b>Group Sizes at the Time of Program Launch</b> |                     |                      |                    |
| 1 – High users                                   | 114,596             | 97,368               | 17,228             |
| 2 – Medium users                                 | 98,409              | 88,482               | 9,927              |
| 3 – Low users                                    | 76,435              | 53,459               | 22,976             |
| Total                                            | 289,440             | 239,309              | 50,131             |

Over time, residential behaviour programs experience attrition, i.e. they lose customers in the study because of account closures or participants move. These are considered as inactive accounts. Moreover, in the case of E1 Residential Behaviour, customers who switch to a solar rate code due to the installation of solar photovoltaic systems are also removed from the study because they no longer offer a valid billing analysis comparison to non-solar customers. Together, these customer losses form the attrition rate. Customers do not receive **Efficiency Insights** reports after their accounts become inactive or they switch to solar.

This attrition explains why some participants were lost between the treatment and control group selection (March 2024) and program launch (May 2024). Then, during the first program year between May and December 2024, 13,439 treatment group accounts became inactive or switched to solar, which represent an overall attrition rate of 5.6%. Figure 56 below illustrates the percentages of initial treatment participants from May 2024 and who became inactive or switched to solar for each wave. The switch to the solar rate code is responsible for a large portion of the attrition rate.

**Figure 56: Proportion of Treatment Customers that Became Inactive or Switched to Solar**





During the period from May to December 2024, 3.5% of treatment participants also opted out of the program component, i.e. asked to stop receiving HERs or did not receive electronic or paper HERs because of an invalid address. The opt-out rate is similar in each wave.

## 30 Residential Behaviour Evaluation Approach

The 2024 Residential Behaviour evaluation consisted of a comprehensive impact evaluation using a billing analysis. The main objectives of the 2024 Residential Behaviour evaluation were as follows:

- › Calculate net results, namely electrical first-year energy savings, and avoided GHG emissions

The Evaluator identified key research questions aimed at achieving the above objectives. Table 81 outlines the evaluation objectives and maps them to the Evaluator's research questions and methods. Each method is described further below.

**Table 81: 2024 Residential Behaviour Evaluation Approach**

| Evaluation Objectives | Research Questions                                                                                                                                                                                                                                                                                                                                           | Methodology                                                                                                                                                               |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate net results | <ul style="list-style-type: none"><li>› What are the evaluated first-year net electrical energy savings?</li><li>› Are the participation levels in other ENS residential programs significantly higher among treatment participants? If yes, what savings deductions should be made?</li><li>› What are the net GHG emission reductions in CO2 eq?</li></ul> | <ul style="list-style-type: none"><li>› Billing analysis</li><li>› Analysis of participation in other E1 programs</li><li>› GHG emission reduction calculations</li></ul> |

### Billing Analysis

A billing analysis including a comparison of the treatment and control group electricity consumption levels using a difference-in-difference approach was conducted to calculate net electrical energy savings.

### Analysis of Participation in Other Programs

The Evaluator compared the participation levels between the treatment and control groups in other residential program components offered by E1, namely Efficient Product Installation (EPI), Green Heat (GH) and Home Energy Assessment (HEA), to verify if higher participation levels are observed in those treatment groups and deduct savings to avoid double counting.

### GHG Emission Reduction Calculation

To obtain net avoided GHG emissions in CO2 eq for Residential Behaviour, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using NS Power data.

### Note on Margin of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>67</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>68</sup>

<sup>67</sup> Precision refers to how reproducible a set of measurements is. It does not take into account how close the measured values are to the true values since this would refer to accuracy.

<sup>68</sup> As part of this evaluation, confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.

As part of the 2024 Residential Behaviour evaluation, the Evaluator calculated the margins of error for savings values obtained from the billing analysis. The margins of error are listed alongside results in the applicable sections below. They are calculated at a confidence level of 90%.



## 31 Residential Behaviour Impact Evaluation

The objectives of the 2024 Residential Behaviour impact evaluation were to determine net electrical energy savings.

The savings calculation methodology for Residential Behaviour is based on evaluation protocols commonly used in North America to assess savings resulting from residential behaviour programs, based on a randomized controlled trial (RCT) design,<sup>6970</sup> the Evaluator's experience in evaluating such programs, and industry best practices. A RCT is a program design through which households in a given population are randomly assigned to two groups – a treatment group and a control group – and the outcomes for the two groups are compared, resulting in unbiased program savings estimates. Residential Behaviour is based on a RCT design.

### 31.1 Tracking Sheet Audit

Considering Residential Behaviour relies on a random selection of treatment group participants among all residential customers, the program component does not have a tracking sheet. Therefore, no tracking sheet audit was conducted for this evaluation.

### 31.2 Net Savings

For Residential Behaviour, savings correspond to the change in electricity consumption resulting from behaviours adopted by treatment group participants compared with the change in electricity consumption observed among control group participants. Savings therefore already correspond to net savings that can be directly attributable to the program component. Indeed, by using a control group in the comparison, the savings already include program influence on participants' decisions. According to the Uniform Methods Project (UMP), net savings are defined by the difference in energy consumption with the program in place versus that consumption that would have occurred in the absence of the program.<sup>71</sup> Subtracting the energy consumption change that is not attributable to the program, as represented by the control group energy consumption change, from the treatment group energy consumption change provides a robust estimate of the net change in energy consumption directly attributed to the program. Therefore, no additional free-ridership or spillover effects need to be applied to the savings established by the comparison. The only additional consideration to be taken into account is if Residential Behaviour results in increased participation in other residential programs to avoid any double counting between ENS programs.

The following subsections describe the steps used to calculate program net savings.

#### 31.2.1 Treatment and Control Group Selection and Equivalency Check

To yield accurate and unbiased results when calculating savings under a RCT approach, the treatment and control groups must be selected properly so that the two groups are similar. For Residential Behaviour, the Evaluator was responsible for selecting the treatment and control groups to ensure they were randomly selected and confirm their equivalency prior to program launch.

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<sup>69</sup> NREL (2020). Chapter 17: Residential Behaviour Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures: September 2011 – August 2020.

<sup>70</sup> State and Local Energy Efficiency Action Network (2012). Evaluation, Measurement, and Verification (EM&V) of Residential Behaviour-Based Energy Efficiency Programs: Issues and Recommendations.

<sup>71</sup> NREL (2020). Chapter 21: Estimating Net Savings – Common Practices, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures: September 2011 – August 2020.

The Evaluator received energy consumption data for all NS Power residential customers in rate codes 02B and 03B, which include most residential customers. The energy consumption data were directly provided by E1 after gathering advanced metering infrastructure (AMI) data aggregated on a monthly basis from the NS Power system. The Evaluator then analyzed the number of active accounts as well as the distribution of their consumption levels. As presented in Subsection 29.3 above, the population was split into three different waves corresponding to high, medium, and low electricity users. For each wave, the Evaluator randomly assigned customers in the treatment or control group. The proportions of treatment versus control group customers were determined by the Evaluator for each wave based on statistical tests in order to optimize the treatment group sizes while ensuring being able to detect savings.

To ensure that the selected groups were statistically equivalent, the Evaluator compared the pre-program energy consumption data and the geographical locations of the treatment and control groups of each wave.

Table 82 below presents the average daily consumption levels of households in the treatment and control groups for each wave during the pre-program period (May 2023 to April 2024) as well as the variation between both groups

**Table 82: Average Daily Electricity Consumption Values for the Pre-program Period**

| Wave             | Group     | Average Daily Consumption (kWh) | Variation Between Control and Treatment Groups |
|------------------|-----------|---------------------------------|------------------------------------------------|
| 1 – High users   | Control   | 46.2070                         | 0.08%                                          |
|                  | Treatment | 46.2437                         |                                                |
| 2 – Medium users | Control   | 24.8000                         | 0.25%                                          |
|                  | Treatment | 24.7379                         |                                                |
| 3 – Low users    | Control   | 11.6720                         | 0.31%                                          |
|                  | Treatment | 11.6361                         |                                                |

As outlined in Table 82 above, the difference in average daily electricity consumption between the control and treatment group for each wave is very minor. This analysis therefore confirms that the Evaluator properly selected households for the treatment and control groups based on electricity consumption data and that both groups demonstrate similar consumption patterns.

This analysis was performed using the AMI data for the pre-program period from May 2023 to April 2024. A similar analysis was conducted with 24 months (divided into year -1 and year 2) of bi-monthly billing data prior to program launch, where available, to ensure that no consumption patterns could be detected. Average daily consumption levels were found to be similar to those calculated in Table 82 and no major differences in consumption levels between year 1 and year 2 were detected. Table 83 compares the geographical locations of households selected in each group using postal codes provided by E1.

**Table 83: Distribution of Geographical Locations**

| Wave             | Region                           | Control | Treatment |
|------------------|----------------------------------|---------|-----------|
| 1 – High users   | Number of Accounts <sup>72</sup> | 17,228  | 97,368    |
|                  | HRM                              | 38.93%  | 38.99%    |
|                  | Cape Breton                      | 14.06%  | 14.14%    |
|                  | Rest of Mainland NS              | 47.01%  | 46.87%    |
| 2 – Medium users | Number of Accounts               | 9,967   | 88,482    |
|                  | HRM                              | 36.04%  | 35.60%    |
|                  | Cape Breton                      | 16.75%  | 16.85%    |
|                  | Rest of Mainland NS              | 47.21%  | 47.55%    |
| 3 – Low users    | Number of Accounts               | 22,976  | 53,459    |
|                  | HRM                              | 54.69%  | 55.67%    |
|                  | Cape Breton                      | 13.19%  | 13.28%    |
|                  | Rest of Mainland NS              | 32.12%  | 31.05%    |

The Evaluator conducted statistical tests to verify whether the small differences in home locations between the control and treatment groups were statistically significant. In all cases, the difference was found to be insignificant, thereby confirming that home locations were randomly assigned to the control and treatment groups.

### 31.2.2 Installation Rates

Considering a billing analysis is used to calculate Residential Behaviour savings, the savings already take into account installation rates. Therefore, no additional installation rates needed to be applied.

### 31.2.3 Energy Savings

The model used to calculate savings for Residential Behaviour is the difference-in-difference (DiD). The DiD serves to compare **the average change in electricity consumption** in the treatment group prior to and during program participation to the change in energy use in the control group for the same periods. The **pre-program period** consists of the 12-month period prior to program launch, i.e. **from May 2023 to April 2024**. The **post-program period** corresponds to any evaluation year after the program launch. For the 2024 evaluation, since the program component was launched in May 2024, the post-program period is **from May to December 2024**.

Using the DiD model, the Evaluator calculated both monthly savings and annual savings (or cumulative savings). The monthly savings approach makes it possible to see the trend in energy savings month by month. The cumulative approach serves to directly calculate the savings for the whole evaluation period. While the monthly savings approach presents savings estimates for each month of the year, it can lead to results that are not statistically significant for certain months of the year due to larger margins of error. For this reason, the Evaluator elected to use the cumulative approach for official program component reporting while also presenting monthly savings for indicative purposes.

<sup>72</sup> The numbers of customers indicated here differ from those indicated in Table 80 because of account closures and the use of filters to exclude outliers and customers with missing information.



## Data Preparation

Before calculating savings, the Evaluator cleaned and prepared the AMI data provided by E1.

The received AMI data contained consumption data aggregated on a monthly basis. The pre-program data cover the 12-month period prior to program launch, i.e. from May 2023 to April 2024. The post-program data for the 2024 evaluation period cover the months of May 2024 to December 2024 inclusively.

When developing the data preparation procedure, the Evaluator asked the service provider to share their data cleaning procedure to ensure that their criteria were consistent. The data preparation procedure applied by the Evaluator included the following actions:

- › Remove outlier data
- › Remove duplicate data
- › Remove customer accounts that became inactive from the month when they became inactive (the list of inactive accounts, essentially corresponding to customers having moved or who closed their account, was provided by the program implementer)
- › Remove customer accounts that were switched to solar rate codes from the month when the switch occurred

After applying these data preparation steps to each treatment and control group customer, 5.6% of customers were removed at some point during the evaluation period (corresponding to the attrition rate) and 0.6% of observations (monthly consumption data) were also removed.

It should be noted that treatment group customers who opted out or who did not receive electronic or paper HERs because of an invalid address or not being registered with the NS Power My Account were kept in the analysis to avoid unbalancing the treatment and control groups (since these situations only occur in the treatment group) and causing bias in the savings estimates. Keeping opted-out accounts is the recommended approach in behaviour program evaluation protocols. Conversely, inactive accounts or accounts that switched to solar could be removed from the analysis as they occur equally in both the treatment and control groups.

## Cumulative Savings

The DiD model serves to compare the difference in the average daily consumption between the treatment group and the control group before and after program participation. The cumulative approach uses the average daily consumption within the entire period. The Evaluator also calculated monthly savings to observe monthly trends, the details of which are presented in Appendix XXXVI. The equation used under the cumulative approach to calculate total savings is expressed as follows.

$$\begin{aligned} \text{Cumulative Savings} &= [(Post\_kWh_{Control} - Post\_kWh_{Treat}) - (Pre\_kWh_{Control} - Pre\_kWh_{Treat})] \\ &\times \sum_{i=1}^N Nb\_Days \end{aligned}$$

Where:

- ›  $Post\_kWh_{Control}$  = The control group's average daily consumption over the given post-program year
- ›  $Post\_kWh_{Treat}$  = The treatment group's average daily consumption over the given post-program year
- ›  $Pre\_kWh_{Control}$  = The control group's average daily consumption over the pre-program period
- ›  $Pre\_kWh_{Treat}$  = The treatment group's average daily consumption over the pre-program period
- ›  $\sum_{i=1}^N Nb\_Days$  = The total number of active treatment days in the given year of each participating household (i)

Since the number of participating households in the treatment group with available AMI data varies from month to month, the Evaluator needed to adjust the cumulative savings approach to properly account for this and obtain the total savings value. Instead of multiplying the average daily savings by the number of participating households as was done for the monthly approach, the average daily savings obtained using the cumulative approach are multiplied by the total number of treatment days of each participating household.

Table 84 presents the 2024 electrical savings values established by the Evaluator based on the cumulative approach. Cumulative savings are used for reporting annual evaluated savings.

**Table 84: 2024 Evaluated Cumulative Electrical Energy Savings**

| Parameters and Results                                  | Cumulative Savings |
|---------------------------------------------------------|--------------------|
| <b>Wave 1 – High users</b>                              |                    |
| Initial Number of Active Participants (Treatment Group) | 97,368             |
| Attrition Rate (%)                                      | 5.2%               |
| Total Number of Treatment Days*                         | 23,110,379         |
| Average Daily Consumption (Treatment kWh/day)           | 37.8               |
| Average Daily Savings (kWh/day)                         | 0.132              |
| Percentage of Savings (%)                               | 0.34%              |
| Margin or Error (%)                                     | 0.30%              |
| <b>Total Savings (GWh)</b>                              | <b>3.051</b>       |



| Parameters and Results                                                                                                                          | Cumulative Savings |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <b>Wave 2 – Medium users</b>                                                                                                                    |                    |
| Initial Number of Active Participants (Treatment Group)                                                                                         | 88,482             |
| Attrition Rate (%)                                                                                                                              | 5.2%               |
| Total Number of Treatment Days*                                                                                                                 | 21,017,949         |
| Average Daily Consumption (Treatment kWh/day)                                                                                                   | 21.8               |
| Average Daily Savings (kWh/day)                                                                                                                 | 0.135              |
| Percentage of Savings (%)                                                                                                                       | 0.62%              |
| Margin or Error (%)                                                                                                                             | 0.37%              |
| <b>Total Savings (GWh)</b>                                                                                                                      | <b>2.837</b>       |
| <b>Wave 3 – Low users</b>                                                                                                                       |                    |
| Initial Number of Active Participants (Treatment Group)                                                                                         | 53,459             |
| Attrition Rate (%)                                                                                                                              | 7.0%               |
| Total Number of Treatment Days*                                                                                                                 | 12,554,547         |
| Average Daily Consumption (Treatment kWh/day)                                                                                                   | 11.2               |
| Average Daily Savings (kWh/day)                                                                                                                 | 0.062              |
| Percentage of Savings (%)                                                                                                                       | 0.57%              |
| Margin or Error (%)                                                                                                                             | 0.30%              |
| <b>Total Savings (GWh)</b>                                                                                                                      | <b>0.781</b>       |
| *Total number of treatment days is the sum-product of the number of active participants in each month by the number of days in the given month. |                    |

As mentioned at the beginning of Subsection 31.2.3 above, the savings obtained through the cumulative approach are used for official program component reporting because they are more inclusive of the monthly fluctuations in the margins of error that occur within a year. The sum of the savings calculated using the monthly approach differs from that obtained with the cumulative savings results because of the statistically insignificant savings for most months of the evaluation period. Interestingly, with the cumulative approach, savings values are similar for waves 1 and 2 mainly because the first months of wave 1 demonstrate very low savings and even negative savings in May. Wave 1 is expected to generate more savings in the upcoming months once the ramp-up period is passed.

### 31.2.4 Peak Demand Savings

No peak demand savings targets were set for Residential Behaviour and no peak demand savings were calculated as part of the 2024 evaluation.

### 31.2.5 Interactive Effects

Interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling. For Residential Behaviour, interactive effects are already taken into account through the savings calculations since the billing analysis is conducted using whole house energy consumption data.



### 31.2.6 Effective Useful Life

For Residential Behaviour, energy savings are assessed annually through a billing analysis that serves to calculate the change in electricity consumption between the program evaluation year (post-program period) with the pre-program period. The pre-program period remains the same throughout the years. Therefore, the resulting savings correspond to both first-year savings and savings that persist over time. Therefore, an EUL of one year is used.

In the literature, behavioural programs typically use an EUL of one year across various jurisdictions, including Massachusetts, Illinois, Vermont, and New York, for the same reason.

### 31.2.7 Savings Deductions for Participation in Other Residential Programs

As mentioned in Subsection 29.1 above, a secondary aim of Residential Behaviour is to encourage customers to engage with other ENS programs tailored to their usage profiles. Therefore, treatment group customers are more encouraged to participate in other residential programs than control group customers. To avoid double counting Residential Behaviour savings already accounted for through other ENS programs, the Evaluator compared, for each wave, the treatment and control group levels of participation in EPI, GH, and HEA. Considering no information is collected on participants in Instant Savings, it was not possible to include that program component in the analysis.

If a statistically significant higher program participation level is observed in one of the treatment groups, savings deductions need to be calculated for that program. To calculate these deductions, the Evaluator estimates an average per household net annual savings value associated with each program with a higher participation level. The total savings deduction for each program consists of multiplying the difference in percentage of the participation level between the treatment and control groups by the average per household net annual savings value and the number of participants in the treatment group. If no statistically significant difference is found, no savings deduction is necessary.

As outlined in Table 85 below, there are statistically significant differences in participation levels between the treatment and control groups in Green Heat and EPI for high users as well as in Green Heat for medium users. Thus, savings deductions for participation in other residential programs needed to be made to those waves, the results of which are presented in Subsection 31.2.8 below. These results reveal that Residential Behaviour is successful at encouraging customers to participate in other residential programs offered by E1.

**Table 85: Other 2024 Program Participation Levels**

| Program                      | Treatment Participation Level | Control Participation Level | Difference (%) | Is the Difference Statistically Significant? |
|------------------------------|-------------------------------|-----------------------------|----------------|----------------------------------------------|
| <b>Wave 1 – High users</b>   |                               |                             |                |                                              |
| HEA                          | 1.6%                          | 1.7%                        | -0.1%          | No                                           |
| Green Heat                   | 0.4%                          | 0.3%                        | 0.1%           | Yes                                          |
| EPI                          | 2.0%                          | 1.6%                        | 0.4%           | Yes                                          |
| <b>Wave 2 – Medium users</b> |                               |                             |                |                                              |
| HEA                          | 1.6%                          | 1.7%                        | 0.0%           | No                                           |
| Green Heat                   | 0.2%                          | 0.1%                        | 0.1%           | Yes                                          |
| EPI                          | 2.1%                          | 1.9%                        | 0.2%           | No                                           |
| <b>Wave 3 – Low users</b>    |                               |                             |                |                                              |
| HEA                          | 1.0%                          | 0.9%                        | 0.1%           | No                                           |
| Green Heat                   | 0.0%                          | 0.0%                        | 0.0%           | No                                           |
| EPI                          | 1.3%                          | 1.3%                        | 0.0%           | No                                           |

### 31.2.8 Evaluated Net Savings

Net electrical energy savings are defined as the energy use reductions that are specifically attributable to Residential Behaviour. Program component net electrical energy savings were estimated using the following equation:

$$\text{Net Savings} = \text{Cumulative Savings} - \text{Savings Deductions for Participation in Other Programs}$$

The detailed results are listed in Table 86 below. The net electrical energy savings resulted in 2,961 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions. GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>73</sup> for GHG emissions generated by electricity production to Residential Behaviour electrical energy savings.

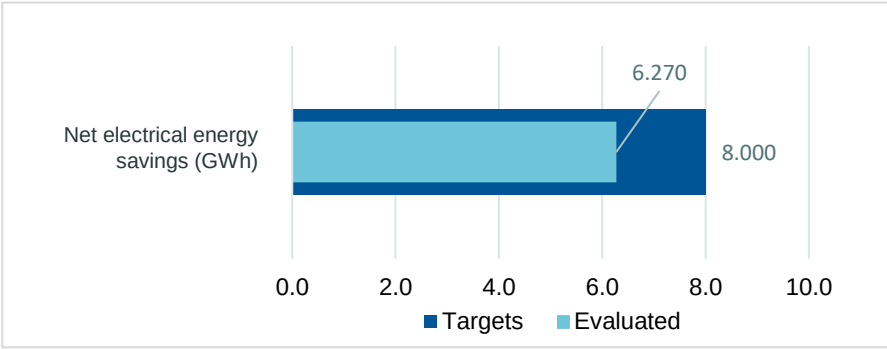
**Table 86: Evaluated 2024 Residential Behaviour Net Electrical Energy Savings**

| Cohort                             | Wave 1       | Wave 2       | Wave 3       | Total        |
|------------------------------------|--------------|--------------|--------------|--------------|
| <b>Energy Savings</b>              |              |              |              |              |
| <b>Energy Savings (GWh)</b>        | <b>3.051</b> | <b>2.837</b> | <b>0.781</b> | <b>6.669</b> |
| Savings Deductions (GWh)           | 0.354        | 0.044        | 0.000        | 0.399        |
| <b>Net Energy Savings (GWh)</b>    | <b>2.696</b> | <b>2.793</b> | <b>0.781</b> | <b>6.270</b> |
| Effective Useful Life (years)      | 1            | 1            | 1            | 1            |
| <b>Net Lifetime Energy Savings</b> | <b>2.696</b> | <b>2.793</b> | <b>0.781</b> | <b>6.270</b> |

<sup>73</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO<sub>2</sub> eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

As outlined in Figure 57 below, Residential Behaviour fell short of its target of 8.000 GWh in net electrical energy savings by 22%.

Figure 57: 2024 Residential Behaviour Targets and Evaluated Results



### 31.3 Realization Rate

No tracked savings were calculated for Residential Behaviour; therefore, there is no realization rate.



## 32 Residential Behaviour Key Findings and Recommendations

The main objectives of the 2024 Residential Behaviour evaluation were as follows:

- › Calculate net results, namely electrical first-year energy savings, as well as avoided GHG emissions

This section provides the Evaluator's key findings in relation to the above objectives. Pursuant to the 2024 evaluation, the Evaluator has no recommendations for Residential Behaviour.

### **2024 Residential Behaviour-Finding: Residential Behaviour fell short of its net electrical energy savings targets.**

Residential Behaviour achieved 6.270 GWh in net electrical energy savings in 2024, thus falling short of the planned net electrical energy savings of 8.000 GWh. This outcome is not surprising since the program component is still in its ramp-up phase after only eight months of operation. Savings are expected to gradually increase in the next months as participant engagement and adoption of new energy-saving actions increase. With achieved savings percentages ranging from 0.87% to 1.3% in the fall of 2024 depending on the wave, results are promising and indicate that the program component has potential for greater savings as it is scaled up.

### **2024 Residential Behaviour-Finding: The composition of the control and treatment groups remained similar between the initial selection (March 2024) and program component launch (May 2024).**

The Evaluator was responsible for selecting the treatment and control groups to ensure customers were randomly selected. An equivalency check was then performed as part of this evaluation to validate that the control and treatment groups remained similar at the time of program launch and confirm that no statistical differences that could negatively affect either group by introducing bias into savings calculations were revealed. Over the first year of evaluation, 13,439 accounts either became inactive or switched to solar. The attrition rate for high and medium users was 5.2% between May 2024 and December 2024 while it was 7.0% for low users. A large portion of the high attrition rates numbers is due to customers transitioning to solar.

### **2024 Residential Behaviour-Finding: Treatment group customers showed higher participation in other residential programs compared to the control group.**

Residential Behaviour successfully encouraged treatment participants to engage in other residential programs. Statistically significant differences in participation levels were observed among high users for Green Heat and EPI as well as among medium users for Green Heat. To avoid double-counting savings already attributed to other residential programs, savings deductions were applied to these cohorts.

## CONCLUSION

Table 87 presents the participation levels, net-to-gross ratios (NTGRs), evaluated gross and net savings at the generator, annual greenhouse gas (GHG) emission reductions, as well effective useful life (EUL) values for each program component and for Existing Residential as a whole.

**Table 87: Overall 2024 Existing Residential Participation and Evaluated Savings**

|                                | Participation Level |                    | Gross Savings |                  | NTGR   | Net Savings |                  |
|--------------------------------|---------------------|--------------------|---------------|------------------|--------|-------------|------------------|
|                                | Value               | Unit               | Value         | Unit             | Value* | Value       | Unit             |
| AMH                            |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 83                  | Projects           | 1.159         | GWh              | 1.00   | 1.159       | GWh              |
| Lifetime Energy Savings        |                     |                    | 19.397        | GWh              | 1.00   | 19.397      | GWh              |
| Peak Demand Savings            |                     |                    | 0.570         | MW               | 1.00   | 0.570       | MW               |
| Annual GHG Emission Reductions |                     |                    | 547           | Tonnes of CO2 eq | 1.00   | 547         | Tonnes of CO2 eq |
| EUL                            |                     |                    | 16.7          | Years            |        | 16.7        | Years            |
| ASFH                           |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 1,193               | Participants       | 3.719         | GWh              | 1.00   | 3.719       | GWh              |
| Lifetime Energy Savings        |                     |                    | 74.428        | GWh              | 1.00   | 74.428      | GWh              |
| Peak Demand Savings            |                     |                    | 2.089         | MW               | 1.00   | 2.089       | MW               |
| Annual GHG Emission Reductions |                     |                    | 1,756         | Tonnes of CO2 eq | 1.00   | 1,756       | Tonnes of CO2 eq |
| EUL                            |                     |                    | 20.0          | Years            |        | 20.0        | Years            |
| EPI                            |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 9,993               | Participants       | 9.093         | GWh              | 0.98   | 8.948       | GWh              |
| Lifetime Energy Savings        |                     |                    | 52.872        | GWh              | 0.99   | 52.525      | GWh              |
| Peak Demand Savings            |                     |                    | 0.898         | MW               | 0.98   | 0.880       | MW               |
| Annual GHG Emission Reductions |                     |                    | 4,294         | Tonnes of CO2 eq | 0.98   | 4,225       | Tonnes of CO2 eq |
| EUL                            |                     |                    | 5.8           | Years            |        | 5.9         | Years            |
| Green Heat                     |                     |                    |               |                  |        |             |                  |
| Energy Savings                 | 1,408               | Measures installed | 1.651         | GWh              | 0.53   | 0.872       | GWh              |
| Lifetime Energy Savings        |                     |                    | 29.724        | GWh              | 0.53   | 15.697      | GWh              |
| Peak Demand Savings            |                     |                    | 2.748         | MW               | 0.56   | 1.529       | MW               |
| Annual GHG Emission Reductions |                     |                    | 780           | Tonnes of CO2 eq | 0.53   | 412         | Tonnes of CO2 eq |
| EUL                            |                     |                    | 18.0          | Years            |        | 18.0        | Years            |



|                                                                                                                                                                  | Participation Level |                        | Gross Savings |                  | NTGR   | Net Savings |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------------|---------------|------------------|--------|-------------|------------------|
|                                                                                                                                                                  | Value               | Unit                   | Value         | Unit             | Value* | Value       | Unit             |
| HEA                                                                                                                                                              |                     |                        |               |                  |        |             |                  |
| Energy Savings                                                                                                                                                   | 5,367               | Participants           | 38.984        | GWh              | 0.82   | 31.962      | GWh              |
| Lifetime Energy Savings                                                                                                                                          |                     |                        | 1,070.988     | GWh              | 0.80   | 859.594     | GWh              |
| Peak Demand Savings                                                                                                                                              |                     |                        | 9.698         | MW               | 0.90   | 8.681       | MW               |
| Annual GHG Emission Reductions                                                                                                                                   |                     |                        | 18,408        | Tonnes of CO2 eq | 0.82   | 15,093      | Tonnes of CO2 eq |
| EUL                                                                                                                                                              |                     |                        | 27.5          | Years            |        | 26.9        | Years            |
| MHEEP                                                                                                                                                            |                     |                        |               |                  |        |             |                  |
| Energy Savings                                                                                                                                                   | 192                 | Participants           | 0.401         | GWh              | 1.00   | 0.401       | GWh              |
| Lifetime Energy Savings                                                                                                                                          |                     |                        | 8.141         | GWh              | 1.00   | 8.141       | GWh              |
| Peak Demand Savings                                                                                                                                              |                     |                        | 0.481         | MW               | 1.00   | 0.481       | MW               |
| Annual GHG Emission Reductions                                                                                                                                   |                     |                        | 189           | Tonnes of CO2 eq | 1.00   | 189         | Tonnes of CO2 eq |
| EUL                                                                                                                                                              |                     |                        | 20.3          | Years            |        | 20.3        | Years            |
| Residential Behaviour                                                                                                                                            |                     |                        |               |                  |        |             |                  |
| Energy Savings                                                                                                                                                   | 239,309             | Treatment Participants | -             | GWh              | -      | 6.270       | GWh              |
| Lifetime Energy Savings                                                                                                                                          |                     |                        | -             | GWh              | -      | 6.270       | GWh              |
| Peak Demand Savings                                                                                                                                              |                     |                        | -             | MW               | -      | -           | MW               |
| Annual GHG Emission Reductions                                                                                                                                   |                     |                        | -             | Tonnes of CO2 eq | -      | 2,961       | Tonnes of CO2 eq |
| EUL                                                                                                                                                              |                     |                        | -             | Years            |        | 1.0         | Years            |
| Total                                                                                                                                                            |                     |                        |               |                  |        |             |                  |
| Energy Savings                                                                                                                                                   |                     |                        | 55.006        | GWh              |        | 53.331      | GWh              |
| Lifetime Energy Savings                                                                                                                                          |                     |                        | 1,255.550     | GWh              |        | 1,036.052   | GWh              |
| Peak Demand Savings                                                                                                                                              |                     |                        | 16.484        | MW               |        | 14.229      | MW               |
| Annual GHG Emission Reductions                                                                                                                                   |                     |                        | 25,974        | Tonnes of CO2 eq |        | 25,183      | Tonnes of CO2 eq |
| EUL                                                                                                                                                              |                     |                        | 22.8          | Years            |        | 19.4        | Years            |
| * The average NTGR values presented in this table correspond to the ratios of net savings to gross savings by program component and then for the entire program. |                     |                        |               |                  |        |             |                  |

Existing Residential was aimed at achieving 46.523 GWh in net electrical energy savings and 11.495 MW in net peak demand savings at the generator for 2024. The program was able to achieve planned energy and peak demand savings. AMH, EPI, Green Heat, MHEEP and Residential Behaviour fell below their energy targets, while ASFH and HEA exceeded theirs. AMH, EPI and Green Heat also fell below their peak demand targets, while ASFH, HEA and MHEEP exceeded theirs. AMH, ASFH, HEA and MHEEP participation levels reached their highest point in 2024, while Residential Behaviour was launched in 2024. HEA was the largest contributor to total program net energy (60%) and peak demand savings (61%).

**Figure 58: 2024 Existing Residential Program Targeted and Evaluated Net Energy Savings**

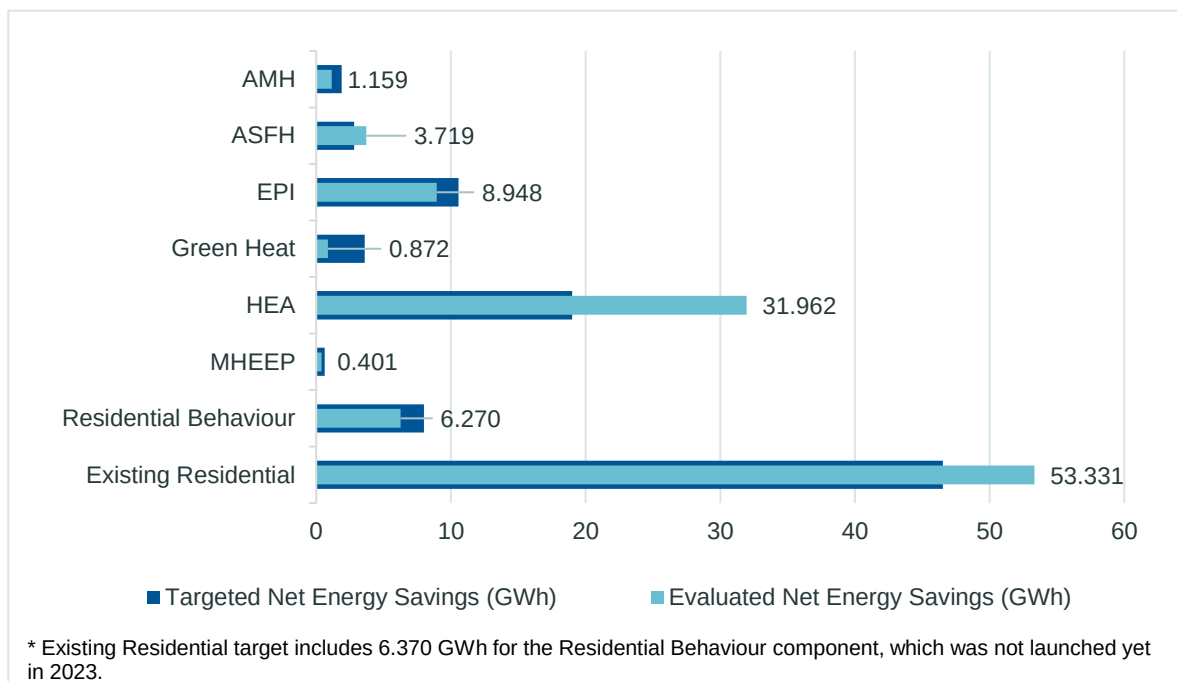
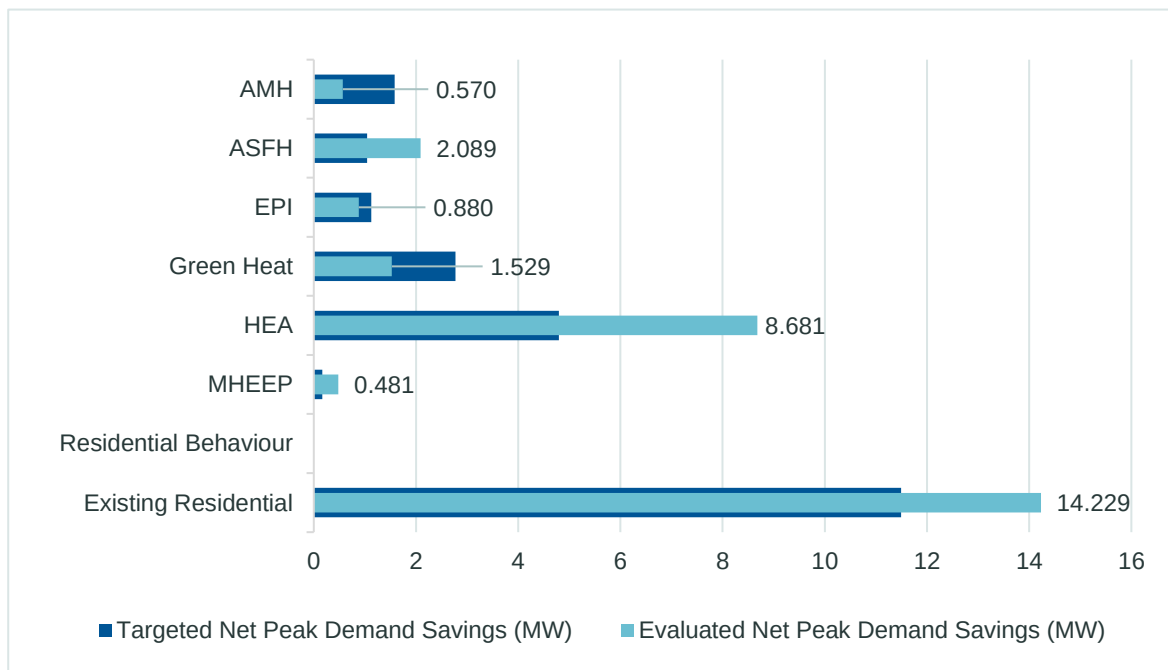


**Figure 59: 2024 Existing Residential Program – Targeted and Evaluated Net Peak Demand Savings**







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### **Efficient Product Installation**

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## **Green Heat**

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## **Home Energy Assessment**

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## **Mi'kmaw Home Energy Efficiency Project**

Appendix XXXIV: MHEEP Tracking Sheet Audit

Appendix XXXV: MHEEP 2024 Recommendations

## **Residential Behaviour**

Appendix XXXVI Residential Behaviour: Monthly Savings Approach

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EfficiencyOne

# EXISTING RESIDENTIAL PROGRAM

Final Appendix Report

2024 DSM EVALUATION

March 25, 2025

In Collaboration with:





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## APPENDIX I

### AMH Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by EfficiencyOne (E1)
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program component results (gross and net electrical energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from tracking sheet audit conducted by the Evaluator.

**Table 1: 2024 AMH Corrected Tracked Savings**

| Program Component Results                        | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                                  | Value               | Unit | Value                   | Unit | Value               |
| <b>AMH</b>                                       |                     |      |                         |      |                     |
| Gross Electrical Energy Savings at the Generator | 1.132               | GWh  | 1.158                   | GWh  | 2.30%               |
| Gross Peak Demand Savings at the Generator       | 0.580               | MW   | 0.580                   | MW   | -                   |
| Net Electrical Energy Savings at the Generator   | 1.132               | GWh  | 1.158                   | GWh  | 2.30%               |
| Net Peak Demand Savings at the Generator         | 0.580               | MW   | 0.580                   | MW   | -                   |

The difference between tracked and corrected electrical energy savings is due to an incorrect line loss factor used by E1 for residential participants.

## APPENDIX II

### AMH Energy Auditor Interview Guide

## AFFORDABLE MULTIFAMILY HOUSING ENERGY ADVISOR INTERVIEWS

**Table 1: Overview of Data Collection Activity**

| Descriptor                      | This Instrument                                              |
|---------------------------------|--------------------------------------------------------------|
| Instrument Type                 | Telephone interview                                          |
| Estimated Time to Complete      | 20 min                                                       |
| Target Audience                 | Affordable Multifamily Housing program (AMH) Energy Advisors |
| Expected Number of Completions  | n=2                                                          |
| Contact List Source             | E1                                                           |
| Fielding Firm                   | Narrative Research                                           |
| Estimated Timeline for Fielding | End October-November                                         |

**Table 2: Research Objectives and Associated Sections**

| Research Objectives                                                                           | Section/<br>Question |
|-----------------------------------------------------------------------------------------------|----------------------|
| Motivations for participating                                                                 | A1                   |
| Overall strengths and weaknesses                                                              | Section B            |
| Participants' questions/concerns                                                              | Section C            |
| Challenges with / Barriers to completing AMH                                                  | Section D            |
| Satisfaction with AMH                                                                         | Section E            |
| Information, tools, support, and training that would make the program team/EAs more effective | F1                   |
| Recommendations for program improvements                                                      | E3, F2               |

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Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**





## Introduction

Please could I speak with <INSERT NAME>?

1. Yes **[CONTINUE]**
2. Not available **[ASK WHEN PERSON MIGHT BE AVAILABLE]**

Hello, my name is \_\_\_\_\_ and I'm calling from Narrative Research, a Halifax based market research company, on behalf of Efficiency Nova Scotia. We are performing an evaluation of Efficiency Nova Scotia's Affordable Multifamily Housing Program, which provides free energy audits and rebates on energy upgrades to those who qualify, and we are interested in your opinion as a program partner. The interview should take about 15 minutes. Is now a good time?

1. (Yes) **[CONTINUE]**
2. (No, later) **[RESCHEDULE]**
3. (No, refused) **[THANK AND TERMINATE]**

### A. Motivations for Participating

A1. From your experience, what are participants' main motivations for taking part in the Affordable Multifamily Housing program? **[MULTIPLE RESPONSES. RECORD FIRST MENTION SEPARATELY] [DO NOT READ]**

1. (The rebates offered / financial support)
2. (The energy efficiency measures included)
3. (To save money on energy bills)
4. (To have a more energy efficient building)
5. (To improve the comfort of their building)
6. (To improve tenant comfort)
7. (To be less wasteful)
8. (To help the environment / address environmental concerns)
9. (To reduce greenhouse gas emissions)
10. (To defer maintenance costs)
11. (To increase property value)
12. (Knowing someone else who had taken part in the program)
96. (Other, specify: \_\_\_\_\_)
98. **[EXCLUSIVE] Don't know [GO TO SECTION B]**
99. **[EXCLUSIVE] Refused [GO TO SECTION B]**

## B. Overall Strengths and Weaknesses

- B1. What are the main strengths of the Affordable Multifamily Program in your opinion? What else does the program do well? **[OPEN END]**.
- B2. And what are the main challenges of or barriers to the program? **[OPEN END]**

## C. Participants' Questions

- C1. What concerns about the program, if any, do participants typically have at the time of scheduling the energy audit with you? **[OPEN END]**
- C2. What concerns about the program, if any, do participants typically have during the energy audit? **[OPEN END]**
- C3. Which recommended technologies or upgrades generate the most questions from participants? **[DO NOT READ. MULTIPLE RESPONSES]**
1. (Building envelope upgrades (insulation))
  2. (Heat pumps)
  3. (Window and door replacements)
  4. (Hybrid heat pump water heaters)
  5. (Bathroom fans)
  6. (Hydronic heating system upgrades)
  7. (Common area lighting)
  96. (Other, specify: \_\_\_\_\_)
  97. (None)
  98. (Don't know)
  99. (Refusal)
- C4. **[DO NOT ASK IF CODES 97, 98, OR 99 AT C3]** What questions or concerns about these technologies or upgrades do participants have? **[OPEN END]**
- C5. What other questions do you typically get from participants during your initial visit for the energy audit? **[OPEN END]**

## D. Challenges/Barriers to Completion

- D1. In your experience, what reasons would lead someone who completed an energy audit of their building to choose not to go ahead with the recommended upgrades and discontinue their participation in the program? **[OPEN END]**
- D2. What (other) challenges do participants experience that may affect their decision to complete their participation in the program? **[OPEN END]**

- 
- D3. What have participants suggested would be useful to help them complete their projects? **[PROBE FOR: better communications, more check-ins, more explanations of the recommendations or upgrades, etc.] [OPEN END]**
- D4. What, if anything, could Efficiency Nova Scotia do to encourage participants to complete their involvement in the program? **[PROBE FOR: marketing, program design changes, etc.] [OPEN END]**

## **E. Satisfaction**

- E1. On a scale of 0 to 10, where 0 is “Not at all satisfied” and 10 is “Completely satisfied,” how satisfied are you with each of the following ten aspects of the Affordable Multifamily Housing program? **[DO NOT RANDOMIZE] [RECORD NUMBER. DO NOT ACCEPT A RANGE] [ASK E2 AND E3 AFTER EACH ITEM <8 AT E1]**
- a. The information about the participant and the project that Efficiency Nova Scotia provides you at the start of a new project
  - b. The initial energy audit scheduling process with the participant
  - c. The initial audit reporting template
  - d. The simulator software you use to complete the audit and establish energy savings
  - e. The timeframe you have to submit your energy audit report, photos, and analysis to Efficiency Nova Scotia (10 days)
  - f. The information Efficiency Nova Scotia sends you about the actual upgrades so you can update the energy model
  - g. The final energy audit scheduling process with the participant
  - h. The final audit reporting template
  - i. The selection of upgrades available in the program
  - j. The communications you have with Efficiency Nova Scotia
  - k. The overall reporting to Efficiency Nova Scotia
- [0-10 SCALE WITH END POINT LABELS– RECORD NUMBER]**
- 97.** Not applicable
  - 98.** Don’t Know/Don’t recall
  - 99.** Refused
- E2. **[ASK FOR EACH ITEM <8 AT E1]** Why aren’t you more satisfied? **[OPEN END]**
- E3. **[ASK FOR EACH ITEM <8 AT E1]** How could this be improved? **[OPEN END]**
- E4. Are there any other issues or challenges you experienced with the Affordable Multifamily Housing program that we haven’t mentioned? **[OPEN END]**



## **F. Recommendations for Program Improvements**

- F1. What information, tools, support, or training would make your role in the Affordable Multifamily Housing program easier? **[OPEN END]**
- F2. Do you have any ideas how to better communicate or market the program to attract more participants? **[OPEN END]**
- F3. Apart from those you have already mentioned, do you have any other recommendations for improving the Affordable Multifamily Housing program? Anything else? **[OPEN END]**
- F4. Do you have any final comments you'd like to add about the program? **[OPEN END]**

**END:** Those are all the questions I have for you. I thank you very much for your time and cooperation. Have a nice day!

## APPENDIX III

### AMH Participant Interview Guide

## AFFORDABLE MULTIFAMILY HOUSING

### PARTICIPANT INTERVIEWS

**Table 1: Overview of Data Collection Activity**

| Descriptor                      | This Instrument                                                             |
|---------------------------------|-----------------------------------------------------------------------------|
| Instrument Type                 | Telephone participant interview                                             |
| Estimated Time to Complete      | 25-30 min                                                                   |
| Target Audience                 | Participants who completed the Affordable Multifamily Housing program (AMH) |
| Expected Number of Completions  | n=10 (aim to get n=5 comprehensive, 5 prescriptive)                         |
| Contact List Source             | 2024 AMH tracking sheet                                                     |
| Fielding Firm                   | Narrative Research                                                          |
| Estimated Timeline for Fielding | End October-November                                                        |

**Table 2: Research Objectives and Associated Sections**

| Research Objectives                                                                                                                             | Section/<br>Question |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Verification                                                                                                                                    | A                    |
| Awareness of program and understanding of program paths                                                                                         | B1, B4-B7            |
| Motivations for participating and reasons for selecting comprehensive or prescriptive paths                                                     | B2-B3, B8            |
| Satisfaction with AMH (and likelihood to recommend), including perceptions about application forms and reports and the energy audit process and | Section C            |
| Challenges with AMH                                                                                                                             | C11                  |
| Questions about the different technologies installed                                                                                            | C12                  |
| Recommendations for program improvements                                                                                                        | E1                   |
| information, tools, support, and training that would make the program team/EAs more effective                                                   | E2                   |
| Improvements in program communications and marketing                                                                                            | E3                   |

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Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**



## Introduction

Please could I speak with <INSERT NAME>?

1. Yes **[CONTINUE]**
2. No **[SAY “PERHAPS YOU CAN HELP ME ANYWAY.” CONTINUE]**

Hello, my name is \_\_\_\_\_ and I’m calling from Narrative Research, a Halifax based market research company on behalf of Efficiency Nova Scotia. We are performing an evaluation of Efficiency Nova Scotia’s energy efficiency services. Our records indicate that you recently participated in the Affordable Multifamily Housing Program for the building at <FACILITY STREET ADDRESS> in <FACILITY TOWN>. Is that correct?

**[IF NEEDED:** The program offers up to 80% in rebates on energy efficient upgrades to qualifying multi-unit residential rental properties and qualifying non-profit support services. Upgrades may include improvements to space and water heating, window and door replacements, insulation, and more]

1. Yes **(CONTINUE)**
2. Someone else might know **(ASK TO SPEAK TO THEM)**
3. No **(THANK AND TERMINATE)**

We would appreciate your help in answering questions about the program. The information you provide will help Efficiency Nova Scotia improve the program. Today’s call should take about 25-30 minutes. Is this a good time for you?

1. (Yes) **[CONTINUE]**
2. (No, later) **[RESCHEDULE]**
3. (No, refused) **[THANK AND TERMINATE]**

## A. Verification

A1. Our records indicate that you received a rebate from Efficiency Nova Scotia for installing <MEASURE TYPE> upgrades. Is this correct?

1. Yes **[CONTINUE]**
2. No **[PROBE:** Are you sure? According to our records, you would have received a rebate from Efficiency Nova Scotia for <MEASURE TYPE>. **[IF YES CONTINUE. IF PERSIST AS NO, THANK, TERMINATE, RECORD AND KEEP DATA]**
99. Don’t know/Refused **[PROBE:** “Is there someone else available who would know about having participated in the Affordable Multifamily Housing program?”] **[IF YES, ASK TO SPEAK TO THE APPROPRIATE PERSON AND RESTART AT INTRODUCTION. IF PERSISTS AS NO, THANK, TERMINATE, RECORD AND KEEP DATA.]**

- 
- A2. What type of building is the building at <FACILITY STREET ADDRESS> in <FACILITY TOWN>?
1. A multi-unit residential building or co-operative with 1 to 3 units
  2. A multi-unit residential building or co-operative with 4 or more units
  3. A non-bed facility
  4. A shelter
  5. A rooming house
  96. Other (specify: \_\_\_\_\_)
  99. (Refused)

[RECORD <PATH> FROM DATABASE AND CHECK QUOTAS]

## **B. Awareness and Motivations for Participating**

- B1. How did you first become aware of the Affordable Multifamily Housing program? **[DO NOT READ. SINGLE RESPONSE]**
1. (Efficiency Nova Scotia Energy Solutions Advisor)
  2. (Contractors)
  3. (Social housing associations)
  4. (Landlord association)
  5. (Trade publication)
  6. (Trade shows / conferences)
  7. (Efficiency Nova Scotia electricity bill)
  8. (Online search (e.g. Google, Yahoo))
  9. (Social media (e.g. Facebook, Twitter, YouTube))
  10. (Efficiency Nova Scotia website)
  11. (Government of Nova Scotia)
  96. (Other (specify) \_\_\_\_\_)
  98. **[EXCLUSIVE]** (Don't know)
  99. **[EXCLUSIVE]** (Refused)

B2. What was the SINGLE most important reason you were interested in participating in the Affordable Multifamily Housing program? **[SINGLE RESPONSE. RECORD VERBATIM] [DO NOT READ]**

1. (Wanted the heat pump)
2. (The rebates offered / financial support)
3. (The energy efficiency measures included)
4. (To save money on energy bills)
5. (To have a more energy efficient building)
6. (To improve the comfort of my building)
7. (To improve tenant comfort)
8. (To be less wasteful)
9. (To help the environment / address environmental concerns)
10. (To reduce greenhouse gas emissions)
11. (To defer maintenance costs)
12. (To increase property value)
13. (I knew someone else who had taken part in the program)
14. (The E1 representative was convincing)
98. **[EXCLUSIVE]** Don't know **[GO TO B4]**
99. **[EXCLUSIVE]** Refused **[GO TO B4]**

B3. Were there any other reasons? **[DO NOT READ. ACCEPT MULTIPLE RESPONSES. RECORD VERBATIM. USE CODES FROM A1]**

97. **[EXCLUSIVE]** None/no other reasons
98. **[EXCLUSIVE]** Don't know
99. **[EXCLUSIVE]** Refused

B4. As you may know, there are two possible pathways through the Affordable Multifamily Housing program: the **Prescriptive** path and the **Comprehensive** path. Did you know that there were two paths through the program?

1. Yes
2. No
99. Refused



- 
- B5. **[ASK IF CODES 2-5 OR 96 AT A2 AND CODE 1 AT A1]** Do you recall which path you followed through the program? **[SINGLE RESPONSE]**
1. Yes, the prescriptive path **[CHECK TO SEE IF MATCHES WITH <PATH>]**
  2. Yes, the comprehensive path **[CHECK TO SEE IF MATCHES WITH <PATH>]**
  3. No, I didn't know there were two paths
  4. No, I don't recall / I'm unsure
98. **[EXCLUSIVE]** Don't know
99. **[EXCLUSIVE]** Refused
- B6. **[ASK IF CODES 1 OR 2 AT B5 AND MATCH WITH <PATH> IS CORRECT]** Could you briefly describe the main differences between the Prescriptive and the Comprehensive paths? **[OPEN END]**
- B7. **[ASK IF CODES 1 OR 2 AT B5 AND MATCH WITH <PATH> IS INCORRECT OR IF CODES 3, 4, 98 OR 99 AT B5]** The Prescriptive path is for affordable rental buildings of one-to-three units and incorporates a selection of lighting, heating and water heating upgrades. The Comprehensive path is for affordable rental buildings of four or more units. An energy audit of the building is conducted, the possible energy efficiency upgrades listed, and the participant selects the upgrades to be installed. Our records show that you took the **<PATH>** path. Do you recall now?
1. Yes
  2. No
99. **[EXCLUSIVE]** (Refusal)
- B8. **[ASK IF CODES 2-5 OR 96 AT A2]** Why did you choose to take the **<PATH>** path of the program? **[OPEN END]**

## **C. Satisfaction**

- C1. **[NET PROMOTER SCORE]** Using a 0 to 10 scale, where 0 means "Definitely would not" and 10 means "Definitely would", what is the likelihood that you recommend the Affordable Multifamily Housing program to other housing providers or affordable multifamily residential building owners? **[RECORD NUMBER. DO NOT ACCEPT A RANGE]**
- [0-10 SCALE WITH END POINT LABELS– RECORD NUMBER]**
98. Don't Know/Don't recall
99. Refused

- C2. Using a scale from 0 to 10 where 0 is “Not at all satisfied” and 10 is “Completely satisfied”, how would you rate your satisfaction with the Affordable Multifamily Housing program overall? **[RECORD NUMBER. DO NOT ACCEPT A RANGE] [ASK E2 AFTER EACH ITEM <8 AT C2].**

**[0-10 SCALE WITH END POINT LABELS– RECORD NUMBER]**

98. Don't Know

99. Refused

- C3. **[IF D<8]** What is the main reason you are not more satisfied with the program overall? Are there other reasons? **[PROBE FOR SPECIFIC REASON. RECORD FIRST MENTION AND THEN ACCEPT MULTIPLE RESPONSES KEEPING CODE 98 EXCLUSIVE]**

96. **RECORD VERBATIM – FIRST RESPONSE:** \_\_\_\_\_

96. **RECORD VERBATIM – SUBSEQUENT RESPONSES:** \_\_\_\_\_

98. Don't know

99. Refused

- C4. Using a scale of 0 to 10, where 0 is “Not at all satisfied” and 10 is “Completely satisfied,” how satisfied were you with each of the following aspects of the Affordable Multifamily Housing program? Please indicate if any do not apply to you. **[DO NOT RANDOMIZE] [ASK E2 AFTER EACH ITEM <8 AT E1]**

a. The program application process

b. The selection of upgrades available in the program

c. The upgrades installed in your building

d. The quality of the work completed

e. The time it took to complete the program

f. The amount of the overall rebate

g. **[ASK COMPREHENSIVE PATH ONLY]** The ability to receive 50% of the rebate before the end of the project

h. The time required to receive the rebate

i. The communications you had with Efficiency Nova Scotia

**[0-10 SCALE WITH END POINT LABELS– RECORD NUMBER]**

97. (Not applicable)

98. (Don't Know/Don't recall)

99. (Refused)

- C5. **[ASK FOR EACH ITEM <8 AT E1]** Why aren't you more satisfied? **[OPEN END]**

C6. Using the same scale of 0 to 10, where 0 is “Not at all satisfied” and 10 is “Completely satisfied,” how satisfied are you with the following forms and reports included in the Affordable Multifamily Housing program? Please indicate if any do not apply to you. **[DO NOT RANDOMIZE] [RECORD NUMBER. DO NOT ACCEPT A RANGE] [ASK C7 AFTER EACH ITEM <8 AT C6]**

- a. **[ASK IF COMPREHENSIVE PATH ONLY]** The energy efficiency Upgrade Recommendation report you received from E1
- b. The Rebate Request form you submit to E1 to request a rebate payment (including all contractor invoices, list of rental rates (for buildings that charge rent), a void cheque and payment information)
- c. The Preapproval Documentation that E1 sends you informing you that you can move forward with the upgrades

**[0-10 SCALE WITH END POINT LABELS– RECORD NUMBER]**

- 97. (Not applicable)
- 98. (Don't Know/Don't recall)
- 99. (Refused)

C7. **[ASK FOR EACH ITEM <8 AT C6]** Why aren't you more satisfied? **[OPEN END]**

C8. Using a scale of 0 to 10, where 0 is “Completely disagree” and 10 is “Completely agree”, how strongly do you agree or disagree with the following statements about the Affordable Multifamily Housing program forms and reports? **[RECORD NUMBER. DO NOT ACCEPT A RANGE]**

- a. The Affordable Multifamily Housing program application form was easy to complete
- b. The instructions on how to fill out the Affordable Multifamily Housing program application form were simple to understand
- c. **[ASK COMPREHENSIVE PATH ONLY]** The energy efficiency Upgrade Recommendation report provided by Efficiency Nova Scotia was simple to understand
- d. The Rebate Request form was easy to complete
- e. The instructions on how to fill out the Rebate Request form were simple to understand
- f. The Preapproval Documentation form provided by Efficiency Nova Scotia was simple to understand

**[0-10 SCALE WITH END POINT LABELS– RECORD NUMBER]**

- 97. (Not applicable)
- 98. (Don't Know/Don't recall)
- 99. (Refused)

C9. **[ASK COMPREHENSIVE PATH ONLY]** We'd like to understand your experience regarding the energy audit process. On a scale of 0 to 10, where 0 is "Not at all satisfied" and 10 is "Completely satisfied," how satisfied are you with each of the following aspects related to the free energy audit you received? **[DO NOT RANDOMIZE] [ASK C10 AFTER EACH ITEM <8 AT C9]**

- a. The overall service provided by the energy auditor
- b. The energy audit appointment scheduling process
- c. The ability of the energy auditor to answer questions
- d. The information provided by the energy auditor

**[0-10 SCALE WITH END POINT LABELS– RECORD NUMBER]**

- 97. (Not applicable)
- 98. (Don't Know/Don't recall)
- 99. (Refused)

C10. **[ASK FOR EACH ITEM <8 AT C9]** Why aren't you more satisfied? **[OPEN END]**

C11. Are there any other issues or challenges you experienced with the Affordable Multifamily Housing program that we haven't mentioned? **[OPEN END]**

C12. What, if any, unanswered questions do you have about the different technologies installed in your building through the program?

Specify \_\_\_\_\_

- 97. None
- 98. (Don't know)
- 99. (Refusal)

## **D. Operating Agreement (Affordability Covenant)**

D1. **[ASK IF A2 ≠ 3 (Non-bed). IF A2 = 3, CODE D1 AS NO]** Do you charge rent to tenants in your building/at your facility?

- 3. Yes
- 4. No
- 99. (Refused)

D2. **[ASK IF D1=1]** You may recall that as part of the conditions of the program, property owners of facilities where rent is charged must agree to the terms of a multi-year transferrable Affordable Multifamily Housing Operating Agreement (or affordability covenant) that ensures affordability for renters. What are your thoughts on the operating agreement/affordability covenant in facilities where rent is charged? **[PROBE FOR PERCEPTIONS ABOUT TERM LENGTH, RENTAL RATES. PROBE TO UNDERSTAND WHETHER IT IS PERCEIVED POSITIVELY OR NEGATIVELY AND WHAT IS POSITIVE/NEGATIVE. NARRATIVE TO PREPARE A "POSITIVE" NET AND A "NEGATIVE" NET.]**

- 
- D3. **[ASK IF PERCEIVED “NEGATIVELY” AT D1]** What specifically about the operating agreement/affordability covenant do you dislike? **[OPEN END]**
- D4. **[ASK IF D1=1]** In your opinion, what, if any, modifications could be made to the operating agreement/affordability covenant to make it more appealing to other owners of affordable multifamily housing? **[OPEN END]**

## **E. Recommendations for Program Improvements**

- E1. Do you have any (other) recommendations for improving the Affordable Multifamily Housing program? **[PROBE]** Anything else? **[DO NOT READ. ACCEPT MULTIPLE KEEPING CODE 97, 98 AND 99 EXCLUSIVE]**
1. (Increase the rebate)
  2. (Offer additional equipment eligible for rebates. Specify \_\_\_\_\_))
  3. (Offer more information on the equipment recommended)
  4. (Simplify program application, forms, and associated paperwork)
  5. (Speed up the process)
  6. (Reduce the term of the Operations Agreement. Specify \_\_\_\_\_)
  7. (“Other” Operations Agreement. Specify \_\_\_\_\_)
  8. (Advertise the program more or in a better way. Specify \_\_\_\_\_)
  9. (Improve the online portal. Specify \_\_\_\_\_)
  96. (Other [SPECIFY \_\_\_\_\_])
  - 97.** (No recommendation)
  - 98.** (Don’t know)
  - 99.** (Refused)

E2. Which of the following seven tools or support would be the most helpful for participants in the Affordable Multifamily Housing program? Please choose your top three. **[READ AND RANDOMIZE. SELECT UP TO THREE. NOTE IN ORDER]**

- a. Case studies
- b. Help selecting equipment
- c. Help finding contractors
- d. Information on the upgrades installed
- e. Technical/maintenance support
- f. Low-interest financing
- g. Co-funding

- 1. Most helpful
- 2. Second most helpful
- 3. Third most helpful

**98.** **[EXCLUSIVE]** (Do not know)

**99.** **[EXCLUSIVE]** (Refusal)

E3. How do you most prefer to receive information about rebate programs and energy retrofits? Please provide your top two most preferred. **[READ. SELECT MAXIMUM OF TWO ANSWERS]**

- 1. Email
- 2. Postal mail
- 3. Website
- 4. Social media
- 5. In-person seminars
- 6. Webinars

**98.** (Do not know)

**99.** (Refusal)

## **F. Annual Energy Efficiency and Budget**

F1. Moving on to a different topic, what is your annual budget for building maintenance and efficiency upgrades?

- 1. Specify \$\_\_\_\_\_

**98.** (Don't know)

**99.** (Refusal)

F2. Did you consider a payback period when deciding whether to go ahead with the Affordable Multifamily Housing program?

1. Yes

2. No

**98.** (Don't Know/Don't recall)

**99.** (Refusal)

F3. **[ASK IF CODE 1 AT F2]** What payback period did you use to decide whether to go ahead with the program? **[READ. SELECT ONE]**

1. Less than 5 years

2. 5 to 10 years

3. 11 to 15 years

4. 16 to 20 years

5. More than 20 years

**98.** (Do not know)

**99.** (Refusal)

F4. Do your tenants pay utility costs?

1. Yes

2. No

**98.** (Don't know)

**99.** (Refusal)

**END:** Those are all the questions I have for you. I thank you very much for your time and cooperation.  
Have a nice day!

**[VARIABLES TO IMPORT FROM DATABASE:**

**< TOTAL DNR REBATE >**

**< HOUSING TYPE >**

**< PRIMARY HEATING FUEL >]**

## APPENDIX IV

### AMH Dropped-out and Non-Participant Interview Guide

## AFFORDABLE MULTIFAMILY HOUSING EVALUATION

### GUIDE FOR INTERVIEWS WITH DROPPED-OUT AND NON-PARTICIPANTS

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                                                                                                |
|---------------------------------|----------------------------------------------------------------------------------------------------------------|
| Instrument Type                 | Telephone interviews                                                                                           |
| Estimated Time to Complete      | 15-20 minutes                                                                                                  |
| Target Audience                 | Dropped-out and non-participants                                                                               |
| Expected Number of Completions  | n=6 dropped-out, n=6 non-participants<br>(aim to get n=3 prescriptive, 3 comprehensive path from each segment) |
| Contact List Source             | E1                                                                                                             |
| Fielding Firm                   | Narrative Research                                                                                             |
| Estimated Timeline for Fielding | End October-November 2024                                                                                      |

Table 2: Research Objectives and Associated Questions

| Research Objectives                                                                                                              | Section    |
|----------------------------------------------------------------------------------------------------------------------------------|------------|
| What motivated dropped participants to initially sign up for program?                                                            | A2, A3     |
| What are reasons that dropped out participants did not complete the participation process? Due to any specific AMH requirements? | B4, E2     |
| What are the barriers to participation?                                                                                          | B4, E2     |
| How is the Operating agreement (affordability covenant) perceived?                                                               | C1, C2     |
| Could the affordability covenant be modified to encourage participation while respecting tenants' rights?                        | C3, C4, C5 |
| Did you consider alternatives for implementing EE measures outside of AMH?                                                       | Section D  |
| What would motivate dropped out participants to complete?                                                                        | F3         |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**





## Introduction

Could I speak with <INSERT NAME>?

1. Yes [CONTINUE]
2. No [SAY “PERHAPS YOU CAN HELP ME ANYWAY.” CONTINUE]

Hello, my name is \_\_\_\_\_ and I’m calling from Narrative Research, a Halifax based market research company, on behalf of Efficiency Nova Scotia. We are performing an evaluation of Efficiency Nova Scotia’s energy efficiency services. We are doing follow-up research with people who [DROPPED OUT PARTICIPANTS INSERT: started but did not complete; NON-PARTICIPANTS INSERT: decided not to participate in], the Affordable Multifamily Housing Program, an energy savings program.

[IF NEEDED: The program offers UP TO 80% in rebates on energy efficient upgrades to qualifying multi-unit residential rental properties and non-profit buildings. Upgrades may include improvements to space and water heating, window and door replacements, insulation, and more. Does that sound familiar?]

1. Yes, that sounds familiar (CONTINUE)
2. Yes, someone else might know (ASK TO SPEAK TO THEM)
3. No (THANK AND TERMINATE)

**S1.** Our records show that you [DROPPED OUT PARTICIPANTS INSERT: decided not to complete your participation in the program for the building at < INSERT FACILITY STREET ADDRESS >; NON-PARTICIPANTS INSERT: talked to an Efficiency Nova Scotia representative but decided not to participate in the Affordable Multifamily Housing program]. We’d like to ask you a few questions to understand the reasons for this. I can assure you that we are not trying to sell you anything. Efficiency Nova Scotia would like this information to assist in their efforts to improve the service they provide for their customers. Today’s call should take about [DROPPED OUT PARTICIPANTS INSERT: 15 to 20 minutes; NON-PARTICIPANTS INSERT: 10 to 15 minutes]. Is this a convenient time to talk? IF NECESSARY: I can assure you that I will not try to sell you anything. Please be advised that this call may be recorded for quality assurance.

1. (Yes) [CONTINUE]
2. (No, later) [RESCHEDULE]
3. (No, refused) [THANK AND TERMINATE]
4. (I am in the process of completing the program) [THANK AND TERMINATE AND RECORD INCIDENCE]
5. I have now completed the program [THANK AND TERMINATE AND RECORD INCIDENCE]

[NOTE FOLLOWING VARIABLES FROM DATABASES:

- PATH (PRESCRIPTIVE OR COMPREHENSIVE)

- HOUSING TYPE (MURB, ROOMING HOUSE, RENTAL/CO-OPERATIVE (1-3 UNITS), RENTAL/CO-OPERATIVE (4+ UNITS), NON-BED, SHELTER]



**S2. [ASK DROPPED OUT PARTICIPANTS AND HOUSING TYPE=MURB ONLY]** The information we have shows that the building at < **INSERT FACILITY STREET ADDRESS** > is a multi-unit residential building. How many units are there in this building?

1. 1 to 3 units
2. 4 or more units

**99. [EXCLUSIVE]** (Refused)

## **A. Program Awareness and Initial Motivations to Participate**

A1. To start, how did you first learn about Efficiency Nova Scotia's Affordable Multifamily Housing program? **[DO NOT READ LIST. ACCEPT MULTIPLE RESPONSES]**

1. (Efficiency Nova Scotia Energy Solutions Advisor)
2. (Contractors)
3. (Social housing associations)
4. (Landlord association)
5. (Trade publication)
6. (Trade shows / conferences)
7. (Efficiency Nova Scotia electricity bill)
8. (Online search (e.g. Google, Yahoo))
9. (Social media (e.g. Facebook, Twitter, YouTube))
10. (Efficiency Nova Scotia website)
11. (Government of Nova Scotia)
96. (Other (specify) \_\_\_\_\_)

**98. [EXCLUSIVE]** (Don't know)

**99. [EXCLUSIVE]** (Refused)

A2. What was it about the program that interested you at first? Anything else? **(DO NOT READ LIST. ACCEPT MULTIPLE RESPONSES)**

1. (The rebates offered / financial support)
2. (The energy efficiency measures included)
3. (To save money on energy bills)
4. (To have a more energy efficient building)
5. (To improve the comfort of my building)
6. (To improve tenant comfort)
7. (To be less wasteful)
8. (To help the environment / address environmental concerns)
9. (Reduce greenhouse gas emissions)
10. (To defer maintenance costs)
11. (To increase property value)
12. (I knew someone else who had taken part in the program)
13. (The E1 representative was convincing)
96. (Other (specify) \_\_\_\_\_)
98. **[EXCLUSIVE]** (Don't Know)
99. **[EXCLUSIVE]** (Refusal)

A3. What were your expectations regarding the benefits you would receive from participating in the Affordable Multifamily Housing program? **[OPEN END]**

A4. Did you know that there are two pathways through the Affordable Multifamily Housing program? The **Prescriptive** path is for affordable rental buildings of one-to-three units and incorporates a selection of lighting, heating and water heating upgrades. The **Comprehensive** path is for affordable rental buildings of four or more units. An energy audit of the building is conducted, the possible energy efficiency upgrades listed, and the participant selects the upgrades to be installed.

1. Yes, I know the two pathways
2. No, I didn't know there were two pathways
99. **[EXCLUSIVE]** (Refusal)



## B. Reasons for Ending / Barriers to Participation

- B1. **[ASK DROPPED OUT PARTICIPANTS ONLY]** The information I have shows that you have not continued your participation in the Affordable Multifamily Housing program for the building at < **INSERT FACILITY STREET ADDRESS** >. Is this correct? **[DO NOT READ]**
1. Yes, correct
  2. No, incorrect
- B2. **[ASK IF NO (CODE 2 AT B1)]** Please could you give me more details about the situation? **[OPEN END]**
- [THANK AND TERMINATE AFTER B2 IF CODE 2 AT B1]**
- B3. **[ASK DROPPED OUT PARTICIPANTS ONLY]** At what stage did you end your participation in the Affordable Multifamily Housing program? Was it... **[READ. ONE ANSWER ONLY]**
1. After the initial contact with the program representative once they'd sent you the application form and operating agreement/affordability covenant documents
  2. After completing the application but before signing the operating agreement/affordability covenant
  3. **[COMPREHENSIVE PATH ONLY]** After you had completed your application and signed the operating agreement/affordability covenant, but before or during the auditor's visit for the initial pre-renovation energy assessment. (IF NEEDED: The energy assessment includes a visit by the auditor to determine the work that can be done.)
  4. **[COMPREHENSIVE PATH ONLY]** After the pre-renovation energy assessment, but before you selected any energy upgrades.
  5. After you had selected the energy upgrades, but before any renovation work was completed.
  96. At another point (specify) \_\_\_\_\_
  98. **[DO NOT READ]** Do not recall

- B4. Why did you [DROPPED OUT PARTICIPANTS INSERT: not continue with; NON-PARTICIPANTS INSERT: decide not to participate in] the Affordable Multifamily Housing program? Any other reasons? [DO NOT READ LIST. ACCEPT MULTIPLE RESPONSES. PROBE IN DEPTH]

**RECORD VERBATIM RESPONSE AND THEN CODE:** \_\_\_\_\_

**[Communication problems]**

1. I lost interest as it took too long for E1/representative to contact/get back to me
2. Other communication problems (**PLEASE SPECIFY** \_\_\_\_\_)

**[Ineligibility]**

3. I was not eligible for the program because I don't have enough low-income tenants
4. My building was not eligible for the program (**PLEASE SPECIFY** \_\_\_\_\_)
5. Other eligibility issues (**PLEASE SPECIFY** \_\_\_\_\_)

**[Application difficulties]**

6. I couldn't provide all the documents required for the application process
7. The requirements for documentation were unclear
8. Other application difficulties (**PLEASE SPECIFY** \_\_\_\_\_)

**[Operating Agreement / Affordability Covenant]**

9. I didn't want to sign the operating agreement/affordability covenant
10. The term of the operating agreement was too long
11. I didn't like the rent rates (too low)
12. I want to be able to manage my rent levels myself (without an affordability covenant)
13. Other operating agreement difficulties (**PLEASE SPECIFY** \_\_\_\_\_)

**[Problems with representative during application process]**

14. The representative I dealt with during the application process was not knowledgeable
15. The representative I dealt with during the application process did not explain the process well
16. The representative I dealt with during the application process was not courteous nor polite

**[Upgrades]**

17. The upgrades I wanted were not offered by the program [**ASK WHICH ONES** \_\_\_\_\_]
18. The work I had wanted completed would not have been included in the renovation [**ASK WHICH WORK** \_\_\_\_\_]



### **[Problems pre-renovation assessment]**

- 19. It took too long to schedule the initial pre-renovation assessment
- 20. The advisor I dealt with during the pre-renovation assessment process was **not knowledgeable**
- 21. The advisor I dealt with during the pre-renovation process **did not explain the process well**
- 22. The advisor I dealt with during the pre-renovation process was **not courteous nor polite**
- 23. The advisor I dealt with during the pre-renovation process **did not arrive on time** for the scheduled appointment
- 24. The advisor I dealt with during the pre-renovation process **did not complete** the assessment **in a timely manner**
- 25. The advisor I dealt with during the pre-renovation process **did not respect my building**

### **[Financial Reasons]**

- 26. I hadn't realised how much the upgrades would cost
- 27. The available budget didn't stretch far enough
- 28. The payback period was too long
- 29. The incentives were too low
- 30. Split incentives (tenants pay their own energy bills, so I don't benefit from the whole incentive)
- 31. Other financial reasons **[PLEASE SPECIFY \_\_\_\_\_]**

### **[Problems renovation work]**

- 32. I hadn't realised how long the renovation work would take / the extent of the renovation work
- 33. I didn't want the mess of the renovation work
- 34. It was taking too long to schedule the renovation work/ difficult to organise
- 35. I was unable to prepare my building for renovation
- 36. It was difficult to find contractors
- 37. Other renovation reasons (**PLEASE SPECIFY \_\_\_\_\_**)

### **[Other]**

- 38. I took part in another program **[ASK WHICH ONE \_\_\_\_\_]**
- 39. Property has been sold
- 40. Personal situation/illness
- 41. External events
- 96. Other (specify \_\_\_\_\_)
- 98. Don't know
- 99. Do not recall



## C. Affordability Covenant

- C1. **[ASK IF HOUSING TYPE ≠ NON-BED. IF HOUSING TYPE = NON-BED, CODE AS NO]** Do you charge rent to tenants in your building/at your facility?
1. Yes
  2. No
- 99.** (Refused)
- C2. **[ASK IF C1=YES]** You may recall that as part of the conditions of the program, property owners of facilities where rent is charged must agree to the terms of a multi-year transferrable Affordable Multifamily Housing Operating Agreement (or affordability covenant) that ensures affordability for renters.] What are your thoughts on the operating agreement/affordability covenant for facilities where rent is charged? **[PROBE FOR PERCEPTIONS ABOUT TERM LENGTH, RENTAL RATES. PROBE TO UNDERSTAND WHETHER IT IS PERCEIVED POSITIVELY OR NEGATIVELY AND WHAT IS POSITIVE/NEGATIVE. OPEN END PREPARE A “POSITIVE” NET AND A “NEGATIVE” NET.]**
- C3. **[ASK IF C1=YES AND CODES 9 OR 13 AT B4]** What specifically about the operating agreement/affordability covenant made you decide not to pursue the program? **[OPEN END]**
- C4. **[ASK IF C1=YES AND CODES 9 OR 13 AT B4 OR IF PERCEIVED “NEGATIVELY” AT D]** In your opinion, what modifications could be made to the operating agreement/affordability covenant that would help you see it in a more positive light? **[OPEN END]**
- C5. **[ASK IF C1=YES AND COMPREHENSIVE PATH]** If the agreement were reduced from 12 years to 10 years, would your opinion of it change?
1. Yes. **[ASK How? \_\_\_\_\_]**
  2. No
- 98.** (Don't know)
- 99.** (Refusal)
- C6. **[ASK IF C1=YES AND PRESCRIPTIVE PATH]** If the agreement were reduced from 6 years to 5 years, would your opinion of it change?
1. Yes. **[ASK How? \_\_\_\_\_]**
  2. No
- 98.** (Don't know)
- 99.** (Refusal)

- C7. **[ASK IF CODE 2 AT C5 OR C6]** What would be an acceptable term length in your opinion? **[SINGLE RESPONSE.]**

PRESCRIPTIVE PATH ACCEPTABLE TERM: \_\_\_\_\_ years

COMPREHENSIVE PATH ACCEPTABLE TERM: \_\_\_\_\_ years

98. (Don't know)

99. (Refusal)

## **D. Alternatives for Implementing Other Energy Efficiency Measures**

- D1. **[ASK IF NOT CODE 38 AT B4]** Have you taken part or considered taking part in another energy efficiency program(s)? **[SINGLE RESPONSE]**

1. Yes, taken part **[ASK WHICH ONE(S) \_\_\_\_\_]**

2. Yes, considered **[ASK WHICH ONE(S) \_\_\_\_\_]**

3. No

99. (Refusal / Prefer not to answer)

- D2. **[IF CODE 1 OR 2 AT D1 OR CODE 38 AT B4]** What made you **[INSERT IF CODE 1 AT D1 OR CODE 38 AT B4: choose; INSERT IF CODE 2 AT D1: consider taking part in]** this program rather than the Affordable Multifamily Housing Program? **[OPEN END]**

- D3. Have you sought additional funding, other than an energy efficiency program, to help implement energy efficiency measures in your building? Please describe. **[PROBE FROM WHAT AND FROM WHERE? OPEN END]**

- D4. What, if any, energy efficiency upgrades have you made to your building in the past year? **(READ. MULTIPLE RESPONSES.)**

1. Building envelope upgrades (insulation)

2. Heat pumps

3. Window and door replacements

4. Hybrid heat pump water heaters

5. Bathroom fans

6. Hydronic heating system upgrades

7. Common area lighting

96. Other custom upgrades (specify: \_\_\_\_\_)

97. None

98. (Don't know)

99. (Refusal)



- D5. What is your annual budget for building maintenance and efficiency upgrades? **[READ. SELECT ONE]**
1. Specify \$\_\_\_\_\_
  - 98.** (Do not know)
  - 99.** (Refusal)
- D6. What payback period do you consider reasonable when implementing energy efficiency upgrades in your building? **[READ. SELECT ONE]**
1. Less than 5 years
  2. 5 to 10 years
  3. 11 to 15 years
  4. 16 to 20 years
  5. More than 20 years
  6. (Depends)
  - 98.** (Do not know)
  - 99.** (Refusal)
- D7. **[ASK IF D6=6]** How does your expectation of the payback period vary based on the types of upgrades? **[OPEN END]**
- D8. Do your tenants pay utility costs?
1. Yes
  2. No
  - 98.** (Don't know)
  - 99.** (Refusal)

## E. Suggested Improvements

- E1. What could Efficiency Nova Scotia do to improve the Affordable Multifamily Housing Program? **[OPEN END]**
- E2. How helpful would the following tools or support be to the program? **[READ AND RANDOMIZE. ASK FOR EACH]**
- a. Case studies
  - b. Help selecting equipment
  - c. Help finding contractors
  - d. Information on the upgrades installed
  - e. Technical/maintenance support
  - f. Low-interest financing
  - g. Co-funding
- 1. Extremely helpful
  - 2. Helpful
  - 3. Not very helpful
  - 4. Not at all helpful
  - 98.** (Do not know)
  - 99.** (Refusal)
- E3. How do you prefer to receive information about rebate programs and energy retrofits? **[READ. SELECT ALL THAT APPLY]**
- 1. Email
  - 2. Postal mail
  - 3. Website
  - 4. Social media
  - 5. In-person seminars
  - 6. Webinars
  - 98.** (Do not know)
  - 99.** (Refusal)



## F. Interest in the AMH Program

- F1. **[DO NOT ASK IF INELIGIBLE AT ANY PART OF B4 (CODE 3, 4, 5)]** Would you be extremely interested, interested, not very interested or not at all interested in **[INSERT IF DROPPED-OUT PARTICIPANTS: completing; IF NON-PARTICIPANTS: reapplying to]** the Affordable Multifamily Housing Program you started?
1. Extremely interested
  2. Interested
  3. Not very interested
  4. Not at all interested
- 98.** (Do not know)
- 99.** (Refusal)
- F2. **[ASK IF CODES 3, 4, 98 OR 99 AT F1]** Why aren't you more interested in **[INSERT IF DROPPED-OUT PARTICIPANTS: completing; IF NON-PARTICIPANTS: reapplying to]** the program? **[OPEN END]**
- F3. **[ASK IF CODES 3, 4, 98 OR 99 AT F1]** What could Efficiency Nova Scotia do to motivate you to **[DROPPED-OUT INSERT: complete; NON-PARTICIPANT INSERT: participate in]** the Affordable Multifamily Housing program? **[OPEN END]**
- F4. **[ASK IF CODES 1 OR 2 AT F1]** Would you be willing to be contacted by Efficiency Nova Scotia about completing the program?
1. Yes
  2. No
- 99.** (Refusal)
- F5. Do you have any other comments about the program before we finish? **[OPEN END]**

**END:** That is all the questions I have. Thank you for your time.

## APPENDIX V

### AMH Protocol for Desk Reviews

Desk reviews were conducted to measure information and validate if this information was correctly modelled or used in savings calculations. Table 1 presents the protocol used for project reviews.

**Table 1: Protocol Used for Project Reviews**

|                                                                                           |   |   |       |
|-------------------------------------------------------------------------------------------|---|---|-------|
| Project ID                                                                                |   |   |       |
| Facility Address                                                                          |   |   |       |
| Project Contact Name                                                                      |   |   |       |
| Project Contact Phone Number                                                              |   |   |       |
| Project Contact Email                                                                     |   |   |       |
| Measure Count                                                                             | 1 | 2 | Total |
| Measure Description                                                                       |   |   |       |
| <b>Energy Savings</b>                                                                     |   |   |       |
| Methodology Used for Calculating Savings<br>(RETScreen, Engineering Calculation, HOT2000) |   |   |       |
| Was the building properly modeled?<br>Validate building usage                             |   |   |       |
| Was the model calibrated?                                                                 |   |   |       |
| Claimed Savings in Tracking Sheet (kWh)                                                   |   |   |       |
| Claimed Savings in Audit Report (kWh)                                                     |   |   |       |
| Claimed Savings in Simulation File (kWh)                                                  |   |   |       |
| Discrepancies Description                                                                 |   |   |       |
| Claimed savings are consistent among documentation files?                                 |   |   |       |
| Invoices attest work completion?                                                          |   |   |       |
| Calculation method is reasonable?<br>Is the measure properly modeled?                     |   |   |       |
| Do measure-related inputs match information in the project<br>documentation/invoices?     |   |   |       |
| Calculation accounts for heating/cooling efficiency?                                      |   |   |       |
| <b>Peak Demand Savings</b>                                                                |   |   |       |
| Project Peak Demand Savings in Tracking Sheet (kW)                                        |   |   |       |
| Project Peak Demand Savings in Audit Report (kW)                                          |   |   |       |
| Peak Demand to Energy Ratio Applied in TS (W/kWh)                                         |   |   |       |
| Peak Demand to Energy Ratio Applied in Report (W/kWh)                                     |   |   |       |

| Phone interview/Site visit                                                                                       |  |  |  |
|------------------------------------------------------------------------------------------------------------------|--|--|--|
| Notes and questions before call/visit:                                                                           |  |  |  |
| Comments and responses:                                                                                          |  |  |  |
| Corrected Savings                                                                                                |  |  |  |
| Corrected Energy Savings (kWh)                                                                                   |  |  |  |
| Energy Savings Adjustment (kWh)                                                                                  |  |  |  |
| Corrected Peak Demand Savings (kW)                                                                               |  |  |  |
| Peak Demand Savings Adjustment (kW)                                                                              |  |  |  |
| Notes on savings change:<br>- What was incorrect?<br>- What change was made?<br>- Were the new values come from? |  |  |  |



## APPENDIX VI

### AMH 2024 Recommendations

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This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 AMH evaluation.

| Section           | Recommendations                                                                                                                                                                                                                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | Recommendation #1: To further aid understanding, consider providing participants with case study examples of incentive calculations to show pre-tax costs and how incentive amounts may change based on supplier quotes and/or equipment installed.                                     |
| Executive Summary | Recommendation #2: Ensure that support and handholding are available for participants who may need help navigating the program component and finding various contractors. Make technical guides available, providing general advice to help participants through the program component. |
| Executive Summary | Recommendation #3: Investigate the possibility of improving the audit reporting templates to improve time efficiencies for EAs, for example by streamlining the reports as much as possible.                                                                                            |
| Executive Summary | Recommendation #4: In the early stages of participant engagement, ensure that participants are aware of the co-financing options listed in E1's agreement.                                                                                                                              |

## APPENDIX VII

### ASFH Participant Telephone Survey Questionnaire

#### PARTICIPANT SURVEY

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                  |
|---------------------------------|----------------------------------|
| Instrument Type                 | Telephone Survey                 |
| Estimated Time to Complete      | 10 minutes                       |
| Target Audience                 | Participants                     |
| Expected Number of Completions  | n=60 (30 Heat pump, 30 modelled) |
| Contact List Source             | Efficiency Nova Scotia           |
| Fielding Firm                   | Narrative Research               |
| Estimated Timeline for Fielding | October-November 2024            |

Table 2: Research Objectives and Associated Sections

| Research Objectives           | Section |
|-------------------------------|---------|
| Awareness & Motivations       | A       |
| Satisfaction & Experience     | B       |
| Benefits & Challenges         | C       |
| Opportunities for Improvement | D       |
| Demographics                  | E       |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**



## Introduction

Could I please speak with <INSERT NAME>?

1. Yes **[GO TO INTRODUCTION]**
2. No / Not available **[SAY “Perhaps you can help me anyway.” GO TO INTRODUCTION]**

### **[INTRODUCTION]**

Hello, my name is \_\_\_\_\_ and I am calling from Narrative Research, a market research company. We are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia, and we have a survey today about the HomeWarming program that your household participated in this year. Are you the right person for us to speak with about your household’s participation in the program?

**(IF NEEDED:** The program offers building envelope upgrades, such as insulation and draft proofing, and heat pumps at no cost to eligible homeowners)

**(IF NEEDED:** The survey will take about 10 minutes.)

**[IF ASKED]** This survey is registered with the Canadian Research Insights Council (CRIC), and the survey code is INSERT CODE. You may visit the CRIC website to verify the research at: [canadianresearchinsightscouncil.ca/rvs/home/?lang=en](http://canadianresearchinsightscouncil.ca/rvs/home/?lang=en).

1. Yes **[CONTINUE]**
  2. No, does not recall participating **[PROBE:** “Are you sure? According to our records, you would have benefited from this Efficiency Nova Scotia program this year **[INSERT IF <MEASURE TYPE> = HP ONLY:** for the installation of a heat pump; **INSERT IF <MEASURE TYPE> = MODELLED:** for a home energy assessment and the installation of energy efficiency upgrades]. **[IF PERSIST AS ‘NO,’ THANK, TERMINATE, RECORD AND KEEP DATA]**
98. Don’t know/Refused **[PROBE:** “Is there someone else who would know about your household’s participation in the HomeWarming program?”] **[IF ‘YES,’ ASK TO SPEAK TO THE APPROPRIATE PERSON AND RESTART AT INTRODUCTION. IF PERSISTS AS ‘NO,’ THANK, TERMINATE, RECORD AND KEEP DATA.]**

**[IF REFUSED, ASK** “Can we schedule a more convenient time for you to conduct this survey?”]

**[SCHEDULED, IF NECESSARY, FOR:** \_\_\_\_\_]

Your responses are for research purposes only and will help improve the program. They will be combined with responses from others and used anonymously to prepare an evaluation report for Efficiency Nova Scotia. We will not use your information in a way that could identify you.

### **[RECORD FROM DATABASE: MEASURE TYPE]**

1. **[IF MEASURE CATEGORY = HP-ONLY]** Heat pump participants **[CHECK QUOTA AND CONTINUE]**
2. **[IF MEASURE CATEGORY = MODELLED]** Modelled participants (participant had a home energy assessment) **[CHECK QUOTA AND CONTINUE]**

### **[RECORD FROM DATABASE: “OHPA” YES OR NO]**





## A. Awareness of the Program

A1. a. How did you become aware of Efficiency Nova Scotia's HomeWarming program? **[DO NOT PROBE IF 98 IN 'a']** b. Anything else? **[DO NOT READ. MULTIPLE RESPONSES. PLEASE RECORD THE FIRST MENTION SEPARATELY FROM THE OTHERS]**

1. Efficiency Nova Scotia website
2. Insert in Nova Scotia Power bill
3. Online – general
4. Social media
5. Through participation in another Efficiency Nova Scotia program
6. Through a contractor
7. Word of mouth / Friends / Family
8. Efficiency Nova Scotia newsletter – online/email
9. Radio ads
10. Newspaper
11. TV ad
12. Brochure/handout
13. Special event like a home show
14. Community Energy Efficiency Program
15. Nova Scotia Government announcement
96. Other, please specify: \_\_\_\_\_
98. Don't know
99. Refused

A2. What was the main reason you were interested in participating in the HomeWarming program? **[DO NOT READ. ACCEPT ONLY ONE.]**

1. To save on energy/to save on energy costs
2. For environmental reasons
3. To make my home more comfortable
4. To get it for free
5. I was thinking about/planning to upgrade/needed to replace my heating system anyway
6. I was thinking about/planning to upgrade/needed to install insulation/draft proofing anyway
96. Other, please specify: \_\_\_\_\_
98. Don't know



## B. Satisfaction & Experience with the Program

The following series of questions will be focused on your satisfaction and experience with the HomeWarming program.

- B1. Using a 0 to 10 scale, where 0 is “definitely would not” and 10 is “definitely would”, what is the likelihood you would recommend the HomeWarming program to your family or friends?

Score /10: \_\_\_\_\_

98. (Don't know)

99. (Refused)

- B2. On a scale of 0 to 10, with 0 being “not at all satisfied” and 10 being “completely satisfied,” how satisfied are you with the program overall? **[RECORD NUMBER, 98=DON'T KNOW, 99=REFUSED] [DO NOT ACCEPT A RANGE]**

- B3. **[IF 0B2<8]** What was the main reason you were not more satisfied with the HomeWarming program overall? **[DO NOT READ. PROBE FOR SPECIFIC REASON. ACCEPT MULTIPLE RESPONSES, BUT RECORD FIRST AND SUBSEQUENT RESPONSES SEPARATELY. KEEP CODE 98 AND 99 EXCLUSIVES] PROBE:** Any other reasons?

1. I had to wait a long time between my application and the initial energy assessment
2. After the energy assessment, it took a long time for the proposed upgrades to be approved
3. It took a long time for the installation work to be completed
4. The process was long in general / the program took a long time to complete / long wait times
5. The information I received about the program was not clear
6. Difficulties completing the enrolment process
7. The initial home energy assessment did not go well
8. The low quality of interactions during program participation
9. Work done by the contractor was poor
10. The energy efficiency upgrades I received were not satisfactory
11. The final home energy assessment did not go well
96. Other, please specify \_\_\_\_\_
98. Don't know
99. Refused

- B4. On a scale of 0 to 10, where 0 is 'not at all satisfied' and 10 is 'completely satisfied', how satisfied were you with each of the following aspects of the program? **[RANDOMIZE] [RECORD NUMBER, 98=DON'T KNOW, 99= REFUSED] [DO NOT ACCEPT A RANGE]**
1. The way you enroll in the program
  2. The information you received about the different steps in the program
  3. **[ASK < MEASURE CATEGORY = MODELLED]** The wait time between your enrolment and the initial home energy evaluation assessment
  4. **[ASK < MEASURE CATEGORY = MODELLED]** The initial home energy assessment provided by the Energy Auditor
  5. **[ASK < MEASURE CATEGORY = MODELLED]** The wait time between the energy assessment and the installation work being completed
  6. The quality of the product(s) installed in your home
  7. The quality of the installation work
  8. The information you received about the product(s) installed
  9. **[ASK IF < MEASURE CATEGORY = HP ONLY]** The information you received about how to use your heat pump
- B5. On a scale of 0 to 10, where 0 is 'not at all satisfied' and 10 is 'completely satisfied', how satisfied were you with the interactions you had during your participation in the process? **[RANDOMIZE] [RECORD NUMBER, 98=DON'T KNOW, 99= REFUSED] [DO NOT ACCEPT A RANGE]**
1. Interactions and communications with the contractor **[INSERT <PRIMARY CONTRACTOR>]** who you were in contact with to schedule appointments and organize the installation of the upgrade(s)
  2. **[ASK < MEASURE CATEGORY = MODELLED]** Interactions with the Energy Auditor that conducted the home energy assessment
  3. The service provided by those responsible for installing the upgrade(s)(e.g., contractors, subcontractors...)
- B6. On a scale of 0 to 10, where 0 is 'do not agree at all' and 10 is 'completely agree', what is your level of agreement with the following statements? **[RANDOMIZE] [RECORD NUMBER, 95= NOT APPLICABLE, 98=DON'T KNOW, 99= REFUSED] [DO NOT ACCEPT A RANGE]**
1. **[ASK IF < MEASURE CATEGORY = MODELLED]** I learned about my home's energy usage during the initial Home Energy assessment
  2. **[ASK IF < MEASURE CATEGORY = MODELLED]** I received all the energy efficiency upgrades I expected to receive after the Home Energy assessment
  3. I received information about the products installed
  4. **[ASK IF < MEASURE CATEGORY = HP-ONLY]** I understand how to operate and maintain the equipment that was installed by this program
  5. It was easy to participate in the HomeWarming program
  6. It was worthwhile participating in the HomeWarming program



## C. Benefits and challenges

The following series of questions will be focused on the benefits you received and challenges you may have experienced from participating in the Home Warming program.

- C1. On a scale of 0 to 10, where 0 is “do not agree at all” and 10 is “completely agree”, what is your level of agreement with the following statements? **[RANDOMIZE] [98 = DON'T KNOW, 99 = REFUSED]**
1. My home is more comfortable because of the energy efficient upgrades I received
  2. I am spending less money to heat my home
  3. I am now able to utilize additional space(s) in my home after participating in this program
  4. After participating in the program, I can keep my home warmer in the winter
- C2. Apart from what you have already mentioned, did you experience any other benefits with the program?
1. Yes
  2. No **[SKIP to C4]**
- C3. What other benefits did you experience thanks to the program? **[OPEN END]**
- C4. And, other than those you already mentioned, did you experience any other issues?
1. Yes
  2. No **[SKIP to D1]**
- C5. What other issues or challenges did you have with the program? **[OPEN END – ONE LINE PER SEPARATE ISSUE]**
98. (Don't Know)
99. (Refused)

## D. Opportunities for Improvement

The following series of questions will be focused on improving the HomeWarming program.

- D1. **[ASK IF < MEASURE CATEGORY = MODELLED >]** What questions, if any, do you have about the different upgrades installed through the Home Warming program? **[TEXT BOX, 97=NOTHING/ALL IS GOOD, 98=DON'T KNOW] [OPEN END]**
- D2. **[ASK IF < MEASURE CATEGORY = HP-ONLY>]** What questions, if any, do you have about the heat pump installed through the Home Warming program? **[TEXT BOX, 97=NOTHING/ALL IS GOOD, 98=DON'T KNOW] [OPEN END]**

- D3. **[ASK IF RESPONDENT HAS QUESTIONS AT D1 OR D2]** How would you prefer those questions to be answered? **[READ. RANDOMIZE. MULTIPLE RESPONSES POSSIBLE]**
1. Over the phone with the contractor **[INSERT <PRIMARY CONTRACTOR>]** you've been dealing with throughout the program
  2. Having a dedicated number to call
  3. Through leaflets and education materials that the contractor/installer/inspector can leave behind
  4. Through an online chat service
  5. On a dedicated website with frequently asked questions about the program
  96. Other (specify)
  97. **[EXCLUSIVE]** Nothing/ All is good
  98. **[EXCLUSIVE]** Don't know
- D4. Is there any other information you would have liked to know about the program before going through it? **[TEXT BOX, 97=NOTHING/ALL IS GOOD, 98=DON'T KNOW]**
- D5. What recommendations do you have for improving the HomeWarming program? **[DO NOT READ. MULTIPLE RESPONSES]**
1. Have more upgrades available
  2. Simpler/ easier process/enrolment
  3. More information on the program
  4. More information about the installed products
  5. More information about how to operate the heat pump
  6. Better quality of installed products
  7. Improved interaction and communication with stakeholders
  8. Improved wait times
  96. Other, please specify \_\_\_\_\_
  97. **[EXCLUSIVE]** Nothing/ All is good
  98. **[EXCLUSIVE]** Don't know



## E. Demographics

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

- E1. What type of residence do you live in? **[READ RESPONSES 1-5 IN ORDER, THEN 96; SELECT ONE RESPONSE]**
1. Detached single-family home
  2. Semi-detached house
  3. Mobile home or house trailer
  4. Townhouse or duplex which share adjacent walls
  5. Row house
  96. Other, please specify \_\_\_\_\_
  98. (Don't know)
  99. (Refused)
- E2. Please indicate the town or city where your primary residence is located: \_\_\_\_\_  
**[To code URBAN/RURAL on back-end]**
- E3. Including yourself, how many people live in this residence on a full-time basis?
- Number of people: \_\_\_\_\_ **[NOTE: DON'T ALLOW ZERO FOR A RESPONSE]**
97. Nobody lives in the house on a full-time basis
  99. (Refused)
- E4. What is your age group? Are you ....: **[READ; STOP WHEN ANSWER IS VOLUNTEERED]**
1. 18 to 24
  2. 25 to 34
  3. 35 to 44
  4. 45 to 54
  5. 55 to 64
  6. 65 or over
  99. (Refused)
- E5. What is the highest level of education you have completed? **[READ IF NECESSARY]**
1. Less than high school graduation diploma
  2. High school graduation diploma and/or some post secondary
  3. Trade certificate or diploma
  4. College certificate or diploma
  5. University degree, certificate or diploma
  96. Other, please specify: \_\_\_\_\_
  99. (Refused)



E6. What is your gender?

1. Male
2. Female
3. Non-binary
4. Another gender (Please specify this gender if you are comfortable doing so: \_\_\_\_\_)
5. Prefer not to say

**END:** Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day.

## APPENDIX VIII

### ASFH Participant Survey Results

The participant survey results are presented in the following tables.

#### A. Awareness of the Program

A1. How did you become aware of Efficiency Nova Scotia's HomeWarming program? Anything else?

|                                                                 | Overall % | Measure Category |            |
|-----------------------------------------------------------------|-----------|------------------|------------|
|                                                                 |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                          | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Word of mouth/friends/family                                    | 37%       | 36%              | 37%        |
| Online – general                                                | 31%       | 23%              | 37%        |
| Social media                                                    | 21%       | 41%              | 7%         |
| TV ad                                                           | 13%       | 18%              | 10%        |
| Efficiency Nova Scotia newsletter – online/email                | 10%       | 5%               | 13%        |
| Newspaper                                                       | 8%        | 9%               | 7%         |
| Through participation in another Efficiency Nova Scotia program | 4%        | 0%               | 7%         |
| Brochure/handout                                                | 4%        | 0%               | 7%         |
| Insert in Nova Scotia Power bill                                | 4%        | 9%               | 0%         |
| Nova Scotia Government announcement                             | 2%        | 5%               | 0%         |
| Efficiency Nova Scotia website                                  | 2%        | 5%               | 0%         |
| Other                                                           | 8%        | 0%               | 13%        |
| Don't know                                                      | 4%        | 0%               | 7%         |



A2. What was the main reason you were interested in participating in the HomeWarming program?

|                                                                                             | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                             |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                      | <b>52</b> | <b>22</b>        | <b>30</b>  |
| To save on energy/to save on energy costs                                                   | 54%       | 59%              | 50%        |
| I was thinking about/planning to upgrade/needed to replace my heating system anyway         | 12%       | 18%              | 13%        |
| I was thinking about/planning to upgrade/needed to install insulation/draft proofing anyway | 12%       | 9%               | 7%         |
| To get it for free                                                                          | 6%        | 0%               | 10%        |
| For environmental reasons                                                                   | 8%        | 5%               | 10%        |
| To make my home more comfortable                                                            | 6%        | 9%               | 3%         |
| Other                                                                                       | 2%        | 0%               | 3%         |
| Don't know                                                                                  | 2%        | 0%               | 3%         |

## B. Satisfaction & Experience with the Program

B1. Using a 0 to 10 scale, where 0 is “definitely would not” and 10 is “definitely would”, what is the likelihood you would recommend the HomeWarming program to your family or friends?

|                                                                                      | Overall % | Measure Category |            |
|--------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                      |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                               | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Definitely would                                                                | 79%       | 82%              | 77%        |
| 9                                                                                    | 6%        | 0%               | 10%        |
| 8                                                                                    | 10%       | 9%               | 10%        |
| 7                                                                                    | 4%        | 5%               | 3%         |
| 6                                                                                    | 2%        | 5%               | 0%         |
| 5                                                                                    | 0%        | 0%               | 0%         |
| 4                                                                                    | 0%        | 0%               | 0%         |
| 3                                                                                    | 0%        | 0%               | 0%         |
| 2                                                                                    | 0%        | 0%               | 0%         |
| 1                                                                                    | 0%        | 0%               | 0%         |
| 0 - Definitely would not                                                             | 0%        | 0%               | 0%         |
| Don't know                                                                           | 0%        | 0%               | 0%         |
| Refused                                                                              | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                      | 94%       | 91%              | 97%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                    | 6%        | 9%               | 3%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                | 0%        | 0%               | 0%         |
| MEAN                                                                                 | 9.6       | 9.5              | 9.6        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation |           |                  |            |

B2. On a scale of 0 to 10 scale, with 0 being “not at all satisfied” and 10 being “completely satisfied,” how satisfied are you with the program overall?

|                                                                                      | Overall % | Measure Category |            |
|--------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                      |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                               | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                            | 67%       | 64%              | 70%        |
| 9                                                                                    | 8%        | 0%               | 13%        |
| 8                                                                                    | 12%       | 14%              | 10%        |
| 7                                                                                    | 8%        | 14%              | 3%         |
| 6                                                                                    | 2%        | 5%               | 0%         |
| 5                                                                                    | 4%        | 5%               | 3%         |
| 4                                                                                    | 0%        | 0%               | 0%         |
| 3                                                                                    | 0%        | 0%               | 0%         |
| 2                                                                                    | 0%        | 0%               | 0%         |
| 1                                                                                    | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                             | 0%        | 0%               | 0%         |
| Don't know                                                                           | 0%        | 0%               | 0%         |
| Refused                                                                              | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                      | 87%       | 77%              | 93%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                    | 13%       | 23%              | 7%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                | 0%        | 0%               | 0%         |
| MEAN                                                                                 | 9.2       | 8.9              | 9.4        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation |           |                  |            |

B3. [IF B2<8] What was the main reason you were not more satisfied with the HomeWarming program overall?

|                                                                                              | Overall % | Measure Category |            |
|----------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                              |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                       | <b>7</b>  | <b>5</b>         | <b>2</b>   |
| The low quality of interactions during program participation                                 | 29%       | 40%              | 0%         |
| The energy efficiency upgrades I received were not satisfactory                              | 43%       | 60%              | 0%         |
| Difficulties completing the enrolment process                                                | 29%       | 20%              | 50%        |
| The final home energy assessment did not go well                                             | 14%       | 20%              | 0%         |
| The initial home energy assessment did not go well                                           | 14%       | 20%              | 0%         |
| The process was long in general / the program took a long time to complete / long wait times | 14%       | 20%              | 0%         |
| It took a long time for the installation work to be completed                                | 14%       | 20%              | 0%         |
| Other                                                                                        | 29%       | 20%              | 50%        |
| Refused                                                                                      | 14%       | 0%               | 50%        |

B4. On a scale of 0 to 10, where 0 is 'not at all satisfied' and 10 is 'completely satisfied', how satisfied were you with each of the following aspects of the program?

a. The way you enroll in the program

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                             | 69%       | 77%              | 63%        |
| 9                                                                                     | 8%        | 14%              | 3%         |
| 8                                                                                     | 13%       | 5%               | 20%        |
| 7                                                                                     | 4%        | 5%               | 3%         |
| 6                                                                                     | 4%        | 0%               | 7%         |
| 5                                                                                     | 2%        | 0%               | 30%        |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 90%       | 95%              | 87%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 10%       | 5%               | 13%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 0%        | 0%               | 0%         |
| MEAN                                                                                  | 9.3       | 9.6              | 9.0        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

b. The information you received about the different steps in the program

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                             | 46%       | 45%              | 47%        |
| 9                                                                                     | 8%        | 5%               | 10%        |
| 8                                                                                     | 17%       | 27%              | 10%        |
| 7                                                                                     | 10%       | 5%               | 13%        |
| 6                                                                                     | 6%        | 5%               | 7%         |
| 5                                                                                     | 8%        | 9%               | 7%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| Don't know                                                                            | 6%        | 5%               | 7%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 71%       | 77%              | 67%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 23%       | 18%              | 27%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 0%        | 0%               | 0%         |
| MEAN                                                                                  | 8.6       | 8.6              | 8.6        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

c. [IF MEASURE CATEGORY = MODELLED] The wait time between your enrolment and the initial home energy evaluation assessment

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>22</b> | <b>22</b>        | <b>0</b>   |
| 10 - Completely satisfied                                                             | 36%       | 36%              | 0%         |
| 9                                                                                     | 5%        | 5%               | 0%         |
| 8                                                                                     | 14%       | 14%              | 0%         |
| 7                                                                                     | 5%        | 5%               | 0%         |
| 6                                                                                     | 18%       | 18%              | 0%         |
| 5                                                                                     | 5%        | 5%               | 0%         |
| 4                                                                                     | 9%        | 9%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 5%        | 5%               | 0%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                              | 5%        | 5%               | 0%         |
| Don't know                                                                            | 0%        | 0%               | 0%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 55%       | 55%              |            |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 27%       | 27%              |            |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 18%       | 18%              |            |
| MEAN                                                                                  | 7.2       | 7.2              |            |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

d. [IF MEASURE CATEGORY = MODELLED] The initial home energy assessment provided by the Energy Auditor

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>22</b> | <b>22</b>        | <b>0</b>   |
| 10 - Completely satisfied                                                             | 55%       | 55%              | 0%         |
| 9                                                                                     | 5%        | 5%               | 0%         |
| 8                                                                                     | 23%       | 23%              | 0%         |
| 7                                                                                     | 0%        | 0%               | 0%         |
| 6                                                                                     | 0%        | 0%               | 0%         |
| 5                                                                                     | 0%        | 0%               | 0%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 9%        | 9%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| Don't know                                                                            | 9%        | 9%               | 0%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 82%       | 82%              |            |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 0%        | 0%               |            |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 9%        | 9%               |            |
| MEAN                                                                                  | 8.8       | 8.8              |            |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

e. [IF MEASURE CATEGORY = MODELLED] The wait time between the energy assessment and the installation work being completed

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>22</b> | <b>22</b>        | <b>0</b>   |
| 10 - Completely satisfied                                                             | 41%       | 41%              | 0%         |
| 9                                                                                     | 5%        | 5%               | 0%         |
| 8                                                                                     | 32%       | 32%              | 0%         |
| 7                                                                                     | 9%        | 9%               | 0%         |
| 6                                                                                     | 0%        | 0%               | 0%         |
| 5                                                                                     | 0%        | 0%               | 0%         |
| 4                                                                                     | 5%        | 5%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 5%        | 5%               | 0%         |
| 0 - Not at all satisfied                                                              | 5%        | 5%               | 0%         |
| Don't know                                                                            | 0%        | 0%               | 0%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 77%       | 77%              |            |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 9%        | 9%               |            |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 14%       | 14%              |            |
| MEAN                                                                                  | 7.9       | 7.9              |            |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

f. The quality of the product(s) installed in your home

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                             | 73%       | 82%              | 67%        |
| 9                                                                                     | 10%       | 5%               | 13%        |
| 8                                                                                     | 6%        | 0%               | 10%        |
| 7                                                                                     | 4%        | 5%               | 3%         |
| 6                                                                                     | 0%        | 0%               | 0%         |
| 5                                                                                     | 4%        | 5%               | 3%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| Don't know                                                                            | 4%        | 5%               | 3%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 88%       | 86%              | 90%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 8%        | 9%               | 7%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 0%        | 0%               | 0%         |
| MEAN                                                                                  | 9.5       | 9.6              | 9.4        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |



g. The quality of the installation work

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                             | 79%       | 82%              | 77%        |
| 9                                                                                     | 8%        | 0%               | 13%        |
| 8                                                                                     | 6%        | 5%               | 7%         |
| 7                                                                                     | 4%        | 5%               | 3%         |
| 6                                                                                     | 2%        | 5%               | 0%         |
| 5                                                                                     | 0%        | 0%               | 0%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| Don't know                                                                            | 2%        | 5%               | 0%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 92%       | 86%              | 97%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 6%        | 9%               | 3%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 0%        | 0%               | 0%         |
| MEAN                                                                                  | 9.6       | 9.6              | 9.6        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

h. The information you received about the product(s) installed

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                             | 52%       | 50%              | 53%        |
| 9                                                                                     | 10%       | 5%               | 13%        |
| 8                                                                                     | 10%       | 9%               | 10%        |
| 7                                                                                     | 10%       | 14%              | 7%         |
| 6                                                                                     | 6%        | 14%              | 0%         |
| 5                                                                                     | 4%        | 5%               | 3%         |
| 4                                                                                     | 4%        | 0%               | 7%         |
| 3                                                                                     | 4%        | 5%               | 3%         |
| 2                                                                                     | 2%        | 0%               | 3%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 71%       | 64%              | 77%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 19%       | 32%              | 10%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 10%       | 5%               | 13%        |
| MEAN                                                                                  | 8.3       | 8.3              | 8.4        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

- i. [IF MEASURE CATEGORY = HP ONLY] The information you received about how to use your heat pump

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>30</b> | <b>0</b>         | <b>30</b>  |
| 10 - Completely satisfied                                                             | 60%       | 0%               | 60%        |
| 9                                                                                     | 10%       | 0%               | 10%        |
| 8                                                                                     | 17%       | 0%               | 17%        |
| 7                                                                                     | 3%        | 0%               | 3%         |
| 6                                                                                     | 0%        | 0%               | 0%         |
| 5                                                                                     | 0%        | 0%               | 0%         |
| 4                                                                                     | 3%        | 0%               | 3%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 3%        | 0%               | 3%         |
| 1                                                                                     | 3%        | 0%               | 3%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| Don't know                                                                            | 0%        | 0%               | 0%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 87%       |                  | 87%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 3%        |                  | 3%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 10%       |                  | 10%        |
| MEAN                                                                                  | 8.7       |                  | 8.7        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

B5. On a scale of 0 to 10, where 0 is 'not at all satisfied' and 10 is 'completely satisfied', how satisfied were you with the interactions you had during your participation in the process?

a. Interactions and communications with the contractor [INSERT <PRIMARY CONTRACTOR>] who you were in contact with to schedule appointments and organize the installation of the upgrade(s)

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                             | 67%       | 59%              | 73%        |
| 9                                                                                     | 10%       | 9%               | 10%        |
| 8                                                                                     | 12%       | 14%              | 10%        |
| 7                                                                                     | 4%        | 5%               | 3%         |
| 6                                                                                     | 0%        | 0%               | 0%         |
| 5                                                                                     | 2%        | 0%               | 3%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 2%        | 5%               | 0%         |
| 1                                                                                     | 4%        | 9%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| Don't know                                                                            | 0%        | 0%               | 0%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 88%       | 82%              | 93%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 6%        | 5%               | 7%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 6%        | 14%              | 0%         |
| MEAN                                                                                  | 9.0       | 8.3              | 9.4        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

b. [IF MEASURE CATEGORY = MODELLED] Interactions with the Energy Auditor that conducted the home energy assessment

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>22</b> | <b>22</b>        | <b>0</b>   |
| 10 - Completely satisfied                                                             | 73%       | 73%              | 0%         |
| 9                                                                                     | 9%        | 9%               | 0%         |
| 8                                                                                     | 9%        | 9%               | 0%         |
| 7                                                                                     | 0%        | 0%               | 0%         |
| 6                                                                                     | 5%        | 5%               | 0%         |
| 5                                                                                     | 0%        | 0%               | 0%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 5%        | 5%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| (VOL) Don't know                                                                      | 0%        | 0%               | 0%         |
| (VOL) Refused                                                                         | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 91%       | 91%              |            |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 5%        | 5%               |            |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 5%        | 5%               |            |
| MEAN                                                                                  | 9.1       | 9.1              |            |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

c. The service provided by those responsible for installing the upgrade(s) (e.g., contractors, subcontractors...)

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely satisfied                                                             | 73%       | 77%              | 70%        |
| 9                                                                                     | 13%       | 9%               | 17%        |
| 8                                                                                     | 6%        | 0%               | 10%        |
| 7                                                                                     | 2%        | 0%               | 3%         |
| 6                                                                                     | 0%        | 0%               | 0%         |
| 5                                                                                     | 4%        | 9%               | 0%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 2%        | 5%               | 0%         |
| 0 - Not at all satisfied                                                              | 0%        | 0%               | 0%         |
| Don't know                                                                            | 0%        | 0%               | 0%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 92%       | 86%              | 97%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 6%        | 9%               | 3%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 2%        | 5%               | 0%         |
| MEAN                                                                                  | 9.3       | 9.0              | 9.5        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

B6. On a scale of 0 to 10, where 0 is 'do not agree at all' and 10 is 'completely agree', what is your level of agreement with the following statements?

a. [IF MEASURE CATEGORY = MODELLED] I learned about my home's energy usage during the initial Home Energy assessment

|                                                                                                        | Overall % | Measure Category |            |
|--------------------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                                        |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                                 | <b>22</b> | <b>22</b>        | <b>0</b>   |
| 10 - Completely agree                                                                                  | 36%       | 36%              | 0%         |
| 9                                                                                                      | 9%        | 9%               | 0%         |
| 8                                                                                                      | 27%       | 27%              | 0%         |
| 7                                                                                                      | 5%        | 5%               | 0%         |
| 6                                                                                                      | 0%        | 0%               | 0%         |
| 5                                                                                                      | 9%        | 9%               | 0%         |
| 4                                                                                                      | 0%        | 0%               | 0%         |
| 3                                                                                                      | 0%        | 0%               | 0%         |
| 2                                                                                                      | 5%        | 5%               | 0%         |
| 1                                                                                                      | 0%        | 0%               | 0%         |
| 0 - - Do not agree at all                                                                              | 9%        | 9%               | 0%         |
| Not applicable                                                                                         | 0%        | 0%               | 0%         |
| Don't know                                                                                             | 0%        | 0%               | 0%         |
| Refused                                                                                                | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                                        | 73%       | 73%              |            |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                                      | 14%       | 14%              |            |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                                  | 14%       | 14%              |            |
| MEAN                                                                                                   | 7.5       | 7.5              |            |
| Note: Responses of 'Not applicable', 'Don't know' and 'Refused' are excluded from the mean calculation |           |                  |            |

b. [IF MEASURE CATEGORY = MODELLED] I received all the energy efficiency upgrades I expected to receive after the Home Energy assessment

|                                                                                                         | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                                         |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                                  | <b>22</b> | <b>22</b>        | <b>0</b>   |
| 10 - Completely agree                                                                                   | 59%       | 59%              | 0%         |
| 9                                                                                                       | 5%        | 5%               | 0%         |
| 8                                                                                                       | 9%        | 9%               | 0%         |
| 7                                                                                                       | 5%        | 5%               | 0%         |
| 6                                                                                                       | 5%        | 5%               | 0%         |
| 5                                                                                                       | 5%        | 5%               | 0%         |
| 4                                                                                                       | 0%        | 0%               | 0%         |
| 3                                                                                                       | 5%        | 5%               | 0%         |
| 2                                                                                                       | 5%        | 5%               | 0%         |
| 1                                                                                                       | 0%        | 0%               | 0%         |
| 0 - Do not agree at all                                                                                 | 0%        | 0%               | 0%         |
| Not applicable                                                                                          | 5%        | 5%               | 0%         |
| Don't know                                                                                              | 0%        | 0%               | 0%         |
| Refused                                                                                                 | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                                         | 73%       | 73%              |            |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                                       | 14%       | 14%              |            |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                                   | 9%        | 9%               |            |
| MEAN                                                                                                    | 8.5       | 8.5              |            |
| Note: Responses of 'Not applicable', 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |



c. I received information about the products installed

|                                                                                                         | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                                         |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                                  | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely agree                                                                                   | 60%       | 65%              | 63%        |
| 9                                                                                                       | 4%        | 5%               | 3%         |
| 8                                                                                                       | 13%       | 5%               | 20%        |
| 7                                                                                                       | 6%        | 9%               | 3%         |
| 6                                                                                                       | 4%        | 9%               | 0%         |
| 5                                                                                                       | 4%        | 5%               | 3%         |
| 4                                                                                                       | 0%        | 0%               | 0%         |
| 3                                                                                                       | 2%        | 0%               | 3%         |
| 2                                                                                                       | 0%        | 0%               | 0%         |
| 1                                                                                                       | 2%        | 5%               | 0%         |
| 0 - Do not agree at all                                                                                 | 6%        | 9%               | 3%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                                         | 77%       | 64%              | 87%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                                       | 13%       | 23%              | 7%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                                   | 10%       | 14%              | 7%         |
| MEAN                                                                                                    | 8.3       | 7.7              | 8.7        |
| Note: Responses of 'Not applicable', 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

d. [IF MEASURE CATEGORY = HP-ONLY] I understand how to operate and maintain the equipment that was installed by this program

|                                                                                                         | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                                         |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                                  | <b>30</b> | <b>0</b>         | <b>30</b>  |
| 10 - Completely agree                                                                                   | 53%       | 0%               | 53%        |
| 9                                                                                                       | 7%        | 0%               | 7%         |
| 8                                                                                                       | 10%       | 0%               | 10%        |
| 7                                                                                                       | 13%       | 0%               | 13%        |
| 6                                                                                                       | 3%        | 0%               | 3%         |
| 5                                                                                                       | 0%        | 0%               | 0%         |
| 4                                                                                                       | 0%        | 0%               | 0%         |
| 3                                                                                                       | 7%        | 0%               | 7%         |
| 2                                                                                                       | 0%        | 0%               | 0%         |
| 1                                                                                                       | 3%        | 0%               | 3%         |
| 0 - Do not agree at all                                                                                 | 0%        | 0%               | 0%         |
| Not applicable                                                                                          | 0%        | 0%               | 0%         |
| Don't know                                                                                              | 3%        | 0%               | 3%         |
| Refused                                                                                                 | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                                         | 70%       |                  | 70%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                                       | 17%       |                  | 17%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                                   | 10%       |                  | 10%        |
| MEAN                                                                                                    | 8.4       |                  | 8.4        |
| Note: Responses of 'Not applicable', 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

e. It was easy to participate in the HomeWarming program

|                                                                                                         | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                                         |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                                  | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely agree                                                                                   | 71%       | 77%              | 67%        |
| 9                                                                                                       | 8%        | 5%               | 10%        |
| 8                                                                                                       | 10%       | 5%               | 10%        |
| 7                                                                                                       | 6%        | 5%               | 7%         |
| 6                                                                                                       | 2%        | 0%               | 3%         |
| 5                                                                                                       | 2%        | 5%               | 0%         |
| 4                                                                                                       | 0%        | 0%               | 0%         |
| 3                                                                                                       | 0%        | 0%               | 0%         |
| 2                                                                                                       | 2%        | 0%               | 3%         |
| 1                                                                                                       | 0%        | 0%               | 0%         |
| 0 - Do not agree at all                                                                                 | 0%        | 0%               | 0%         |
| Not applicable                                                                                          | 0%        | 0%               | 0%         |
| Don't know                                                                                              | 0%        | 0%               | 0%         |
| Refused                                                                                                 | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                                         | 88%       | 91%              | 87%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                                       | 10%       | 9%               | 10%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                                   | 2%        | 0%               | 3%         |
| MEAN                                                                                                    | 9.2       | 9.4              | 9.1        |
| Note: Responses of 'Not applicable', 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

f. It was worthwhile participating in the HomeWarming program

|                                                                                                         | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                                         |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                                  | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely agree                                                                                   | 88%       | 86%              | 90%        |
| 9                                                                                                       | 4%        | 0%               | 7%         |
| 8                                                                                                       | 4%        | 9%               | 0%         |
| 7                                                                                                       | 4%        | 5%               | 3%         |
| 6                                                                                                       | 0%        | 0%               | 0%         |
| 5                                                                                                       | 0%        | 0%               | 0%         |
| 4                                                                                                       | 0%        | 0%               | 0%         |
| 3                                                                                                       | 0%        | 0%               | 0%         |
| 2                                                                                                       | 0%        | 0%               | 0%         |
| 1                                                                                                       | 0%        | 0%               | 0%         |
| 0 - Do not agree at all                                                                                 | 0%        | 0%               | 0%         |
| Not applicable                                                                                          | 0%        | 0%               | 0%         |
| Don't know                                                                                              | 0%        | 0%               | 0%         |
| Refused                                                                                                 | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                                         | 96%       | 95%              | 97%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                                       | 4%        | 5%               | 3%         |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                                   | 0%        | 0%               | 0%         |
| MEAN                                                                                                    | 9.8       | 9.7              | 9.8        |
| Note: Responses of 'Not applicable', 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

## C. Benefits and Challenges

C1. On a scale of 0 to 10, where 0 is “do not agree at all” and 10 is “completely agree”, what is your level of agreement with the following statements?

a. My home is more comfortable because of the energy efficient upgrades I received

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely agree                                                                 | 60%       | 64%              | 57%        |
| 9                                                                                     | 4%        | 0%               | 7%         |
| 8                                                                                     | 19%       | 14%              | 23%        |
| 7                                                                                     | 8%        | 9%               | 7%         |
| 6                                                                                     | 2%        | 5%               | 0%         |
| 5                                                                                     | 2%        | 0%               | 3%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 2%        | 5%               | 0%         |
| 0 - Do not agree at all                                                               | 0%        | 0%               | 0%         |
| Don't know                                                                            | 4%        | 5%               | 3%         |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 83%       | 77%              | 87%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 12%       | 14%              | 10%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 2%        | 5%               | 0%         |
| MEAN                                                                                  | 9.0       | 8.8              | 9.1        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

b. I am spending less money to heat my home

|                                                                                      | Overall % | Measure Category |           |
|--------------------------------------------------------------------------------------|-----------|------------------|-----------|
|                                                                                      |           | Modelled         | Heat Pump |
| <b>Sample Size (#)</b>                                                               | <b>52</b> | <b>22</b>        | <b>30</b> |
| 10 - Completely agree                                                                | 29%       | 36,4%            | 23%       |
| 9                                                                                    | 4%        | 4,5%             | 3%        |
| 8                                                                                    | 15%       | 4,5%             | 23%       |
| 7                                                                                    | 4%        | 5%               | 3%        |
| 6                                                                                    | 4%        | 5%               | 3%        |
| 5                                                                                    | 8%        | 9%               | 7%        |
| 4                                                                                    | 0%        | 0%               | 0%        |
| 3                                                                                    | 2%        | 5%               | 0%        |
| 2                                                                                    | 2%        | 5%               | 0%        |
| 1                                                                                    | 0%        | 0%               | 0%        |
| 0 - Do not agree at all                                                              | 2%        | 0%               | 3%        |
| Don't know                                                                           | 31%       | 27%              | 33%       |
| Refused                                                                              | 0%        | 0%               | 0%        |
| TOP 3 BOX % (ratings of 8,9,10)                                                      | 48%       | 45,5%            | 50%       |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                    | 15%       | 18%              | 13%       |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                | 6%        | 9%               | 3%        |
| MEAN                                                                                 | 7.9       | 7.8              | 7.9       |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation |           |                  |           |

c. I am now able to utilize additional space(s) in my home after participating in this program

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely agree                                                                 | 31%       | 32%              | 30%        |
| 9                                                                                     | 2%        | 0%               | 3%         |
| 8                                                                                     | 6%        | 0%               | 10%        |
| 7                                                                                     | 2%        | 5%               | 0%         |
| 6                                                                                     | 8%        | 5%               | 10%        |
| 5                                                                                     | 15%       | 9%               | 20%        |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 4%        | 5%               | 3%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 2%        | 0%               | 3%         |
| 0 - Do not agree at all                                                               | 15%       | 23%              | 10%        |
| Don't know                                                                            | 13%       | 18%              | 10%        |
| Refused                                                                               | 2%        | 5%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 38%       | 32%              | 43%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 25%       | 18%              | 30%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 21%       | 27%              | 17%        |
| MEAN                                                                                  | 6.2       | 5.6              | 6.5        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |

d. After participating in the program, I can keep my home warmer in the winter

|                                                                                       | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                       |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 10 - Completely agree                                                                 | 50%       | 59%              | 43%        |
| 9                                                                                     | 6%        | 5%               | 7%         |
| 8                                                                                     | 6%        | 5%               | 7%         |
| 7                                                                                     | 4%        | 0%               | 7%         |
| 6                                                                                     | 2%        | 0%               | 3%         |
| 5                                                                                     | 4%        | 9%               | 0%         |
| 4                                                                                     | 0%        | 0%               | 0%         |
| 3                                                                                     | 0%        | 0%               | 0%         |
| 2                                                                                     | 0%        | 0%               | 0%         |
| 1                                                                                     | 0%        | 0%               | 0%         |
| 0 - Do not agree at all                                                               | 2%        | 0%               | 3%         |
| Don't know                                                                            | 27%       | 23%              | 30%        |
| Refused                                                                               | 0%        | 0%               | 0%         |
| TOP 3 BOX % (ratings of 8,9,10)                                                       | 62%       | 68%              | 57%        |
| MIDDLE 3 BOX % (ratings of 5,6,7)                                                     | 10%       | 9%               | 10%        |
| BOTTOM 5 BOX % (ratings of 0,1,2,3,4)                                                 | 2%        | 0%               | 3%         |
| MEAN                                                                                  | 9.0       | 9.2              | 8.8        |
| Note: Responses of 'Don't know' and 'Refused' are excluded from the mean calculation. |           |                  |            |



C2. Apart from what you have already mentioned, did you experience any other benefits with the program?

|                        | Overall % | Measure Category |            |
|------------------------|-----------|------------------|------------|
|                        |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b> | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Yes                    | 31%       | 14%              | 43%        |
| No                     | 69%       | 86%              | 57%        |

C3. [IF 'YES' IN C2] What other benefits did you experience thanks to the program?

|                                                          | Overall % | Measure Category |            |
|----------------------------------------------------------|-----------|------------------|------------|
|                                                          |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                   | <b>16</b> | <b>3</b>         | <b>13</b>  |
| Air conditioning is a plus                               | 38%       | 67%              | 31%        |
| Savings/Spending less money                              | 19%       | 33%              | 15%        |
| Air quality improvement                                  | 25%       | 33%              | 23%        |
| Energy efficient lightbulbs                              | 19%       | 33%              | 15%        |
| Reduced other heating methods usage                      | 13%       | 0%               | 15%        |
| Better warming capabilities/More comfortable temperature | 6%        | 0%               | 8%         |
| Hot water tank wrapping/insulating                       | 13%       | 33%              | 8%         |
| Energy efficient showerhead                              | 13%       | 33%              | 8%         |
| Cooling and heating capabilities in one                  | 13%       | 0%               | 15%        |
| Other                                                    | 25%       | 0%               | 31%        |

C4. And, other than those you already mentioned, did you experience any other issues?

|                        | Overall % | Measure Category |            |
|------------------------|-----------|------------------|------------|
|                        |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b> | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Yes                    | 10%       | 9%               | 10%        |
| No                     | 90%       | 91%              | 90%        |

C5. [IF 'YES' IN C4] What other issues or challenges did you have with the program?

|                                                           | Overall % | Measure Category |            |
|-----------------------------------------------------------|-----------|------------------|------------|
|                                                           |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                    | <b>5</b>  | <b>2</b>         | <b>3</b>   |
| Poor quality upgrades/work done                           | 40%       | 50%              | 33%        |
| Poor communications/Unable to reach anyone/get in contact | 40%       | 0%               | 67%        |
| Other                                                     | 20%       | 50%              | 0%         |

## D. Opportunities for Improvement

D1. [IF MEASURE CATEGORY = MODELLED] What questions, if any, do you have about the different upgrades installed through the Home Warming program?

|                                                              | Overall % | Measure Category |            |
|--------------------------------------------------------------|-----------|------------------|------------|
|                                                              |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                       | <b>22</b> | <b>22</b>        | <b>0</b>   |
| Other efficiency upgrades/products available                 | 14%       | 14%              | 0%         |
| More clear energy assessment process/report                  | 9%        | 9%               | 0%         |
| More details about the approval/application process          | 5%        | 5%               | 0%         |
| Information about the heat pump/how to operate the heat pump | 9%        | 9%               | 0%         |
| More information in general                                  | 9%        | 9%               | 0%         |
| Other                                                        | 9%        | 9%               | 0%         |
| Nothing/All is good                                          | 59%       | 59%              | 0%         |

D2. [IF MEASURE CATEGORY = HP-ONLY] What questions, if any, do you have about the heat pump installed through the Home Warming program?

|                           | Overall % | Measure Category |            |
|---------------------------|-----------|------------------|------------|
|                           |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>    | <b>30</b> | <b>0</b>         | <b>30</b>  |
| How to use/Best practices | 13%       | 0%               | 13%        |
| Other                     | 13%       | 0%               | 13%        |
| Nothing/All is good       | 70%       | 0%               | 70%        |
| Don't know                | 3%        | 0%               | 3%         |

D3. [ASK IF RESPONDENT HAS QUESTIONS AT D1 OR D2] How would you prefer those questions to be answered?

|                                                                                                   | Overall % | Measure Category |            |
|---------------------------------------------------------------------------------------------------|-----------|------------------|------------|
|                                                                                                   |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                                                            | <b>17</b> | <b>9</b>         | <b>8</b>   |
| Over the phone with the contractor you've been dealing with throughout the program                | 65%       | 44%              | 88%        |
| Having a dedicated number to call                                                                 | 41%       | 44%              | 38%        |
| Through an online chat service                                                                    | 24%       | 11%              | 38%        |
| Through leaflets and education materials that the contractor/installer/inspector can leave behind | 24%       | 22%              | 25%        |
| In-person visits                                                                                  | 18%       | 11%              | 25%        |
| Email communications                                                                              | 12%       | 0%               | 25%        |
| On a dedicated website with frequently asked questions about the program                          | 6%        | 11%              | 0%         |
| Other                                                                                             | 6%        | 11%              | 0%         |

D4. Is there any other information you would have liked to know about the program before going through it?

|                                                | Overall % | Measure Category |            |
|------------------------------------------------|-----------|------------------|------------|
|                                                |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                         | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Nothing/All is good                            | 83%       | 82%              | 83%        |
| More information in general about the programs | 10%       | 18%              | 3%         |
| More efficiency upgrade options                | 2%        | 0%               | 3%         |
| Other                                          | 6%        | 0%               | 10%        |

D5. What recommendations do you have for improving the HomeWarming program?

|                                                          | Overall % | Measure Category |            |
|----------------------------------------------------------|-----------|------------------|------------|
|                                                          |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                   | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Improved interaction and communication with stakeholders | 12%       | 23%              | 3%         |
| Have more upgrades available                             | 10%       | 9%               | 10%        |
| Improved wait times                                      | 8%        | 14%              | 3%         |
| More information about the installed products            | 8%        | 14%              | 3%         |
| More information on the program                          | 6%        | 5%               | 7%         |
| More advertising/Increase awareness of the program       | 4%        | 0%               | 7%         |
| Simpler/easier process/enrolment                         | 4%        | 9%               | 0%         |
| Better quality of installed products                     | 2%        | 0%               | 3%         |
| More information about how to operate the heat pump      | 2%        | 0%               | 3%         |
| Other                                                    | 12%       | 14%              | 10%        |
| Nothing/All is good                                      | 48%       | 36%              | 57%        |
| Don't know                                               | 2%        | 0%               | 3%         |

## E. Demographics

E1. What type of residence do you live in?

|                                                | Overall % | Measure Category |            |
|------------------------------------------------|-----------|------------------|------------|
|                                                |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                         | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Detached single-family home                    | 75%       | 91%              | 63%        |
| Semi-detached house                            | 4%        | 0%               | 7%         |
| Mobile home or house trailer                   | 15%       | 9%               | 20%        |
| Townhouse or duplex which share adjacent walls | 6%        | 0%               | 10%        |

E2. Please indicate the town or city where your primary residence is located: CODED INTO URBAN/RURAL

|                        | Overall % | Measure Category |            |
|------------------------|-----------|------------------|------------|
|                        |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b> | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Urban                  | 44%       | 23%              | 60%        |
| Rural                  | 54%       | 73%              | 40%        |
| Unspecified            | 2%        | 5%               | 0%         |

E3. Including yourself, how many people live in this residence on a full-time basis?

|                        | Overall % | Measure Category |            |
|------------------------|-----------|------------------|------------|
|                        |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b> | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 1                      | 27%       | 32%              | 23%        |
| 2                      | 58%       | 50%              | 63%        |
| 3                      | 8%        | 9%               | 7%         |
| 4                      | 2%        | 5%               | 0%         |
| 5                      | 2%        | 0%               | 3%         |
| 6                      | 4%        | 5%               | 3%         |

E4. What is your age group? Are you ....:

|                        | Overall % | Measure Category |            |
|------------------------|-----------|------------------|------------|
|                        |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b> | <b>52</b> | <b>22</b>        | <b>30</b>  |
| 18 to 24               | 2%        | 0%               | 3%         |
| 25 to 34               | 2%        | 0%               | 3%         |
| 35 to 44               | 10%       | 9%               | 10%        |
| 45 to 54               | 12%       | 14%              | 10%        |
| 55 to 64               | 17%       | 23%              | 13%        |
| 65 or over             | 58%       | 55%              | 60%        |

E5. What is the highest level of education you have completed?

|                                                             | Overall % | Measure Category |            |
|-------------------------------------------------------------|-----------|------------------|------------|
|                                                             |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b>                                      | <b>52</b> | <b>22</b>        | <b>30</b>  |
| (Less than high school graduation diploma)                  | 17%       | 14%              | 20%        |
| (High school graduation diploma and/or some post secondary) | 38%       | 41%              | 37%        |
| (Trades certificate or diploma)                             | 10%       | 9%               | 10%        |
| (College certificate or diploma)                            | 17%       | 18%              | 17%        |
| (University degree, certificate or diploma)                 | 15%       | 14%              | 17%        |
| (Refused)                                                   | 2%        | 5%               | 0%         |

E6. What is your gender?

|                        | Overall % | Measure Category |            |
|------------------------|-----------|------------------|------------|
|                        |           | Modelled%        | Heat Pump% |
| <b>Sample Size (#)</b> | <b>52</b> | <b>22</b>        | <b>30</b>  |
| Male                   | 35%       | 32%              | 37%        |
| Female                 | 65%       | 68%              | 63%        |

## APPENDIX IX

### ASFH Heat Pump Contractor Interview Guide

#### AFFORDABLE SINGLE-FAMILY HOMES (ASFH) PROGRAM EVALUATION

#### GUIDE FOR INTERVIEWS WITH HP CONTRACTORS

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                  |
|---------------------------------|----------------------------------|
| Instrument Type                 | Semi-directed in-depth interview |
| Estimated Time to Complete      | 20-25 minutes                    |
| Target Audience                 | Contractors                      |
| Expected Number of Completions  | 2 large<br>2 small               |
| Contact List Source             | Efficiency One                   |
| Fielding Firm                   | Narrative Research               |
| Estimated Timeline for Fielding | October/November 2024            |

Table 2: Research Objectives and Associated Questions

| Research Questions                     | Question # |
|----------------------------------------|------------|
| Respondent Involvement in the Program  | B1-B5      |
| Program Strengths and Challenges       | C1-C11     |
| Program Effectiveness and Satisfaction | D1-D2      |
| Suggestions for Improvements           | E1-E5      |

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Black text: instructions for interviewer **[NOTE: xxxx]** / **[PROBE: xxxx]**





## Introduction

Hello, may I speak with **[Contact name]**?

My name is **[Interviewer name]** and I'm calling from Narrative Research, a market research firm. Efficiency One has mandated the evaluation of its HomeWarming Program, which provides building envelope upgrades, such as insulation and draft proofing, and heat pumps at no cost to eligible homeowners. Efficiency Nova Scotia has informed us that **[BUSINESS NAME]** has participated in the program, and we are interested in your opinion from your perspective as a contractor. Are you the person most familiar with **[BUSINESS NAME]**'s involvement in the program? Our discussion should last about 20-25 minutes.

### A. Identification and Screening of Respondent

- › Person responsible available **[CONTINUE]**
- › Person responsible currently unavailable **[ARRANGE CALL BACK WITH THE RIGHT PERSON]**
- › Don't know **[ASK TO SPEAK TO ANOTHER PERSON WHO WOULD KNOW ABOUT THE PROGRAM]**
- › Refused **[THANK AND TERMINATE]**
- › Do you have any questions before we start?

### B. Respondent Involvement in the Program

- B1. To begin, what is your title, and could you briefly describe your company and your role and responsibilities?
- B2. How long have you been completing heat pump projects for Efficiency Nova Scotia as part of the HomeWarming program?
- B3. Approximately how many heat pump projects do you complete each year under the HomeWarming program?

### C. Program Strengths and Challenges

Now, I would like to discuss the HomeWarming program – heat pump delivery process with you. In general, we understand that a project includes the following steps: **[READ]**The contractor receives information about interested participants from the Efficiency Nova Scotia HomeWarming/Heat pump team.

1. The contractor receives information about interested participants from the Efficiency Nova Scotia HomeWarming.
2. The contractor contacts the participant to schedule an appointment to size the heat pump.
3. The contractor conducts the initial visit with participants to size the heat pump.
4. After the initial visit, the contractor submits the proposed heat pump and required photos, forms and details to Efficiency Nova Scotia for review.
5. Efficiency Nova Scotia reviews and approves the proposed heat pump.
6. The contractor informs the participant of approval and organizes and completes the installation of the heat pump.
7. Finally, the contractor invoices Efficiency Nova Scotia for the service and gets paid.

- C1. Is my understanding of the heat pump delivery process, correct? **[RECTIFY WHERE NECESSARY]**
- C2. For each of the program steps, I'd like to know what is working well, what issues have been faced – both for you as the contractor and for participants when relevant, and what improvements could be made.

**[ASK FOR EVERY STEP]**

- h. What is working well for you?
- (i) What problems or issues, if any, have you faced?
- (ii) What is working well for participants?
- (iii) What problems or issues, if any, have participants faced?
- (iv) What could be improved?

| Steps |                                                                                                                                                     | (a)<br>Problems Faced<br>by DAs         | (b)<br>Working Well<br>for DAs         | (c)<br>Problems Faced<br>by Participants | (d)<br>Working Well for<br>Participants | (e)<br>What could be<br>improved? | ASK IF NOT COVERED                                                             |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------|--------------------------------------------------------------------------------|
| 1     | The contractor receives information about interested participants from the Efficiency Nova Scotia HomeWarming                                       |                                         |                                        |                                          |                                         |                                   |                                                                                |
| 2     | The contractor contacts the participant to schedule an appointment to size the heat pump.                                                           |                                         |                                        |                                          |                                         |                                   |                                                                                |
| 3     | The contractor conducts the initial visit with participants to size the heat pump.                                                                  |                                         |                                        |                                          |                                         |                                   |                                                                                |
| 4     | After the initial visit, the contractor submits the proposed heat pump and required photos, forms and details to Efficiency Nova Scotia for review. |                                         |                                        |                                          |                                         |                                   |                                                                                |
| Steps |                                                                                                                                                     | (a)<br>Problems Faced<br>by contractors | (b)<br>Working Well<br>for contractors | (c)<br>Problems Faced<br>by Participants | (d)<br>Working Well for<br>Participants | (e)<br>What could be<br>improved? | ASK IF NOT COVERED                                                             |
| 5     | Efficiency Nova Scotia reviews and approves the proposed heat pump.                                                                                 |                                         |                                        |                                          |                                         |                                   | (f) Under what circumstances does Efficiency Nova Scotia not approve the work? |
| 6     | The contractor informs the participant of approval and organizes and completes the installation of the heat pump.                                   |                                         |                                        |                                          |                                         |                                   |                                                                                |
| 7     | Finally, the contractor invoices Efficiency Nova Scotia for the service and gets paid.                                                              |                                         |                                        |                                          |                                         |                                   |                                                                                |

- C3. What questions, if any, do program participants ask you about heat pump technology, or about how it works?
- C4. What other questions, if any, do participants have about energy efficiency?
- C5. After completing the upgrades, do you let homeowners know how to operate and maintain their heat pump or about the potential benefits of heat pumps? Do you leave any information or documents behind with them?
- C6. How strongly do you agree with the following statements? Please use a 1 to 10 scale, where 1 means “completely disagree” and 10 means “completely agree”.
- (i) It is easy to deliver Efficiency Nova Scotia’s HomeWarming program.
  - (ii) It is worthwhile being involved in the delivery of Efficiency Nova Scotia’s HomeWarming program.

## D. Program Effectiveness and Satisfaction

Now, I would like to discuss your satisfaction with the HomeWarming program.

- D1. On a scale of 0 to 10, where 0 is “not at all satisfied” and 10 is “completely satisfied”, how would you rate your satisfaction with each of the following six aspects of the HomeWarming Program  
[ASK FOR REASON IF 7 OR LOWER]

| Aspects of the Program                                                            | Score<br>0 = Not at all satisfied<br>10 = Completely Satisfied | Reason<br>If 7 or less, please share the reason(s) for your score. |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------|
| a. The overall program                                                            | --/10                                                          | What could be improved?                                            |
| b. The selection of heat pumps eligible for the program                           | --/10                                                          | What could be improved?                                            |
| c. The quality of the product(s) installed                                        | --/10                                                          | What could be improved?                                            |
| d. The effectiveness of communications with Efficiency Nova Scotia                | --/10                                                          | What could be improved?                                            |
| e. The marketing materials and tools provided by Efficiency Nova Scotia           | --/10                                                          | What could be improved?                                            |
| f. The data/record keeping process and reporting to Efficiency Nova Scotia        | --/10                                                          | What could be improved?                                            |
| g. The benefits resulting from being an Efficiency Preferred Partner (EPP) Member | --/10                                                          | What could be improved?                                            |
| h. The user-friendliness of the customer information system                       | --/10                                                          | What could be improved?                                            |



## E. Suggestions for Improvements

- E1. What additional support, tools, or training could Efficiency Nova Scotia provide to help make your job easier?
- E2. **[IF SUPPORT MENTIONED AT E1]** How would you like Efficiency Nova Scotia to deliver this support to you? **[PROBE: webinar, lunch-and-learn session...]**
- E3. What information, tools, or support could Efficiency Nova Scotia provide you to help you educate or inform participants about heat pump technology or how to use heat pumps efficiently?
- E4. What other suggestions do you have for improving the HomeWarming Program?
- E5. Using a 0 to 10 scale, where 0 is “definitely would not” and 10 is “definitely would”, what is the likelihood you would recommend the HomeWarming program to your family or friends?
- Score /10: \_\_\_\_\_
98. (Don't know)
- (b) (Refused)
- E6. And finally, do you have any other comments about the HomeWarming Program?

Thank you very much for your time and collaboration today!

**END**

## APPENDIX X

### ASFH Delivery Agent Interview Guide

#### GUIDE FOR INTERVIEW WITH DELIVERY AGENT

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                  |
|---------------------------------|----------------------------------|
| Instrument Type                 | Semi-directed in-depth interview |
| Estimated Time to Complete      | 30 minutes                       |
| Target Audience                 | Delivery agent                   |
| Expected Number of Completions  | n=4 DAs (mix of large and small) |
| Contact List Source             | E1                               |
| Fielding Firm                   | Econoler                         |
| Estimated Timeline for Fielding | October/November 2024            |

Table 2: Research Objectives and Associated Questions

| Research Questions             | Question # |
|--------------------------------|------------|
| Program Delivery               | B1-B6      |
| Satisfaction                   | C1         |
| Improvements and Opportunities | D1-D4      |

Blue text: answer text [RESPONSE]

Black text: instructions for interviewer [TEXT]



## Introduction

Hello, may I speak with **[CONTACT NAME]**?

My name is **[INTERVIEWER NAME]** and I'm calling from Econoler on behalf of Efficiency Nova Scotia.

Efficiency Nova Scotia is evaluating its HomeWarming Program. They let us know that you are a delivery agent for this program, and we are interested in your opinion regarding the program from the delivery agent perspective. Are you the person most familiar with **[INSERT DA NAME]**'s involvement in the HomeWarming program?

Do you have any questions before we start?

**[IF ASKED]** The interview should take about 30 minutes.

### A. Respondent Involvement in the Program

First, I would like to know more about your background and involvement with the program.

A1. Please tell me your title and briefly describe your role in the HomeWarming Program.

### B. Program Delivery

Now, I would like to discuss the HomeWarming program delivery process with you. In general, we understand that a project includes the following steps: **[READ]**

1. The delivery agent (DA) receives information about interested participants from the Efficiency Nova Scotia HomeWarming team.
2. The DA contacts the participant to schedule an appointment to complete the energy assessment or size the heat pump.
3. The DA conducts the initial visit with participants. If an energy assessment is being conducted, the DA models the home using HOT2000.
4. After the initial visit, the DA submits the proposed upgrades and required photos, forms and details to Efficiency Nova Scotia for review.
5. Efficiency Nova Scotia reviews and approves the proposed upgrades.
6. The DA informs the participant of approval and what upgrades are available. Then, the participant has the right to refuse any or all upgrades.
7. The DA organizes and completes the installation of the upgrades.
8. The DA conducts the final energy assessment, if applicable, and submits the details to Efficiency Nova Scotia.
9. Finally, the DA invoices Efficiency Nova Scotia for the service and gets paid.



- B1. Is my understanding of the HomeWarming delivery process, correct? **[RECTIFY WHERE NECESSARY]**
- B2. For each of the program steps, I'd like to know what is working well, what issues have been faced – both for you as the delivery agent and for participants when relevant, and what improvements could be made.

**[ASK FOR EVERY STEP]**

- a. What is working well for you?
- b. What problems or issues, if any, have you faced?
- c. What is working well for participants?
- d. What problems or issues, if any, have participants faced?
- e. What could be improved?



| Steps |                                                                                                                                                | (a)<br>Problems<br>Faced by<br>DAs | (b)<br>Working<br>Well for<br>DAs | (c)<br>Problems<br>Faced by<br>Participants | (d)<br>Working Well<br>for<br>Participants | (e)<br>What could<br>be improved? | ASK IF NOT COVERED                                                             |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------------------------------|---------------------------------------------|--------------------------------------------|-----------------------------------|--------------------------------------------------------------------------------|
| 1     | The delivery agent (DA) receives information about interested participants from the Efficiency Nova Scotia HomeWarming team.                   |                                    |                                   |                                             |                                            |                                   |                                                                                |
| 2     | The DA contacts the participant to schedule an appointment to complete the energy assessment or size the heat pump.                            |                                    |                                   |                                             |                                            |                                   |                                                                                |
| 3     | The DA conducts the initial visit with participants. If an energy assessment is being conducted, the DA models the home using HOT2000.         |                                    |                                   |                                             |                                            |                                   |                                                                                |
| 4     | After the initial visit, the DA submits the proposed upgrades and required photos, forms and details to Efficiency Nova Scotia for review.     |                                    |                                   |                                             |                                            |                                   |                                                                                |
| Steps |                                                                                                                                                | (a)<br>Problems<br>Faced by<br>DAs | (b)<br>Working<br>Well for<br>DAs | (c)<br>Problems<br>Faced by<br>Participants | (d)<br>Working Well<br>for<br>Participants | (e)<br>What could<br>be improved? | ASK IF NOT COVERED                                                             |
| 5     | Efficiency Nova Scotia reviews and approves the proposed upgrades.                                                                             |                                    |                                   |                                             |                                            |                                   | (f) Under what circumstances does Efficiency Nova Scotia not approve the work? |
| 6     | The DA informs the participant of approval and what upgrades are available. Then, the participant has the right to refuse any or all upgrades. |                                    |                                   |                                             |                                            |                                   |                                                                                |
| 7     | The DA organizes and completes the installation of the upgrades.                                                                               |                                    |                                   |                                             |                                            |                                   |                                                                                |
| 8     | The DA conducts the final energy assessment, if applicable, and submits the details to Efficiency Nova Scotia.                                 |                                    |                                   |                                             |                                            |                                   |                                                                                |
| 9     | Finally, the DA invoices Efficiency Nova Scotia for the service and gets paid.                                                                 |                                    |                                   |                                             |                                            |                                   |                                                                                |

- B3. What questions do participants have about energy efficiency or about the different upgrades being installed in their home?
- B4. Are there any other issues or challenges with the HomeWarming Program we haven't mentioned?
- B5. How strongly do you agree with the following statements? Please use a 1 to 10 scale, where 1 means "completely disagree" and 10 means "completely agree".
- (i) It is easy to deliver Efficiency Nova Scotia's HomeWarming program.
  - (ii) It is worthwhile being involved in the delivery of Efficiency Nova Scotia's HomeWarming program.

## C. Satisfaction

Now I would like to discuss your satisfaction with the program.

- C1. On a scale of 1 to 10, where 1 is "not at all satisfied" and 10 is "completely satisfied", how satisfied are you with each of these aspects of the HomeWarming Program. **[ASK FOR REASON IF 7 OR LOWER]**

| Aspects of the Program                                                     | Score<br>0 = Not at all<br>satisfied<br>10 = Completely<br>Satisfied | Reason<br>If 7 or less, please share the<br>reason(s) for your score. |
|----------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------|
| a. The HomeWarming program overall                                         | --/10                                                                | What could be improved?                                               |
| b. HW participation levels                                                 | --/10                                                                | What could be improved?                                               |
| c. The range of upgrades included in the HW program                        | --/10                                                                | What could be improved?                                               |
| d. The quality of the product(s) installed                                 | --/10                                                                | What could be improved?                                               |
| e. The effectiveness of your communications with EfficiencyOne             | --/10                                                                | What could be improved?                                               |
| f. The marketing materials and tools provided by Efficiency Nova Scotia    | --/10                                                                | What could be improved?                                               |
| g. The data/record keeping process and reporting to Efficiency Nova Scotia | --/10                                                                | What could be improved?                                               |
| h. The user-friendliness of the customer information system                | --/10                                                                | What could be improved?                                               |

## D. Improvements and Opportunities

- D1. Apart from what you have already mentioned, what other suggestions do you have for improving the HomeWarming program, if any?
- D2. **[IF NOT ALREADY MENTIONED]** What additional support, tools, or training could Efficiency Nova Scotia provide to help make your job easier?
- D3. **[IF NOT ALREADY MENTIONED]** What information, tools, or support could Efficiency Nova Scotia provide you to help you educate or inform participants about upgrades efficiently?



D4. Is there anything else you'd like to mention about the program?

## **E. End of Interview**

That is all the questions I have. Thank you for your time.

## APPENDIX XI

### ASFH Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 ASFH Corrected Tracked Savings**

| Program Component Result                   | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>Modelled Measures</b>                   |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 4.758               | GWh  | 4.635                   | GWh  | -2.58%              |
| Gross Peak Demand Savings at the Generator | 2.157               | MW   | 2.150                   | MW   | -0.36%              |
| Net Energy Savings at the Generator *      | 4.758               | GWh  | 4.635                   | GWh  | -2.58%              |
| Net Peak Demand Savings at the Generator * | 2.157               | MW   | 2.150                   | MW   | -0.36%              |
| <b>Non-modelled Measures</b>               |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 0.050               | GWh  | 0.058                   | GWh  | 14.8%               |
| Gross Peak Demand Savings at the Generator | 0.009               | MW   | 0.010                   | MW   | 11.6%               |
| Net Energy Savings at the Generator *      | 0.050               | GWh  | 0.058                   | GWh  | 14.8%               |
| Net Peak Demand Savings at the Generator * | 0.009               | MW   | 0.010                   | MW   | 11.6%               |
| <b>ASFH Total</b>                          |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 4.808               | GWh  | 4.693                   | GWh  | -2.39%              |
| Gross Peak Demand Savings at the Generator | 2.167               | MW   | 2.160                   | MW   | -0.31%              |
| Net Energy Savings at the Generator *      | 4.808               | GWh  | 4.693                   | GWh  | -2.39%              |
| Net Peak Demand Savings at the Generator * | 2.167               | MW   | 2.160                   | MW   | -0.31%              |

\* Net savings are not included as a separate value in the tracking sheet since net savings are equal to gross savings.

The differences between the tracked and corrected energy savings of modelled measures were due to correcting the overestimation ratios, line loss factors, or unitary savings for a few projects as well as the use of a different calculation approach by E1 for a few entries, notably a new calculation approach for non-modeled heat pumps, which the Evaluator recalculated using the same calculation approach as in the 2023 evaluation.

The differences between the tracked and corrected peak demand savings of modelled measures were slightly smaller. These were due to the Evaluator and E1 using slightly different calculation approaches in some instances. In addition, the same issues as for energy savings were also observed. These differences were a mix of upward and downward adjustments that partly cancelled each other.

The differences between the tracked and corrected energy peak demand savings of non-modelled measures were due to the Evaluator using the unitary savings values established as part of the 2023 evaluation while older values were used by E1.

## APPENDIX XII

### ASFH 2024 Recommendations

This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 ASFH evaluation.

| Section           | Recommendations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | Recommendation #1: To assess progress with participant wait times, E1 could track wait times as well as program delivery satisfaction levels (e.g. in quarterly customer satisfaction surveys) throughout 2025 to determine how strategies are performing and make adjustments if necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Executive Summary | <p>Recommendation #2: Provide participants with more information about ASFH to help them understand program options, eligible measures, and participation steps by implementing the following:</p> <ul style="list-style-type: none"> <li>a) Investigate ways to inform participants about eligible measures in ASFH and to ensure that other program options and their differences (i.e. Oil to Heat Pump Affordability [OHPA]) are clearly presented to participants verbally and through marketing materials.</li> <li>b) Review the application template for clarity and adapt it to confirm with participants to which program they are applying (i.e. ASFH, OHPA). Ensure that the information in the application is shared with DAs/contractors.</li> <li>c) Once participants have submitted their application, clearly communicate (perhaps using a visual) the touchpoints that will occur along their journey (e.g. who will be contacting them, at what point, and what to expect).</li> </ul> |
| Executive Summary | Recommendation #3: Reinforce participant awareness of the Energy Solution Advisor's role as E1 program navigator to help participants better understand and navigate E1's programs (including ASFH).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Executive Summary | Recommendation #4: To maximize energy savings, ensure that all participants receive the necessary information to operate and maintain the equipment installed in language that is easy to understand. Implement checklists for DAs and heat pump contractors if necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Executive Summary | Recommendation #5: Ensure that DAs/contractors provide a leave-behind so that participants know who to contact in case of questions or difficulties or to better understand how to operate and maintain their heat pump.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Executive Summary | Recommendation #6: Look for opportunities to streamline record keeping/reporting processes to reduce the administrative burden for DAs and contractors, taking into account program tracking and evaluation needs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Executive Summary | Recommendation #7: Update the DA/contractor training guides on the record keeping/reporting processes and use of the software tools to reflect current practices and offer regular training sessions to provide updates on any changes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## APPENDIX XIII

### EPI Tracking Sheet Audit

This appendix presents the results of the EPI tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by the following:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator. More details are described further below.

**Table 1: 2024 EPI Corrected Tracked Savings**

| Program Component Results                  | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>EPI</b>                                 |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 9.515               | GWh  | 9.516                   | GWh  | 0.02%               |
| Gross Peak Demand Savings at the Generator | 1.752               | MW   | 0.879                   | MW   | -49.81%             |
| Net Energy Savings at the Generator        | 9.495               | GWh  | 9.519                   | GWh  | 0.26%               |
| Net Peak Demand Savings at the Generator   | 1.803               | MW   | 0.872                   | MW   | -51.61%             |

The difference between tracked and corrected gross energy savings is explained by the 20% reduction in the unitary savings value for smart thermostats (for MSHPs and electric baseboards) for multifamily dwellings. This reduction had only been applied to unitary savings values as of August 23, 2024, so the Evaluator adjusted the ones before that date for consistency. As for the difference between tracked and corrected net energy savings, this is mainly due to the correction of net-to-gross (NTGR) values.

For both net and gross peak demand savings, there were certain unitary peak demand savings values, notably for humidity sensors, dimmer switches, and solar security fixtures, which were expressed in W and not kW and were therefore 1,000 times too high. Correcting these incorrect values explains the large reduction between the tracked and corrected peak demand savings.

## APPENDIX XIV

### EPI Participant Survey Questionnaire

## EFFICIENT PRODUCT INSTALLATION

### PARTICIPANT SURVEY

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                                                                                      |
|---------------------------------|------------------------------------------------------------------------------------------------------|
| Instrument Type                 | Participant Survey                                                                                   |
| Estimated Time to Complete      | 15 minutes                                                                                           |
| Target Audience                 | Non-Low-income participants                                                                          |
| Expected Number of Completions  | 100 (40 smart thermostats, 60 DHW measures [30 low-flow showerheads, 15 faucet aerators, 15 others]) |
| Contact List Source             | EfficiencyOne                                                                                        |
| Fielding Firm                   | Narrative Research                                                                                   |
| Estimated Timeline for Fielding | October - November                                                                                   |

Table 2: Research Objectives and Associated Questions

| Research Objectives                         | Section |
|---------------------------------------------|---------|
| Verification                                | A       |
| Awareness and Motivations for Participating | B       |
| Satisfaction                                | C       |
| Barriers                                    | D       |
| Recommendations for Program Improvement     | E       |
| Demographics                                | F       |

To be adapted by Econoler **[Blue text]**

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Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**





## Introduction

Could I speak with [INSERT NAME]?

1. Yes [CONTINUE]
2. No [SAY “PERHAPS YOU CAN HELP ME ANYWAY.” CONTINUE]

Hello, my name is \_\_\_\_\_ and I am with Narrative Research, and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia. Our records indicate that you or your household recently participated in the Efficient Product Installation Service. Are you the person who was most involved with this service?

(IF NEEDED: As part of this service, someone would have come to your house and installed energy-efficient products such as smart thermostats, LED light bulbs and faucet aerators, at no charge, as well as offered advice on ways your house can save energy).

[IF NO, ASK TO SPEAK TO THE APPROPRIATE PERSON]: “May I please speak to the person who knows the most about this service?”]

We would appreciate your help in answering questions related to your participation in this service. The information you provide will be used to help Efficiency Nova Scotia evaluate and improve the service. Is this a good time for you?

(IF NEEDED: You may have recently been contacted by Narrative Research and Efficiency Nova Scotia about your experience with the service. This survey is different as it focuses on other aspects of your participation in the service.)

(IF NEEDED: The survey will take about 12 minutes.)

1. Yes [CONTINUE]
2. No, I don't remember the service / Don't know [PROMPT: “Are you sure? Someone would have come to your house and installed energy-efficient products, at no charge, for you to save energy and money?” RECODE AS “YES” IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO: Is there someone else in the household who would know about having participated in this Efficiency Nova Scotia service? [IF YES: ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
3. No, but they came to my previous home [CONTINUE]
4. No [THANK, TERMINATE, RECORD, AND KEEP DATA]
99. Refused [THANK, TERMINATE, RECORD, AND KEEP DATA]

[IF REFUSED, ASK “Can we schedule a more convenient time for you to conduct this survey?”]

[SCHEDULED, IF NECESSARY, FOR: \_\_\_\_\_]



## A. Verification

- A1. I am going to read you a list of energy-efficient products that, according to our records, were installed in your home by the Efficient Product Installation Service. For each one, can you please confirm that this product was in fact installed through the service? **[READ WHAT IS ON RECORD (MEASURE#0 IN THE DATABASE)]. [NOTE FOR PROGRAMMER: DO NOT PUT THE NUMBER OF EACH MEASURE]**
- a. LED bulbs
  - b. LED nightlights
  - c. Pipe insulation
  - d. Hot water tank wrap
  - e. Low-flow showerheads or showerwands
  - f. Thermostatic shut-off valve for showers [IF NEEDED: This valve shuts off the water once hot water is flowing. You then have to open the valve to begin showering.]
  - g. Foam gaskets for switch and plug insulation
  - h. Door sweeps
  - i. Window air sealing
  - j. Door weather stripping
  - k. Window film kit
  - l. Bathroom and/or kitchen faucet aerators
  - m. Smart thermostat (IF NECESSARY: Smart thermostats can be controlled by a smartphone, tablet or computer)
  - n. Smart power strip/bar
- 1. Yes, installed through the service
  - 2. No, not installed through the service
  - 98.** Don't know
  - 99.** Refused

**[THANK, TERMINATE, RECORD AND KEEP DATA IF RESPONDENT SAYS "NO", "DK" OR "REFUSED" TO ALL QUESTIONS FROM A1]**



## B. Awareness and Motivations for Participating

B1. How did you first learn about the Efficient Product Installation Service? **[ACCEPT ONE RESPONSE] [DO NOT READ]**

1. TV ads
2. Print ads (magazine or newspaper)
3. Radio ads
4. Through a third-party contractor or service provider (other than Efficiency Nova Scotia)
5. Email
6. Efficiency Nova Scotia website
7. Social media (Facebook, Twitter, Instagram, Google Ads)
8. Online advertisement on smart phone, computer or tablet
9. Word of mouth
10. Through another Efficiency Nova Scotia program
11. Efficiency Nova Scotia Efficiency Insights Report
96. Other [SPECIFY \_\_\_\_\_]
- 98. Don't know**

B2. What was the SINGLE most important reason you were interested in participating in the Efficient Product Installation Service? **[ACCEPT ONE RESPONSE] [DO NOT READ]**

1. To save on energy/to save on energy costs
2. For better comfort
3. To help protect the environment
4. No cost for services/service was free of charge
5. To reduce my water consumption
6. Wanted energy-efficient upgrades
96. Other [SPECIFY \_\_\_\_\_]
- 98. Don't know [GO TO B4]**
- 99. Refused [GO TO B4]**

- B3. Were there any other reasons? **[DO NOT READ. ACCEPT MULTIPLE KEEPING CODE 97, 98 AND 99 EXCLUSIVES; DO NOT SHOW RESPONSE FROM B2]**
1. To save on energy/to save on energy costs
  2. For better comfort
  3. To help protect the environment
  4. No cost for services/service was free of charge
  5. To reduce my water consumption
  6. Wanted energy-efficient upgrades
  96. Other [SPECIFY \_\_\_\_\_]
  97. None/no other reasons
  - 98.** Don't know
  - 99.** Refused
- B4. Were you present when these energy-efficient products were installed? **[DO NOT READ, CODE ONE ONLY]**
1. Yes
  2. No
  - 98.** Don't know
  - 99.** Refused
- B5. **[ASK IF B4 = YES]** Did you receive information about these energy-efficient products during the visit from the installer? **[DO NOT READ, CODE ONE ONLY]**
1. Yes, received some information
  2. No, did not receive any information
  - 98.** Don't recall
- B6. **[ASK IF NO OR DON'T RECALL IN B5]** Would you have liked to receive information about energy-efficient products from the installer? **[DO NOT READ, CODE ONE ONLY]**
1. Yes
  2. No
  - 98.** Don't know
  - 99.** Refused



## C. Satisfaction

- C1. Using a scale from 1 to 10 where 1 is “not at all satisfied” and 10 is “completely satisfied,” how satisfied are you with the Efficient Product Installation Service overall? **[DO NOT ACCEPT A RANGE]**

1-10 SCALE WITH END POINT LABELS– RECORD NUMBER

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

- C2. **[ASK IF C1 < 8, DO NOT ASK IF DK OR REFUSED IN C1]** What was the most important reason you were not more satisfied with the service overall? **[DO NOT READ. PROBE FOR SPECIFIC REASON. ACCEPT MULTIPLE RESPONSE KEEPING CODE 98 AND 99 EXCLUSIVE]**

1. I expected more
2. Did not like the products installed
3. I did not like the installer who came to my home
4. I did not notice any savings on my energy bill
5. The process was complicated

96. Other - Specify: \_\_\_\_\_

**98.** Don't know

**99.** Refused

- C3. **[IF C1 ≥ 8]** What was the most important reason you were satisfied with the service overall? **[PROBE FOR SPECIFIC REASON. DO NOT READ – ACCEPT MULTIPLE RESPONSE KEEPING CODE 98 AND 99 EXCLUSIVE]**

1. Lowered energy bill
2. Good service
3. Saves energy
4. Better lights/lighting
5. Informative/Information received
6. I like the installer who visited the home
7. Service was free
8. Everything went smooth
9. Reasonable time frame
10. Products/services offered through service
96. Other: Please specify: \_\_\_\_\_
- 98.** Don't know
- 99.** Refused

C4. Using a scale from 1 to 4, where 1 is “not at all satisfied” and 4 is “completely satisfied,” how satisfied are you with each of the following aspects of the Efficient Product Installation Service. **[DO NOT RANDOMIZE; DO NOT ACCEPT A RANGE; REPEAT SCALE AS NEEDED ONLY]**

- a. **[ASK IF YES IN B4]** The time required to complete work
- b. The energy-efficient products installed
- c. The quality of the work completed
- d. **[ASK IF YES IN B5]** The information you received about energy-efficient products

1-10 SCALE WITH END POINT LABELS– RECORD NUMBER

**[VOLUNTEERED]**

- 97. Not applicable
- 98. Don’t know
- 99. Refused

## **D. Barriers**

D1. When you initially thought about participating in the Efficient Product Installation Service, what were your concerns, if any?

RECORD VERBATIM: \_\_\_\_\_

**[VOLUNTEERED]**

- 97. No concerns
- 98. Don’t know
- 99. Refused

## **E. Free-Ridership**

**@INSTRUCTION: FREE-RIDERSHIP SERIES SHOULD BE ASKED ONLY TO RESPONDENTS WHO INDICATED:**

**“YES” IN A1A (LED BULBS) – ASK FR LED BULBS SECTION**

**AND/OR**

**“YES” IN A1M (SMART THERMOSTAT) – ASK FR SMART THERMOSTAT SECTION**

**AND/OR**

**“NO” IN A196.99.M (SMART THERMOSTAT) AND “YES” IN EITHER A196.99.C (PIPE INSULATION), A196.99.D (HOT WATER TANK WRAP), A196.99.E (LOW FLOW SHOWERHEADS), A196.99.F (THERMOSTATIC SHUT-OFF VALVE), OR A196.99.L (FAUCET AERATORS) – ASK FR DHW MEASURES SECTION**

**OTHERWISE SKIP TO G SECTION**



## FR - LED BULBS [ASK IF YES IN A1A]

The next questions will be about the LED bulbs that were installed through the service, excluding night lights.

E1. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install LED bulbs in your home? [CODE ONE ONLY]

1. Yes
2. No

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E2. **[IF E1=YES]** Just to confirm: Have I understood correctly that you had already made the decision to purchase and install LED bulbs in your home before you learned about the Efficient Product Installation Service?

1. Yes, correct (already made decision)
2. No, incorrect (not already made decision)

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E3. Without the Efficient Product Installation Service, what is the likelihood you would have paid for the LED bulbs, knowing that the cost is about \$2 to \$4 per bulb?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

**[ASK E4, E5, E6 SEQUENCE IN ORDER/DO NOT RANDOMIZE; REPEAT SCALE IF NECESSARY]**

E4. Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them in your home?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E5. **[IF CODES 1,2,3,4 AT E4]** Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your bulbs with LEDs by at least one year?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E6. **[ASK IF LED BULBS QUANTITY>1 AND CODES 1,2,3,4 AT E4]** Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred? You would have purchased...

1. ...exactly the same number of LED bulbs
2. ...fewer LED bulbs
3. You would not have purchased or installed LED bulbs

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

**[IF ONLY LED BULBS A1A=YES, GO TO E19. OTHERWISE GO TO E7]**

**FR – SMART THERMOSTAT [ASK IF YES IN A196.99.M]**

The next questions will be about the smart thermostat you had installed through the service.

E7. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install smart thermostats in your home? **[CODE ONE ONLY]**

1. Yes
2. No

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E8. **[IF E7=YES]** Just to confirm: Have I understood correctly that you had already made the decision to purchase and install smart thermostats in your home before you learned about the Efficient Product Installation Service?

1. Yes, correct (already made decision)
2. No, incorrect (not already made decision)

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused



E9. Without the Efficient Product Installation Service, what is the likelihood you would have paid for the smart thermostat, knowing that the cost is about \$140 per thermostat?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

**[ASK E10, E11, E12 SEQUENCE IN ORDER/DO NOT RANDOMIZE]**

E10. Without the Efficient Product Installation Service, how likely would have been to take the initiative to purchase smart thermostats at a store and install them in your home?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E11. **[IF CODES 1,2,3,4 AT E10]** Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your old thermostats with smart thermostats by at least one year?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused



E12. **[ASK IF SMART THERMOSTAT QUANTITY>1 AND IF CODES 1,2,3,4 AT E10]** Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred? You would have purchased and installed...

1. ...exactly the same number of smart thermostats
2. ...fewer smart thermostats
3. You would not have purchased or installed any smart thermostats

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

**FR – DOMESTIC HOT WATER MEASURES [ASK IF NO IN A1M AND IF YES IN A196.99.C, A196.99.D, A196.99.E, A196.99.F, OR A196.99.L, OTHERWISE GO TO E19]**

The next questions will be about the **<DHW MEASURE>** that you had installed through the service.

E13. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install **<DHW MEASURE>** in your home?

1. Yes
2. No

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E14. **[IF E13=YES]** Just to confirm: Have I understood correctly that you had already made the decision to purchase and install **<DHW MEASURE>** in your home before you learned about the Efficient Product Installation Service?

1. Yes, correct (already made decision)
2. No, incorrect (not already made decision)

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E15. Without the Efficient Product Installation Service, what is the likelihood you would have paid for the **<DHW MEASURE>** knowing that the cost is about...

A1C. Pipe insulation: \$2 per foot

A1D. Hot water tank wrap: \$50

A1E. Low-flow showerheads or showerwands: \$50

A1F. Thermostatic shut-off valve for showers: \$50

A1L. Bathroom and/or kitchen faucet aerators: \$8-\$10

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

**[ASK E16, E17, E18 SEQUENCE IN ORDER/DO NOT RANDOMIZE]**

E16. Without the efficient product installation service, how likely would you have been to take the initiative to purchase **<DHW MEASURE>** at a store and install them in your home?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E17. **[IF CODES 1,2,3,4 AT E16]** Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your **<DHW MEASURE>** by at least one year?

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

E18. [ASK IF <DHW MEASURE> QUANTITY>1 AND IF CODES 1,2,3,4 AT E16] Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred? You would have purchased and installed...

1. ...exactly the same number of <DHW MEASURE>
2. ...fewer <DHW MEASURE>
3. You would not have purchased or installed any <DHW MEASURE>

[VOLUNTEERED]

98. Don't know

99. Refused

[ASK E19 ONCE AT THE END OF SECTION E FOR EVERYONE, WHATEVER THEIR MEASURE, NOT FOR EACH PRODUCT]

E19. How influential were the following two factors in your decision to have energy-efficient products installed in your home? [RANDOMIZE]

| Factor (READ AND RANDOMIZE)                                                       | Responses                                                                                                                         |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| a. The free installation of energy-efficient products offered through the service | 1 Very influential<br>2 Somewhat influential<br>3 Not very influential<br>4 Not at all influential<br>98 Don't Know<br>99 Refused |
| b. The information or advice provided by the service staff                        | 1 Very influential<br>2 Somewhat influential<br>3 Not very influential<br>4 Not at all influential<br>98 Don't Know<br>99 Refused |

## F. Cross-Influence

INSTRUCTION: CROSS-INFLUENCE SERIES SHOULD BE ASKED ONLY TO RESPONDENTS WHO INDICATED

“YES” IN A1A (LED BULBS) AND/OR “YES” IN A196.99.M (SMART THERMOSTAT) AND/OR “YES” IN EITHER A196.99.C (PIPE INSULATION), A196.99.D (HOT WATER TANK WRAP), A196.99.E (LOW FLOW SHOWERHEADS), A196.99.F (THERMOSTATIC SHUT-OFF VALVE), OR A196.99.L (FAUCET AERATORS)

OTHERWISE SKIP TO G SERIES.

READ AND ROTATE (F1 + F2 - F4) AND (F5 + F6 - F8) SEQUENCES

F1. Before participating in the efficient product installation service in <MONTH/YEAR>, had you at any time in the past participated in any efficiency nova scotia program or service?

1. Yes
2. No

**[VOLUNTEERED]**

- 98.** Don't know  
**99.** Refused

For the following three statements, please indicate whether you agree or disagree.

F2. **[IF F1=1]** Do you agree or disagree that your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home?

1. Agree
2. Disagree

**[VOLUNTEERED]**

- 98.** Don't know  
**99.** Refused

F3. **[IF F1=1]** Do you agree or disagree that because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating in the service, you requested the installation of energy-efficient products at no cost in your home?

1. Agree
2. Disagree

**[VOLUNTEERED]**

- 98.** Don't know  
**99.** Refused

F4. **[IF F1=1]** Do you agree or disagree that because of your previous participation in another Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home?

1. Agree
2. Disagree

**[VOLUNTEERED]**

- 98.** Don't know  
**99.** Refused

F5. Before participating in the Efficient Product Installation Service in <MONTH/YEAR>, had you at any time in the past seen Efficiency Nova Scotia advertisements or information discussing the benefits of energy efficiency?

1. Yes
2. No

**[VOLUNTEERED]**

- 98.** Don't know
- 99.** Refused

For the following three statements, please indicate whether you agree or disagree.

F6. **[IF F5=1]** Do you agree or disagree that the promotion of energy efficiency by Efficiency Nova Scotia was a major factor in your decision to have energy-efficient products installed in your home?

1. Agree
2. Disagree

**[VOLUNTEERED]**

- 98.** Don't know
- 99.** Refused

F7. **[IF F5=1]** Do you agree or disagree that the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home?

1. Agree
2. Disagree

**[VOLUNTEERED]**

- 98.** Don't know
- 99.** Refused

F8. **[IF F5=1]** Do you agree or disagree that you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia?

1. Agree
2. Disagree

**[VOLUNTEERED]**

- 98.** Don't know
- 99.** Refused

## G. Spillover

G1. **[ASK ALL]** Since participating in the Efficient Product Installation Service, have you installed any additional energy-efficient products in your home?

1. Yes
2. No **[GO TO G5]**

**[VOLUNTEERED]**

**98.** Don't know/Don't recall **[GO TO G5]**

**99.** Refused **[GO TO G5]**

G2. **[IF G1=YES]** What energy-efficient products have you installed in your home since participating in the Efficient Product Installation Service? **[DO NOT READ, ALLOW MULTIPLE KEEPING CODE 97 AND 98 EXCLUSIVE]** Probe: Any others?

1. LED bulbs
2. LED fixtures
3. Low flow showerheads
4. Smart power strip/smart power bar
5. ENERGY STAR refrigerator
6. ENERGY STAR clothes washer
7. NEST or smart thermostats
8. Programmable thermostats
9. Dehumidifiers
10. Air purifiers
11. Clothesline
12. Variable speed pool pumps
13. Heat pump water heaters
14. Faucet aerators
15. Pipe insulation
16. Tank wrap
17. Thermostatic shut-off valves
18. Door sweeps
19. Window air sealing kits
20. Door weather stripping kits
96. Other: Please specify: \_\_\_\_\_
- 97.** None **[GO TO G5]**
- 98.** Don't know **[GO TO G5]**

G3. **[IF ANY OF CODE 1-20 AND/OR 96 IN G2; ASK FOR EACH RESPONSE IN G2]** How many **[INSERT ANSWER FROM G2]** **[FOR STATEMENT L (CODE 15 IN G2):** feet of pipe insulation] did you purchase and install?

- a. LED bulbs
- b. LED fixtures
- c. Low flow showerheads
- d. Smart power strip/smart power bar
- e. NEST or smart thermostats
- f. Programmable thermostats
- g. Dehumidifiers
- h. Air purifiers
- i. Clothesline
- j. Faucet aerators
- k. Pipe insulation
- l. Thermostatic shut-off valves
- m. Door sweeps
- n. Window air sealing kits
- o. Door weather stripping kits
- p. Other

RECORD NUMBER IN QUANTITY OR NUMBER OF FEET OF PIPE INSULATION

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused

G4. **[IF ANY OF G3A-H > 0; SHOW ONLY PRODUCTS FROM G3 IF > 0]** Did you receive an instant rebate at the cashier for the **[INSERT PRODUCT FROM G2 IF G2 > 0]** you purchased?

- 1. Yes
- 2. No

**[VOLUNTEERED]**

**98.** Don't know

**99.** Refused



G5. **[ASK IF ANY OF G3A-O > 0]** How influential was your experience with the Efficient Product Installation Service in your decision to install these additional energy-efficient products?

1. Extremely influential
2. Influential
3. Not very influential
4. Not at all influential

**[VOLUNTEERED]**

98. Don't know
99. Refused

## H. Recommendations for Program Improvements

H1. Do you have any recommendations to help improve the Efficient Product Installation Service?  
**PROBE:** Anything else? **[DO NOT READ, RECORD VERBATIM]**

RECORD VERBATIM: \_\_\_\_\_

97. None
98. Don't know
99. Refused

## I. Demographics

**[ASK ALL]** These final questions are asked for statistical purposes only. The information collected is strictly confidential.

I1. What type of residence do you live in? **[READ RESPONSES 1-7, THEN 8; SELECT ONE RESPONSE]**

1. Apartment building that has fewer than five stories
2. Apartment building that has five or more stories
3. Row house (Single story apartment building)
4. Detached single-family home
5. Semi-detached house
6. Mobile home or house trailer
7. Townhouse or duplex with shared adjacent walls
8. Or some other type **[SPECIFY: \_\_\_\_\_]**

**[VOLUNTEERED]**

98. Don't know
99. Refused

12. How many bedrooms are in your home? **[RECORD NUMBER, DO NOT ACCEPT RANGE; ENTER ZERO FOR A STUDIO APARTMENT WITH NO BEDROOMS]**

RECORD NUMBER: \_\_\_\_

**98.** Don't know

13. Do you own or rent this home? **[DO NOT READ; CODE ONE ONLY]**

1. Own/buying

2. Rent/lease

96. Other [SPECIFY \_\_\_\_\_]

**99.** Refused

14. Do you pay the electric bills for your home, either on your own or shared with someone else? **[DO NOT READ; CODE ONE ONLY]**

1. Yes, on your own or shared with someone else

2. No

96. Other [SPECIFY \_\_\_\_\_]

**98.** Don't know

**99.** Refused

15. Including yourself, how many people live in this residence on a full-time basis?

Number of people: \_\_\_\_ **[DO NOT ALLOW ZERO FOR A RESPONSE]**

**[VOLUNTEERED]**

**97.** Nobody lives in the house on a full-time basis

**99.** Refused

16. Please stop me when I reach your age group. Are you ....: **[READ; STOP WHEN ANSWER IS VOLUNTEERED]**

1. 18 to 24

2. 25 to 34

3. 35 to 44

4. 45 to 54

5. 55 to 64

6. 65 or over

**[VOLUNTEERED]**

**99.** Refused

17. What is the highest level of education you have completed? **[READ IF NECESSARY]**

1. Less than high school graduation diploma
2. High school graduation diploma and/or some post secondary
3. Trades certificate or diploma
4. College certificate or diploma
5. University degree, certificate or diploma

**[VOLUNTEERED]**

**99.** Refused

18. What is your gender?

1. Male
2. Female
3. Non-binary
4. Another gender (Please specify this gender if you are comfortable doing so: \_\_\_\_\_)
5. Prefer not to say

Those are all the questions I have for you. Thank you for your time and assistance and have a nice day.

## APPENDIX XV

### EPI Participant Survey Results

The participant survey results are presented in the following tables.

B1. How did you first learn about the Efficient Product Installation Service?

| First Learned About EPI Service                                                                                                                           | 2021       | 2024       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|
| <b>Sample Size</b>                                                                                                                                        | <b>100</b> | <b>100</b> |
| Word-of-mouth                                                                                                                                             | 32%        | 22%        |
| Online advertisement on smart phone, computer or tablet                                                                                                   | 8%         | 16%        |
| 2021: Social media (e.g., Facebook, Twitter, Instagram, Snapchat, TikTok, Youtube, etc.)<br>2024: Social media (Facebook, Twitter, Instagram, Google Ads) | 13%        | 9%         |
| Brochure/flyer in the mail                                                                                                                                | 11%        | 8%         |
| Through another Efficiency Nova Scotia program                                                                                                            | -          | 8%         |
| Efficiency Nova Scotia website                                                                                                                            | 4%         | 6%         |
| Through a third-party contractor or service provider (other than Efficiency Nova Scotia)                                                                  | 7%         | 5%         |
| Print ads (magazine or newspaper)                                                                                                                         | 4%         | 4%         |
| TV ads                                                                                                                                                    | 4%         | 4%         |
| Email                                                                                                                                                     | 3%         | 3%         |
| Home Show                                                                                                                                                 | -          | 3%         |
| Efficiency Nova Scotia Efficiency Insights Report                                                                                                         | -          | 1%         |
| Radio ads                                                                                                                                                 | -          | 1%         |
| Internet/Google search                                                                                                                                    | 6%         | -          |
| Others                                                                                                                                                    | 7%         | 6%         |
| Don't know                                                                                                                                                | 1%         | 4%         |

B2. What was the SINGLE most important reason you were interested in participating in the Efficient Product Installation Service? \*<sup>1</sup>

<sup>1</sup> The table below B3 summarizes participant responses for both B2 and B3.

B3. Were there any other reasons?

| Reasons for Participating                                                                   | 2018                      |                                | 2021                      |                                | 2024                      |                                |
|---------------------------------------------------------------------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|---------------------------|--------------------------------|
|                                                                                             | Most Important Motivation | Other Important Motivations ** | Most Important Motivation | Other Important Motivations ** | Most Important Motivation | Other Important Motivations ** |
| <b>Sample Size</b>                                                                          | <b>100</b>                | <b>100</b>                     | <b>100</b>                | <b>100</b>                     | <b>100</b>                | <b>99</b>                      |
| To save on energy/energy costs                                                              | 77%                       | 16%                            | 61%                       | 18%                            | 61%                       | 7%                             |
| Wanted energy efficient upgrades                                                            | 4%                        | 11%                            | 16%                       | 13%                            | 26%                       | 13%                            |
| No cost for services/service was free of charge                                             | 2%                        | 10%                            | 3%                        | 5%                             | 5%                        | 4%                             |
| For better comfort                                                                          | -                         | -                              | 2%                        | 3%                             | 3%                        | 4%                             |
| To help protect the environment                                                             | 3%                        | 10%                            | 5%                        | 15%                            | 1%                        | 10%                            |
| To get my home more energy efficient                                                        | -                         | -                              | 4%                        | 6%                             | -                         | -                              |
| To receive LED bulbs                                                                        | 13%                       | 4%                             | 3%                        | 1%                             | -                         | -                              |
| To reduce my water consumption                                                              | -                         | 1%                             | -                         | 1%                             | -                         | -                              |
| Others                                                                                      | 2%                        | 1%                             | 6%                        | 2%                             | 3%                        | 1%                             |
| None/no other reasons                                                                       | -                         | 55%                            | -                         | 46%                            | -                         | 62%                            |
| Don't know                                                                                  | -                         | -                              | -                         | 1%                             | 1%                        | 2%                             |
| *Wording change in 2021                                                                     |                           |                                |                           |                                |                           |                                |
| **Multiple Responses; B3 was not asked of those who responded 'Don't Know' or Refused in B2 |                           |                                |                           |                                |                           |                                |

B4. Were you present when these energy efficient products were installed? \*

| Was Present During Installation | 2018       | 2021       | 2024       |
|---------------------------------|------------|------------|------------|
| <b>Sample Size</b>              | <b>100</b> | <b>100</b> | <b>100</b> |
| Yes                             | 92%        | 91%        | 95%        |
| No                              | 8%         | 8%         | 4%         |
| Refused                         | -          | 1%         | 1%         |
| *Wording change in 2021         |            |            |            |

B5. Did you receive information about these energy-efficient products during the visit from the installer? \*

| Received Information from Installer                             | 2018      | 2021      | 2024      |
|-----------------------------------------------------------------|-----------|-----------|-----------|
| <b>Sample Size</b>                                              | <b>92</b> | <b>91</b> | <b>95</b> |
| Yes, received some information                                  | 62%       | 84%       | 88%       |
| No, did not receive any information                             | 17%       | 14%       | 11%       |
| Don't recall                                                    | 21%       | 2%        | 1%        |
| Base: Respondents who were home/present during the installation |           |           |           |
| *Wording change in 2021                                         |           |           |           |

B6. Would you have liked to receive information about energy efficient products from the installer? \*

| Interested in Receiving Information                                                           | 2018      | 2021<br>(#) | 2024<br>(#) |
|-----------------------------------------------------------------------------------------------|-----------|-------------|-------------|
| <b>Sample Size</b>                                                                            | <b>34</b> | <b>15</b>   | <b>11</b>   |
| Yes                                                                                           | 68%       | 7           | 5           |
| No                                                                                            | 28%       | 6           | 6           |
| Don't know                                                                                    | 4%        | 2           | -           |
| Base: Respondents who did not receive information during the visit<br>*Wording change in 2021 |           |             |             |

C1. Using a scale from 1 to 10 where 1 is 'not at all satisfied' and 10 is 'completely satisfied', how satisfied are you with the Efficient Product Installation Service overall? \*

| Satisfaction with EPI Overall                                            | 2018      | 2021      | 2024       |
|--------------------------------------------------------------------------|-----------|-----------|------------|
| <b>Sample Size</b>                                                       | <b>99</b> | <b>99</b> | <b>100</b> |
| Mean                                                                     | 9.3       | 8.7       | 9.4        |
| Don't know/Refused excluded from calculations<br>*Wording change in 2021 |           |           |            |

C2. What was the most important reason you were not more satisfied with the service overall?

| Key Reasons Not More Satisfied with EPI Overall                                                                           | 2018<br>(#) | 2021<br>(#) | 2024<br>(#) |
|---------------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|
| <b>Sample Size</b>                                                                                                        | <b>5</b>    | <b>19</b>   | <b>5</b>    |
| I expected more                                                                                                           | 3           | 13          | 3           |
| I don't like the light bulbs I received/I did not like the products installed                                             | 2           | -           | 3           |
| I did not like the installer who visited the home                                                                         | -           | 1           | 1           |
| I did not receive any information                                                                                         | -           | 2           | -           |
| Unsure if program is worthwhile/Waste of taxpayers' money                                                                 | -           | 2           | -           |
| Installation process was too short/quick                                                                                  | -           | 2           | -           |
| Product was not set properly                                                                                              | -           | 1           | -           |
| Others                                                                                                                    | -           | 1           | -           |
| Don't know                                                                                                                | -           | -           | 1           |
| Base: Respondents who were not satisfied with the service (as indicated by a rating of less than 8)<br>Multiple Responses |             |             |             |

C3. What was the most important reason you were satisfied with the service overall?

| Key Reasons Satisfied with EPI Overall                                                          | 2018      | 2021      | 2024      |
|-------------------------------------------------------------------------------------------------|-----------|-----------|-----------|
| <b>Sample Size</b>                                                                              | <b>94</b> | <b>80</b> | <b>95</b> |
| I like the installer who visited the home                                                       | 38%       | 26%       | 41%       |
| Informative/Information received                                                                | 19%       | 26%       | 25%       |
| Good service                                                                                    | 24%       | 24%       | 19%       |
| Everything went smooth                                                                          | 14%       | 13%       | 15%       |
| Products/services offered through service                                                       | 12%       | 13%       | 15%       |
| Reasonable time frame                                                                           | 24%       | 18%       | 11%       |
| Lowered energy bill                                                                             | 6%        | 8%        | 7%        |
| Service was free                                                                                | 5%        | 5%        | 5%        |
| Better lights/lighting                                                                          | 4%        | 5%        | 5%        |
| Improved the house/house is warmer/more comfortable                                             | -         | 1%        | 4%        |
| Saves energy/Improved energy efficiency                                                         | 8%        | 4%        | 3%        |
| Service met my expectations                                                                     | 1%        | 4%        | -         |
| Better for the environment                                                                      | -         | 1%        | -         |
| Others                                                                                          | 4%        | 8%        | 2%        |
| Don't know/Refused                                                                              | 4%        | -         | 5%        |
| Base: Respondents who were satisfied with the service (as indicated by a rating of '8 or more') |           |           |           |
| Multiple responses                                                                              |           |           |           |

Significantly more participants listed *liking the installer who visited their home* as one of the key reasons they were satisfied with the EPI service overall this year, compared to in 2021 (41% and 26%, respectively).

C4. Using a scale from 1 to 10, where 1 is “not at all satisfied” and 10 is “completely satisfied,” how satisfied are you with each of the following aspects of the Efficient Product Installation Service? \*

| Satisfaction with Aspects of EPI                                                                                  | 2018        |      | 2021        |      | 2024        |      |
|-------------------------------------------------------------------------------------------------------------------|-------------|------|-------------|------|-------------|------|
|                                                                                                                   | Sample Size | Mean | Sample Size | Mean | Sample Size | Mean |
| The time required to complete work**                                                                              | 92          | 9.5  | 91          | 9.4  | 93          | 9.3  |
| The quality of the work completed                                                                                 | 100         | 9.5  | 100         | 9.3  | 98          | 9.3  |
| The information you received about energy-efficient products***                                                   | 62          | 9.3  | 76          | 8.9  | 85          | 9.2  |
| The energy-efficient products installed                                                                           | 99          | 8.9  | 99          | 9.0  | 99          | 9.0  |
| Not applicable, Don't know/Don't recall and Refused excluded from calculations                                    |             |      |             |      |             |      |
| *Wording change in 2021                                                                                           |             |      |             |      |             |      |
| **Base: Respondents who were home/present during the installation                                                 |             |      |             |      |             |      |
| ***Base: Respondents who received information during the visit from the installer about energy efficient products |             |      |             |      |             |      |

D1. When you initially thought about participating in the Efficiency product Installation Service, what were your concerns, if any? \*

| Concerns about the Service                                            | 2018       | 2021       | 2024       |
|-----------------------------------------------------------------------|------------|------------|------------|
| <b>Sample Size</b>                                                    | <b>100</b> | <b>100</b> | <b>100</b> |
| Would save money                                                      | -          | 9%         | 8%         |
| Would save energy/be more efficient                                   | -          | -          | 8%         |
| Would qualify/meet the requirements for the program                   | -          | 2%         | 4%         |
| Not sure what to expect from program overall                          | -          | -          | 2%         |
| Additional costs or upselling of products                             | -          | -          | 2%         |
| Having people/someone come into my house                              | -          | -          | 2%         |
| Ability to monitor/manage energy usage                                | -          | -          | 2%         |
| Scheduling availability/Time it would take to get through the program | -          | -          | 2%         |
| Products wouldn't be efficient                                        | -          | 5%         | -          |
| Wouldn't assess my house for drafts                                   | -          | 5%         | -          |
| Length of time it takes                                               | -          | 4%         | -          |
| The service wouldn't be good                                          | -          | 3%         | -          |
| If it was free/who would pay for it                                   | 2%         | 2%         | -          |
| Scheduling issues/Had to be done during weekdays                      | -          | 2%         | -          |
| Wouldn't like the products installed                                  | 3%         | 1%         | -          |
| Others                                                                | -          | 7%         | 7%         |
| No concerns                                                           | 96%        | 61%        | 65%        |
| Don't know                                                            | -          | -          | 1%         |
| *Wording change in 2021                                               |            |            |            |

E1. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install LED bulbs in your home? \*

| Already Decided to Purchase and Install LED Bulbs Installed Through EPI Before Learning About This Service | 2021      | 2024      |
|------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                         | <b>92</b> | <b>70</b> |
| Yes                                                                                                        | 66%       | 70%       |
| No                                                                                                         | 32%       | 29%       |
| Don't know                                                                                                 | 2%        | 1%        |
| Base: Respondents who had LED bulbs installed through EPI                                                  |           |           |
| *Wording change in 2024                                                                                    |           |           |



- E2. Just to confirm: Have I understood correctly that you had already made the decision to purchase and install LED bulbs in your home before you learned about the Efficient Product Installation Service? \*

| To Confirm: Already Decided to Purchase and Install LED Bulbs Before Learning About EPI                                                                                | 2021 | 2024 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|
| Sample Size                                                                                                                                                            | 61   | 49   |
| Yes                                                                                                                                                                    | 97%  | 86%  |
| No                                                                                                                                                                     | 3%   | 14%  |
| Base: Respondents who had LED bulbs installed through EPI and had decided to purchase and install LED bulbs through EPI before learning about this service (yes in E1) |      |      |
| *Wording change in 2024                                                                                                                                                |      |      |

- E1/E2 Combined. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install LED bulbs in your home? \* Just to confirm: Have I understood correctly that you had already made the decision to purchase and install LED bulbs in your home before you learned about the Efficient Product Installation Service? \*

| Already Decided to Purchase and Install LED Bulbs Before Learning About EPI | 2021 | 2024 |
|-----------------------------------------------------------------------------|------|------|
| Sample Size                                                                 | 92   | 70   |
| Yes                                                                         | 64%  | 60%  |
| No                                                                          | 34%  | 39%  |
| Don't know                                                                  | 2%   | 1%   |
| Base: Respondents who had LED bulbs installed through EPI                   |      |      |
| *Wording change in 2024                                                     |      |      |

- E3. Without the Efficient Product Installation Service, what is the likelihood you would have paid for the LED bulbs, knowing that the cost is about \$2 to \$4 per bulb? \*

| If No EPI, Likelihood of Purchasing LED Bulbs at \$2 to \$4 per Bulb * | 2024 |
|------------------------------------------------------------------------|------|
| Sample Size                                                            | 69   |
| Definitely/Probably would                                              | 80%  |
| Probably/Definitely would not                                          | 20%  |
| Base: Respondents who had LED bulbs installed through EPI              |      |
| Don't know and Refused excluded from calculations                      |      |
| *Wording and scale change in 2024                                      |      |

- E4. Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them yourself in your home? \*

| If No EPI, Likelihood of Taking Initiative to Purchase LED Bulbs and Self-Install in Home                                                            |  | 2024 |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--|------|
| Sample Size                                                                                                                                          |  | 69   |
| Definitely/Probably would                                                                                                                            |  | 81%  |
| Probably/Definitely would not                                                                                                                        |  | 19%  |
| Base: Respondents who had LED bulbs installed through EPI<br>Don't know and Refused excluded from calculations<br>* Wording and scale change in 2024 |  |      |

- E5. Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your bulbs with LEDs by at least one year? \*

| If No EPI, Likelihood of Postponing Replacement of Bulbs With LEDs by at Least One Year                                                                                                                                                                                                  |  | 2024 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------|
| Sample Size                                                                                                                                                                                                                                                                              |  | 68   |
| Definitely/Probably would                                                                                                                                                                                                                                                                |  | 74%  |
| Probably/Definitely would not                                                                                                                                                                                                                                                            |  | 26%  |
| Base: Respondents who had LED bulbs installed through EPI, and if no EPI service, likelihood of taking initiative to purchase LED bulbs and self-install in home is not don't know or refused<br>Don't know and Refused excluded from calculations<br>* Wording and scale change in 2024 |  |      |

- E6. Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred? You would have purchased...

| If No EPI, Likelihood of Purchasing and Installing Same or Less Quantity of LED Bulbs Installed Through EPI                                                                                    |  | 2024 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------|
| Sample Size                                                                                                                                                                                    |  | 66   |
| ...exactly the same number of LED bulbs                                                                                                                                                        |  | 42%  |
| ...fewer LED bulbs                                                                                                                                                                             |  | 39%  |
| Would not have purchased or installed LED bulbs                                                                                                                                                |  | 17%  |
| Don't know                                                                                                                                                                                     |  | 2%   |
| Base: Respondents who had >1 LED bulb installed through EPI and if no EPI service, likelihood of taking initiative to purchase LED bulbs and self-install in home is not don't know or refused |  |      |

- E7. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install smart thermostats in your home?

| Already Decided to Purchase and Install Smart Thermostats Installed Through EPI Before Learning About This Service |  | 2024 |
|--------------------------------------------------------------------------------------------------------------------|--|------|
| Sample Size                                                                                                        |  | 31   |
| Yes                                                                                                                |  | 16%  |
| No                                                                                                                 |  | 84%  |
| Base: Respondents who had smart thermostats installed through EPI                                                  |  |      |

- E8. Just to confirm: Have I understood correctly that you had already made the decision to purchase and install smart thermostats in your home before you learned about the Efficient Product Installation Service?

| To Confirm: Already Decided to Purchase and Install Smart Thermostats Before Learning About EPI                                                                            | 2024 (#) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| <b>Sample Size</b>                                                                                                                                                         | <b>5</b> |
| Yes                                                                                                                                                                        | 1        |
| No                                                                                                                                                                         | 4        |
| Base: Respondents who had smart thermostats installed through EPI and had decided to purchase and install smart thermostats through EPI before learning about this service |          |

- E7/E8. Combined. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install smart thermostats in your home? Just to confirm: Have I understood correctly that you had already made the decision to purchase and install smart thermostats in your home before you learned about the Efficient Product Installation Service?

| Already Decided to Purchase and Install Smart Thermostats Installed Through EPI Before Learning About This Service | 2024      |
|--------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Sample Size</b>                                                                                                 | <b>31</b> |
| Yes                                                                                                                | 3%        |
| No                                                                                                                 | 97%       |
| Base: Respondents who had smart thermostats installed through EPI                                                  |           |

- E9. Without the Efficient Product Installation Service, what is the likelihood you would have paid for the smart thermostat, knowing that the cost is about \$140 per thermostat?

| If No EPI, Likelihood of Paying for the Smart Thermostat Knowing the Cost Is About \$140 Per Thermostat                | 2024      |
|------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Sample Size</b>                                                                                                     | <b>31</b> |
| Definitely/Probably would                                                                                              | 19%       |
| Probably/Definitely would not                                                                                          | 81%       |
| Base: Respondents who had smart thermostats installed through EPI<br>Don't know and Refused excluded from calculations |           |

- E10. Without the Efficient Product Installation Service, how likely would have been to take the initiative to purchase smart thermostats at a store and install them in your home?

| If No EPI, Likelihood of Taking Initiative to Purchase and Install Smart Thermostats in Home                           | 2024      |
|------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>Sample Size</b>                                                                                                     | <b>30</b> |
| Definitely/Probably would                                                                                              | 23%       |
| Probably/Definitely would not                                                                                          | 77%       |
| Base: Respondents who had smart thermostats installed through EPI<br>Don't know and Refused excluded from calculations |           |

E11. Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your old thermostats with smart thermostats by at least one year?

| If No EPI, Likelihood of Postponing Replacement of Old Thermostats With Smart Thermostats by at Least One Year                                                                                                |  | 2024 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------|
| Sample Size                                                                                                                                                                                                   |  | 30   |
| Definitely/Probably would                                                                                                                                                                                     |  | 50%  |
| Probably/Definitely would not                                                                                                                                                                                 |  | 50%  |
| Base: Respondents who had smart thermostats installed through EPI, and if no EPI service, likelihood of taking initiative to purchase smart thermostats and self-install in home is not don't know or refused |  |      |
| Don't know and Refused excluded from calculations                                                                                                                                                             |  |      |

E12. Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred? You would have purchased and installed...

| If No EPI, Likelihood of Purchasing and Installing Same or Less Quantity of Smart Thermostats Installed Through EPI                                                                                             |  | 2024 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------|
| Sample Size                                                                                                                                                                                                     |  | 24   |
| ...exactly the same number of smart thermostats                                                                                                                                                                 |  | 17%  |
| ...fewer smart thermostats                                                                                                                                                                                      |  | 21%  |
| Would not have purchased or installed any smart thermostats                                                                                                                                                     |  | 63%  |
| Base: Respondents who had >1 smart thermostats installed through EPI and if no EPI service, likelihood of taking initiative to purchase smart thermostats and self-install in home is not don't know or refused |  |      |

E13. Before learning about the Efficient Product Installation Service, had you already decided to purchase and install <DHW MEASURE> in your home?

| Already Decided to Purchase and Install <DHW MEASURE> Installed Through EPI Before Learning About This Service                                                                                           | 2021 (%)    |     |     | 2024 (# or %) |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----|-----|---------------|-----|-----|
|                                                                                                                                                                                                          | Sample Size | Yes | No  | Sample Size   | Yes | No  |
| Pipe insulation                                                                                                                                                                                          | -           | -   | -   | 8             | 3   | 5   |
| Hot water tank wrap                                                                                                                                                                                      | -           | -   | -   | 18            | 2   | 16  |
| Low-flow showerheads or showerwands                                                                                                                                                                      | 39          | 18% | 82% | 25            | 20% | 80% |
| Thermostatic shut-off valves for showers                                                                                                                                                                 | -           | -   | -   | 1             | -   | 1   |
| Bathroom and/or kitchen faucet aerators                                                                                                                                                                  | -           | -   | -   | 22            | 27% | 73% |
| Base: Respondents who had pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators installed through EPI |             |     |     |               |     |     |

E14. Just to confirm: Have I understood correctly that you had already made the decision to purchase and install **<DHW MEASURE>** in your home before you learned about the Efficient Product Installation Service?

| To Confirm: Already Decided to Purchase and Install <b>&lt;DHW MEASURE&gt;</b> Before Learning About EPI                                                                                                                                                                                                                                                                                                                                                 | 2021<br>(#) |     |    |            | 2024<br>(#) |     |    |            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----|----|------------|-------------|-----|----|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Sample Size | Yes | No | Don't know | Sample Size | Yes | No | Don't know |
| Pipe insulation                                                                                                                                                                                                                                                                                                                                                                                                                                          | -           | -   | -  | -          | 3           | 2   | 1  | -          |
| Hot water tank wrap                                                                                                                                                                                                                                                                                                                                                                                                                                      | -           | -   | -  | -          | 2           | 2   | -  | -          |
| Low-flow showerheads or showerwands                                                                                                                                                                                                                                                                                                                                                                                                                      | 7           | 6   | 1  | -          | 5           | 4   | 1  | -          |
| Thermostatic shut-off valves for showers                                                                                                                                                                                                                                                                                                                                                                                                                 | -           | -   | -  | -          | -           | -   | -  | -          |
| Bathroom and/or kitchen faucet aerators                                                                                                                                                                                                                                                                                                                                                                                                                  | -           | -   | -  | -          | 6           | 4   | 1  | 1          |
| Base: Respondents who had pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators installed through EPI and had decided to purchase and install pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators through EPI before learning about this service |             |     |    |            |             |     |    |            |

E15. Without the Efficient Product Installation Service, what is the likelihood you would have paid for the **<DHW MEASURE>** knowing that the cost is about...

| If No EPI, Likelihood of Paying For The <b>&lt;DHW MEASURE&gt;</b> Knowing The Cost is About..                                                                                                                                                                                         | 2024<br>(# or %) |                           |                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------|-------------------------------|
|                                                                                                                                                                                                                                                                                        | Sample Size      | Definitely/Probably would | Probably/Definitely would not |
| Pipe insulation: \$2 per foot                                                                                                                                                                                                                                                          | 8                | 5                         | 3                             |
| Hot water tank wrap: \$50                                                                                                                                                                                                                                                              | 18               | 4                         | 14                            |
| Low-flow showerheads or showerwands: \$50 *                                                                                                                                                                                                                                            | 25               | 16%                       | 84%                           |
| Thermostatic shut-off valves for showers: \$50                                                                                                                                                                                                                                         | 1                | -                         | 1                             |
| Bathroom and/or kitchen faucet aerators: \$8 to \$10                                                                                                                                                                                                                                   | 22               | 50%                       | 50%                           |
| Base: Respondents who had pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators installed through EPI<br>Don't know and Refused excluded from calculations<br>*Scale change in 2024 |                  |                           |                               |

E16. Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase <DHW MEASURE> at a store and install them in your home ...

| If No EPI, Likelihood of Taking Initiative to Purchase and Install <DHW MEASURE> in Home                                                                                                                                                                                               | 2024<br>(# or %) |                           |                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------|-------------------------------|
|                                                                                                                                                                                                                                                                                        | Sample Size      | Definitely/Probably would | Probably/Definitely would not |
| Pipe insulation                                                                                                                                                                                                                                                                        | 8                | 5                         | 3                             |
| Hot water tank wrap                                                                                                                                                                                                                                                                    | 18               | 4                         | 14                            |
| Low-flow showerheads or showerwands *                                                                                                                                                                                                                                                  | 25               | 32%                       | 68%                           |
| Thermostatic shut-off valves for showers                                                                                                                                                                                                                                               | 1                | -                         | 1                             |
| Bathroom and/or kitchen faucet aerators                                                                                                                                                                                                                                                | 22               | 27%                       | 73%                           |
| Base: Respondents who had pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators installed through EPI<br>Don't know and Refused excluded from calculations<br>*Scale change in 2024 |                  |                           |                               |

E17. Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your <DHW MEASURE> by at least one year?

| If no EPI, Likelihood of Postponing Replacement of <DHW MEASURE> by at Least One Year                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2024<br>(# or %) |                           |                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------|-------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Sample Size      | Definitely/Probably would | Probably/Definitely would not |
| Pipe insulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 8                | 3                         | 5                             |
| Hot water tank wrap                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 17               | 8                         | 9                             |
| Low-flow showerheads or showerwands *                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 25               | 48%                       | 52%                           |
| Thermostatic shut-off valves for showers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1                | 1                         | -                             |
| Bathroom and/or kitchen faucet aerators                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 22               | 45%                       | 55%                           |
| Base: Respondents who had pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators installed through EPI, and if no EPI service, likelihood of taking initiative to purchase pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators and self-install in home is not don't know or refused<br>Don't know and Refused excluded from calculations<br>*Scale change in 2024 |                  |                           |                               |

E18. Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred? You would have purchased and installed...

| If No EPI, Likelihood of Purchasing and Installing Same, Less or No Quantity of <DHW MEASURE> Installed Through EPI                                                                                                                                                                                                                                                                                                                                                                           | 2024<br>(# or %) |                            |          |                                       |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------|----------|---------------------------------------|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Sample Size      | ...exactly the same number | ...fewer | Would not have purchased or installed | Don't know |
| Pipe insulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 8                | 4                          | -        | 4                                     | -          |
| Hot water tank wrap                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 18               | 3                          | -        | 15                                    | -          |
| Low-flow showerheads or showerwands *                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 25               | 16%                        | 16%      | 64%                                   | 4%         |
| Thermostatic shut-off valves for showers                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1                | -                          | -        | 1                                     | -          |
| Bathroom and/or kitchen faucet aerators                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 22               | 32%                        | -        | 68%                                   | -          |
| Base: Respondents who had >1 pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators installed through EPI and if no EPI service, likelihood of taking initiative to purchase pipe insulation/hot water tank wrap/low-flow showerheads or showerwands/thermostatic shut-off valves for showers/bathroom and/or kitchen faucet aerators and self-install in home is not don't know or refused |                  |                            |          |                                       |            |
| *Scale change in 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                  |                            |          |                                       |            |

E19. How influential were the following two factors in your decision to have energy-efficient products installed in your home?

| Influence of Factors in Decision to Have Energy-Efficient Products Installed in Home | 2024        |                           |                                 |
|--------------------------------------------------------------------------------------|-------------|---------------------------|---------------------------------|
|                                                                                      | Sample Size | Very/Somewhat influential | Not very/Not at all influential |
| The free installation of energy-efficient products offered through the service       | 94          | 98%                       | 2%                              |
| The information or advice provided by the service staff                              | 93          | 87%                       | 13%                             |
| Don't know and Refused excluded from calculations                                    |             |                           |                                 |

F1. Before participating in the Efficient Product Installation Service in [MONTH/YEAR], had you at any time in the past participated in any Efficiency Nova Scotia program or Service?

| Prior Participation in ENS Program or Service                                                                                                                                                                                                                                                                                                     | 2021 | 2024 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|
| Sample Size                                                                                                                                                                                                                                                                                                                                       | 98   | 97   |
| Yes                                                                                                                                                                                                                                                                                                                                               | 35%  | 45%  |
| No                                                                                                                                                                                                                                                                                                                                                | 62%  | 53%  |
| Don't know                                                                                                                                                                                                                                                                                                                                        | 3%   | 2%   |
| Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI |      |      |

- F2. Do you agree or disagree that your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home? \*

| Previous Participation in an ENS Program or Service Was a Major Factor in Decision to Have Energy Efficient Products Installed in Home                                                                                                                                                                                                                                                                                                                                                           | 2021      | 2024      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>34</b> | <b>44</b> |
| Agree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 79%       | 95%       |
| Disagree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 21%       | 5%        |
| Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI and had previously participated in ENS program or service. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI and had previously participated in ENS program or service<br>*Wording change in 2024 |           |           |

- F3. Do you agree or disagree that because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating in the service, you requested the installation of energy-efficient products at no cost in your home? \*

| Requested Installation of Energy-Efficient Products Because of Previous ENS Program or Service Participation                                                                                                                                                                                                                                                                                                                                                                                     | 2021      | 2024      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>34</b> | <b>44</b> |
| Agree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 94%       | 98%       |
| Disagree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6%        | 2%        |
| Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI and had previously participated in ENS program or service. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI and had previously participated in ENS program or service<br>*Wording change in 2024 |           |           |

- F4. Do you agree or disagree that because of your previous participation in another Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home? \*

| Took Into Account the Savings on Energy Bill When Evaluating Different Energy-Efficient Products Because of Previous ENS Program or Service Participation                                                                                                                                                                                                                                                                                                                                        | 2021      | 2024      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>34</b> | <b>44</b> |
| Agree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 82%       | 95%       |
| Disagree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 18%       | 2%        |
| Don't know                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -         | 2%        |
| Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI and had previously participated in ENS program or service. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI and had previously participated in ENS program or service<br>*Wording change in 2024 |           |           |



- F5. Before participating in the Efficient Product Installation Service in <MONTH/YEAR>, had you at any time in the past seen Efficiency Nova Scotia advertisements or information discussing the benefits of energy efficiency?

| Seen ENS Advertisement or Information Discussing Benefits of Energy Efficiency Prior to Participating in EPI                                                                                                                                                                                                                                      | 2021      | 2024      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                                                                                                                                                                                                                                                | <b>98</b> | <b>97</b> |
| Yes                                                                                                                                                                                                                                                                                                                                               | 78%       | 73%       |
| No                                                                                                                                                                                                                                                                                                                                                | 20%       | 25%       |
| Don't know                                                                                                                                                                                                                                                                                                                                        | 2%        | 2%        |
| Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI |           |           |

- F6. Do you agree or disagree that the promotion of energy efficiency by Efficiency Nova Scotia was a major factor in your decision to have energy-efficient products installed in your home? \*

| Promotion of Energy Efficiency Carried Out by ENS Was a Major Factor in Decision to Have Energy-Efficient Products Installed in Home                                                                                                                                                                                                                                                                                                                                                                                                                  | 2021      | 2024      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>76</b> | <b>71</b> |
| Agree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 79%       | 94%       |
| Disagree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 20%       | 6%        |
| Don't know                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1%        | -         |
| Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI and had previously seen ENS advertisement or information discussing benefits of energy efficiency. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI and had previously seen ENS advertisement or information discussing benefits of energy efficiency |           |           |
| *Wording change in 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |           |

- F7. Do you agree or disagree that the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home? \*

| Promotion of Energy Efficiency Carried Out by ENS Prompted Ask for Installation of Energy-Efficient Products at No Cost in Home                                                                                                                                                                                                                                                                                                                                                                                                                       | 2021      | 2024      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>76</b> | <b>71</b> |
| Agree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 96%       | 96%       |
| Disagree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3%        | 4%        |
| Refused                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1%        | -         |
| Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI and had previously seen ENS advertisement or information discussing benefits of energy efficiency. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI and had previously seen ENS advertisement or information discussing benefits of energy efficiency |           |           |
| *Wording change in 2024                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |           |

F8. Do you agree or disagree that you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia? \*

| Promotion of Energy Efficiency Carried Out by ENS Prompted Taking Into Account the Savings on Energy Bill When Evaluating Different Energy-Efficient Products for Home                                                                                                                                                                                                                                                                                                                                                                                                                      | 2021      | 2024      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>76</b> | <b>71</b> |
| Agree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 88%       | 97%       |
| Disagree                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 11%       | 1%        |
| Don't know                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -         | 1%        |
| Refused                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1%        | -         |
| <p>Base: In 2021, respondents who had LED bulbs and/or low flow showerheads and/or showerwands installed through EPI and had previously seen ENS advertisement or information discussing benefits of energy efficiency. In 2024, respondents who had LED bulbs and/or smart thermostats and/or pipe insulation and/or hot water tank wrap and/or low flow showerheads and/or thermostatic shut-off valves and/or faucet aerators installed through EPI and had previously seen ENS advertisement or information discussing benefits of energy efficiency</p> <p>*Wording change in 2024</p> |           |           |

G1. Since participating in the Efficient Product Installation Service, have you installed any additional efficient products in your home?

| Installed Additional Efficient Products Since Participating in EPI | 2021       | 2024       |
|--------------------------------------------------------------------|------------|------------|
| <b>Sample Size</b>                                                 | <b>100</b> | <b>100</b> |
| Yes                                                                | 32%        | 28%        |
| No                                                                 | 66%        | 71%        |
| Don't know/Don't recall                                            | 2%         | 1%         |

G2. What energy efficient products have you installed in your home since participating in the Efficient Product Installation Service? Any others?

| Energy efficient Products Installed in Home Since Participating in EPI                                                     | 2021      | 2024      |
|----------------------------------------------------------------------------------------------------------------------------|-----------|-----------|
| <b>Sample Size</b>                                                                                                         | <b>32</b> | <b>28</b> |
| Heat pump water heaters                                                                                                    | 6%        | 21%       |
| LED bulbs                                                                                                                  | 28%       | 18%       |
| Dishwasher                                                                                                                 | -         | 11%       |
| Heat pump                                                                                                                  | 19%       | 7%        |
| Windows                                                                                                                    | 9%        | 7%        |
| LED fixtures                                                                                                               | 3%        | 7%        |
| Fridge                                                                                                                     | -         | 7%        |
| Stove                                                                                                                      | -         | 7%        |
| Dehumidifiers                                                                                                              | 3%        | 4%        |
| Energy Star refrigerator                                                                                                   | 3%        | 4%        |
| Faucet aerators                                                                                                            | -         | 4%        |
| Energy Star clothes washer                                                                                                 | -         | 4%        |
| Insulation                                                                                                                 | 13%       | -         |
| Door weather stripping kits                                                                                                | 13%       | -         |
| Doors                                                                                                                      | 9%        | -         |
| Siding                                                                                                                     | 3%        | -         |
| Solar panels                                                                                                               | 3%        | -         |
| Low flush toilet                                                                                                           | 3%        | -         |
| Window air sealing kits                                                                                                    | 3%        | -         |
| Pipe insulation                                                                                                            | 3%        | -         |
| Smart power strip/smart power bar                                                                                          | 3%        | -         |
| None                                                                                                                       | 3%        | 4%        |
| Others                                                                                                                     | 16%       | 36%       |
| Base: Respondents who installed any additional efficient products in home since participating in EPI<br>Multiple responses |           |           |

G3. How many did you purchase and install?

| Number of Energy Efficient Products Installed Since Participating in EPI             | 2021        |       | 2024        |      |
|--------------------------------------------------------------------------------------|-------------|-------|-------------|------|
|                                                                                      | Sample Size | Mean  | Sample Size | Mean |
| LED bulbs                                                                            | 9           | 8.9   | 5           | 9.4  |
| LED fixtures                                                                         | 1           | 3.0   | 2           | 5.5  |
| Dehumidifiers                                                                        | 1           | 1.0   | 1           | 1.0  |
| Faucet aerators                                                                      | -           | -     | 1           | 1.0  |
| Door weather stripping kits                                                          | 4           | 1.8   | -           | -    |
| Air source heat pump hot water heaters                                               | 2           | 2.0   | -           | -    |
| Pipe insulation                                                                      | 1           | 20.0* | -           | -    |
| Others                                                                               | 17          | 6.4   | 10          | 8.2  |
| Base: Respondents who installed efficient product in home since participating in EPI |             |       |             |      |
| Don't know excluded from Mean calculations                                           |             |       |             |      |
| *Average number of ft                                                                |             |       |             |      |

G4. Did you receive an instant rebate at the cashier for the [energy efficient product] you purchased?

| Received Instant Rebate at Cashier for Energy Efficient Products Installed Since Participating in EPI | 2021 (#)    |     |    |            | 2024 (#)    |     |    |            |
|-------------------------------------------------------------------------------------------------------|-------------|-----|----|------------|-------------|-----|----|------------|
|                                                                                                       | Sample Size | Yes | No | Don't know | Sample Size | Yes | No | Don't know |
| LED bulbs                                                                                             | 9           | -   | 7  | 2          | 5           | 1   | 2  | 2          |
| LED fixtures                                                                                          | 1           | -   | 1  | -          | 2           | -   | 2  | -          |
| Dehumidifiers                                                                                         | 1           | -   | 1  | -          | 1           | -   | 1  | -          |
| Air source heat pump hot water heaters                                                                | 2           | -   | 2  | -          | -           | -   | -  | -          |
| Base: Respondents who purchased >0                                                                    |             |     |    |            |             |     |    |            |

G5. How influential was your experience with the Efficient Product Installation Service in your decision to install these additional energy-efficient products?

| Experience with EPI Influenced Decision to Install Additional Energy-Efficient Products | 2024 (#) |
|-----------------------------------------------------------------------------------------|----------|
| Sample Size                                                                             | 8        |
| Extremely influential/Influential                                                       | 6        |
| Not very influential/Not at all influential                                             | 2        |
| Don't know and Refused excluded from calculations                                       |          |

H1. Do you have any recommendations to help improve the Efficient Product Installation Service?  
Anything else? \*

| Participant Suggestions to Improve EPI                          | 2018       | 2021       | 2024       |
|-----------------------------------------------------------------|------------|------------|------------|
| <b>Sample Size</b>                                              | <b>100</b> | <b>100</b> | <b>100</b> |
| Should have more product options/more items in the program      | 12%        | 5%         | 12%        |
| Improve the installation service/Need better installations/work | -          | -          | 6%         |
| More information on the products/Product guides                 | 8%         | 5%         | 3%         |
| More advice/recommendations                                     | -          | -          | 3%         |
| Less wait times/Quicker installation/renovations                | -          | -          | 2%         |
| Better customer service/More knowledgeable staff/advisors       | -          | -          | 2%         |
| Advertise/promote the program more/People need to know about it | 3%         | 4%         | 2%         |
| Offer more information on EPI/on how to save energy             | -          | 5%         | -          |
| Improve communication                                           | 3%         | 3%         | -          |
| Better/brighter light bulbs                                     | -          | 2%         | -          |
| Improve quality of work                                         | 2%         | 1%         | -          |
| Complete work faster                                            | 2%         | 1%         | -          |
| Replace a higher number of light bulbs                          | 1%         | -          | -          |
| Issues with faucet aerator                                      | 1%         | -          | -          |
| Others                                                          | 4%         | 10%        | 4%         |
| No recommendations                                              | 67%        | 66%        | 75%        |
| Multiple responses                                              |            |            |            |
| *Wording change in 2021                                         |            |            |            |

I1. What type of residence do you live in?

| Type of Home                                                                                | 2018       | 2021       | 2024       |
|---------------------------------------------------------------------------------------------|------------|------------|------------|
| <b>Sample Size</b>                                                                          | <b>100</b> | <b>100</b> | <b>100</b> |
| Detached single-family home                                                                 | 76%        | 80%        | 82%        |
| Mobile home or house trailer                                                                | 6%         | 2%         | 9%         |
| Semi-detached house                                                                         | 10%        | 4%         | 6%         |
| Townhouse or duplex with shared adjacent walls                                              | 6%         | 4%         | 3%         |
| Row house or Single story apartment building                                                | -          | 2%         | -          |
| Apartment building that has five to twenty stories (2021)/<br>five or more stories (2018) * | 1%         | 1%         | -          |
| Apartment building that has fewer than five stories*                                        | -          | 1%         | -          |
| Some other type                                                                             | -          | 4%         | -          |
| Refused                                                                                     | -          | 1%         | -          |
| Don't know                                                                                  | -          | 1%         | -          |
| *Wording change in 2021                                                                     |            |            |            |

I2. How many bedrooms are in your home?

| Number of Bedrooms | 2018       | 2021       | 2024       |
|--------------------|------------|------------|------------|
| <b>Sample Size</b> | <b>100</b> | <b>100</b> | <b>100</b> |
| 1                  | 2%         | -          | 5%         |
| 2                  | 10%        | 23%        | 21%        |
| 3                  | 56%        | 42%        | 49%        |
| 4 or more          | 30%        | 35%        | 25%        |
| Don't know         | 1%         | -          | -          |

I3. Do you own or rent this home?

| Own or Rent Home   | 2021       | 2024       |
|--------------------|------------|------------|
| <b>Sample Size</b> | <b>100</b> | <b>100</b> |
| Own/buying         | 93%        | 98%        |
| Rent/lease         | 7%         | 2%         |
| Other              | -          | -          |
| Refused            | -          | -          |

I4. Do you pay the electric bills for your home, either on your own or shared with someone else? \*

| Pay Electricity Bills                    | 2018       | 2021       | 2024       |
|------------------------------------------|------------|------------|------------|
| <b>Sample Size</b>                       | <b>100</b> | <b>100</b> | <b>100</b> |
| Yes – On own or shared with someone else | 100%       | 98%        | 93%        |
| No                                       | -          | 2%         | 7%         |
| Refused                                  | -          | -          | -          |
| *Wording change in 2021                  |            |            |            |

I5. Including yourself, how many people live in this residence on a full-time basis?

| People in Household                            | 2018       | 2021       | 2024       |
|------------------------------------------------|------------|------------|------------|
| <b>Sample Size</b>                             | <b>100</b> | <b>100</b> | <b>100</b> |
| 1                                              | 18%        | 22%        | 27%        |
| 2                                              | 48%        | 49%        | 53%        |
| 3                                              | 12%        | 10%        | 9%         |
| 4+                                             | 20%        | 16%        | 10%        |
| Nobody lives in the house on a full-time basis | -          | 1%         | 1%         |
| Refused                                        | 1%         | 2%         | -          |

16. Please stop me when I reach your age group. Are you ...? \*

| Age of Respondent       | 2018       | 2021       | 2024       |
|-------------------------|------------|------------|------------|
| <b>Sample Size</b>      | <b>100</b> | <b>100</b> | <b>100</b> |
| 18 to 24                | 1%         | 3%         | 2%         |
| 25 to 34                | 10%        | 15%        | 5%         |
| 35 to 44                | 15%        | 12%        | 15%        |
| 45 to 54                | 18%        | 14%        | 13%        |
| 55 to 64                | 22%        | 19%        | 15%        |
| 65 or over              | 34%        | 37%        | 49%        |
| Refused                 | -          | -          | 1%         |
| *Wording change in 2024 |            |            |            |

17. What is the highest level of education you have completed?

| Level of Education                                                | 2018       | 2021       | 2024       |
|-------------------------------------------------------------------|------------|------------|------------|
| <b>Sample Size</b>                                                | <b>100</b> | <b>100</b> | <b>100</b> |
| Less than high school graduation diploma                          | 4%         | 4%         | 17%        |
| High school graduate diploma and/or some post-secondary education | 18%        | 18%        | 26%        |
| Trades certificate/diploma                                        | 2%         | 7%         | 6%         |
| College certificate/diploma                                       | 22%        | 15%        | 14%        |
| University degree/certificate/diploma                             | 51%        | 53%        | 31%        |
| Others                                                            | -          | -          | 2%         |
| Refused                                                           | 3%         | 3%         | 4%         |

18. What is your gender?

| Gender                  | 2018       | 2021       | 2024       |
|-------------------------|------------|------------|------------|
| <b>Sample Size</b>      | <b>100</b> | <b>100</b> | <b>100</b> |
| Male                    | 48%        | 47%        | 53%        |
| Female                  | 52%        | 52%        | 46%        |
| Prefer not to say       | -          | -          | 1%         |
| Refused                 | -          | 1%         | -          |
| *Wording change in 2024 |            |            |            |



## APPENDIX XVI

# EPI On-site Visit Sampling Methodology and Protocol

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### Sampling Methodology

For the 2024 EPI impact evaluation, 60 on-site visits were conducted with participants. The selected samples included 60 EPI participants as well as 60 back-up participants that had at least four different products installed from January through July 2024.

The sample was verified to be representative of the population within  $\pm 10\%$  of the proportion of participants served by a delivery agent (DA) and a representative mix of product installations. As described earlier, the criteria for selecting the sample were that at least four different products were installed.

### On-site Visit Protocol

The on-site visits were conducted to verify the number of products installed and recorded in the tracking system. The on-site observation protocol was developed to serve two main purposes: (1) Establish the installation rates of products; and (2) determine whether any products had been removed and, if any, the reasons for their removal. The Evaluator then validated the assumptions used to calculate the unitary savings value for each product category by collecting the following types of information during the visits:

- › The locations of the new lamps (indoors or outdoors)
- › The domestic hot water (DHW) heating source and tank size
- › The number of faucets and showerheads in a home
- › The locations of faucet aerators

The Evaluator also collected information about the space heating source and whether an air conditioner was used. This information was useful in determining the impact of installed lighting measure interactive effects.



## On-site Visit Data Collection Form

Fields in light gray are filled prior to the visit based on the information in the tracking sheet. Other fields are filled during the site visit and base on on-site observations and the contact's statement.

### 1) General Information

|                      |                     |   |    |   |                   |   |    |   |
|----------------------|---------------------|---|----|---|-------------------|---|----|---|
| Date of Visit:       |                     |   |    |   |                   |   |    |   |
| Tracking Number:     |                     |   |    |   |                   |   |    |   |
| Delivery Agent ID:   |                     |   |    |   |                   |   |    |   |
| Address:             |                     |   |    |   |                   |   |    |   |
| Contact Name:        |                     |   |    |   |                   |   |    |   |
| Telephone:           |                     |   |    |   |                   |   |    |   |
| Type of Dwelling:    |                     |   |    |   |                   |   |    |   |
| Owner or Tenant:     |                     |   |    |   |                   |   |    |   |
|                      |                     |   |    |   |                   |   |    |   |
|                      | From Tracking Sheet |   |    |   | Confirmed On-site |   |    |   |
| Main Heat Type:      |                     |   |    |   |                   |   |    |   |
| Secondary Heat Type: |                     |   |    |   |                   |   |    |   |
| AC Used in Home      | Yes                 | Y | No | Y | Yes               | Y | No | Y |
| DHW Heat Type:       |                     |   |    |   |                   |   |    |   |

### 2) Product Installation Information

#### Lighting Products

| Product                | Quantity in Tracking Sheet | Quantity On Site | Explanation, If Different | Indoors or Outdoors |
|------------------------|----------------------------|------------------|---------------------------|---------------------|
| 9 W LED                |                            |                  |                           |                     |
| 18 W LED               |                            |                  |                           |                     |
| 7 W PAR20 LED          |                            |                  |                           |                     |
| 15 W PAR38 LED         |                            |                  |                           |                     |
| 7 W GU10 LED           |                            |                  |                           |                     |
| 7 W G25 LED Globe      |                            |                  |                           |                     |
| 5 W E12 LED Chandelier |                            |                  |                           |                     |
| LED Nightlight         |                            |                  |                           |                     |

Notes:

## Domestic Hot Water (DHW) Related Products

Total number of faucets in the house: \_\_\_\_\_

Total number of showerheads in the house: \_\_\_\_\_

| Product                   | Quantity in Tracking Sheet | Quantity On Site | Explanation, If Different | Tank Size (Gal.) or Flow Rate |
|---------------------------|----------------------------|------------------|---------------------------|-------------------------------|
| Hot Water Tank Wrap       |                            |                  |                           |                               |
| Pipe Insulation           |                            |                  |                           | N/A                           |
| Kitchen Faucet Aerators   |                            |                  |                           | N/A                           |
| Bathroom Faucet Aerators  |                            |                  |                           | N/A                           |
| Low-Flow Showerheads      |                            |                  |                           | N/A                           |
| Thermostatic Shower Valve |                            |                  |                           |                               |

Notes:

## Air Sealing Kit and Window Film

Number of Switch and Plug Insulators on exterior walls: \_\_\_\_\_

| Product                   | Quantity in Tracking Sheet | Quantity On Site | Explanation, If Different | Installed by the Delivery Agent or Left Behind? |
|---------------------------|----------------------------|------------------|---------------------------|-------------------------------------------------|
| Door Sweep                |                            |                  |                           |                                                 |
| Door Weatherstripping     |                            |                  |                           |                                                 |
| Window Air Sealing        |                            |                  |                           |                                                 |
| Switch and Plug Insulator |                            |                  |                           |                                                 |
| Window Film Kits          |                            |                  |                           |                                                 |

Notes:

## Thermostats

| Product          | Quantity in Tracking Sheet | Quantity On Site | Explanation, If Different | Type of Controlled Equipment |
|------------------|----------------------------|------------------|---------------------------|------------------------------|
| Smart Thermostat |                            |                  |                           |                              |

Notes:

## Power Strips

| Product              | Quantity in Tracking Sheet | Quantity On Site | Explanation, If Different |
|----------------------|----------------------------|------------------|---------------------------|
| Embertec Power Strip |                            |                  |                           |

Notes:

## APPENDIX XVII

### EPI Algorithms for Free-Ridership Calculation

The tables below present the algorithms used to calculate the free-ridership levels for EPI measures. The algorithms are based on participant survey questions designed to assess program influence on variables such as planning, cost, effort, timing, and quantity on participant decision-making. To better evaluate free-ridership based on which measures were added to participants' homes, three separate algorithms were used, one for LED lamps, one for smart thermostats, and one for all DHW measures. The previous versions of the algorithms are presented on the left as comparisons.

#### EPI – Free-Ridership Algorithm for LED Lamps

Table 1: Free-Ridership – LEDs

| Previous Algorithm |                                                                                                                                                                                     |                           |                     | 2024 Algorithm                                                                                                                                                                                                      |                                              |                     |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------|
| Question           |                                                                                                                                                                                     | Answer                    | Score               | Question                                                                                                                                                                                                            | Answer                                       | Score               |
| INTENTION          |                                                                                                                                                                                     |                           |                     |                                                                                                                                                                                                                     |                                              |                     |
| Planning           |                                                                                                                                                                                     |                           |                     |                                                                                                                                                                                                                     |                                              |                     |
| E1                 | Had you already decided to purchase and install LED bulbs before learning about the Efficient Product Installation Service?                                                         | 1) Yes                    | Use E2              | Before learning about the Efficient Product Installation Service, had you already decided to purchase and install LED bulbs in your home?                                                                           | 1) Yes                                       | Use E2              |
|                    |                                                                                                                                                                                     | 2) No                     | 0%                  |                                                                                                                                                                                                                     | 2) No                                        | 0%                  |
|                    |                                                                                                                                                                                     | 98/99) Don't know/Refused |                     |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                    |                     |
| E2                 | [IF E1=YES] Just to confirm: Before you learned about the Efficient Product Installation Service, you had already made the decision to purchase and install LED bulbs in your home? | 1) Yes                    | 100%                | [IF E1=YES] Just to confirm: Have I understood correctly that you had already made the decision to purchase and install LED bulbs in your home before you learned about the Efficient Product Installation Service? | 1) Yes, correct (already made decision)      | 100%                |
|                    |                                                                                                                                                                                     | 2) No                     | 0%                  |                                                                                                                                                                                                                     | 2) No, incorrect (not already made decision) | 0%                  |
|                    |                                                                                                                                                                                     | 98/99) Don't know/Refused |                     |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                    |                     |
|                    | Planning Score (PA1)                                                                                                                                                                |                           | E1 adjusted with E2 | Planning Score (PS)                                                                                                                                                                                                 |                                              | E1 adjusted with E2 |

| Previous Algorithm |                                                                                                                                                                                                                                                      |                                 |               | 2024 Algorithm                                                                                                                                                            |                                                                                                                                          |            |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Question           |                                                                                                                                                                                                                                                      | Answer                          | Score         | Question                                                                                                                                                                  | Answer                                                                                                                                   | Score      |
| Cost               |                                                                                                                                                                                                                                                      |                                 |               |                                                                                                                                                                           |                                                                                                                                          |            |
| E3                 | If Efficiency Nova Scotia had not installed these LED bulbs at no charge as part of the Efficient Product Installation Service, how likely would you have been to purchase and pay for those LED bulbs, knowing that the cost is about \$4 per bulb? | 1) Answer: ____<br>(scale 0-10) | Answer x 10%  | Without the Efficient Product Installation Service, what is the likelihood you would have paid for the LED bulbs, knowing that the cost is about \$2 to \$4 per bulb?     | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%) |
|                    |                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused       | EMPTY         |                                                                                                                                                                           | 98/99) Don't know/Refused                                                                                                                | EMPTY      |
|                    |                                                                                                                                                                                                                                                      |                                 |               | Cost Score (CS)                                                                                                                                                           |                                                                                                                                          | E3         |
| Effort             |                                                                                                                                                                                                                                                      |                                 |               |                                                                                                                                                                           |                                                                                                                                          |            |
| E4                 | If there was no Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them yourself in your home?                                                               | 1) Answer: ____<br>(scale 0-10) | Answer x 10%  | Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them in your home? | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%) |
|                    |                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused       | EMPTY         |                                                                                                                                                                           | 98/99) Don't know/Refused                                                                                                                | EMPTY      |
|                    | Cost & Effort Score (PA2)                                                                                                                                                                                                                            |                                 | MEAN (E3; E4) | Effort Score (ES)                                                                                                                                                         |                                                                                                                                          | E4         |

| Previous Algorithm |                                                                                                                                                                                                                                               |                                 |                     | 2024 Algorithm                                                                                                                                                                    |                                                                                                                                                                                                   |            |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Question           |                                                                                                                                                                                                                                               | Answer                          | Score               | Question                                                                                                                                                                          | Answer                                                                                                                                                                                            | Score      |
| Timing             |                                                                                                                                                                                                                                               |                                 |                     |                                                                                                                                                                                   |                                                                                                                                                                                                   |            |
| E5                 | [IF E4 ≥ 5] If there was no Efficient Product Installation Service, how likely would you have been to postpone by at least one year replacing your bulbs with LEDs?                                                                           | 1) Answer: ____<br>(scale 0-10) | (10 – Answer) x 10% | [IF CODES 1,2,3,4 AT E4] Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your bulbs with LEDs by at least one year? | 1) Definitely would have (0%)<br>2) Probably would have (25%)<br>3) Probably would not have (75%)<br>4) Definitely would not have (100%)                                                          | Answer (%) |
|                    |                                                                                                                                                                                                                                               | 98/99) Don't know/Refused       | EMPTY               |                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                                         | EMPTY      |
|                    | Timing Score (PA3)                                                                                                                                                                                                                            |                                 | E5                  |                                                                                                                                                                                   | Timing Score (TS)                                                                                                                                                                                 | E5         |
| Quantity           |                                                                                                                                                                                                                                               |                                 |                     |                                                                                                                                                                                   |                                                                                                                                                                                                   |            |
| E6                 | [ASK IF LED BULBS QUANTITY>1] If there was no Efficient Product Installation service, how likely would you have been to purchase and install all [QUANTITY] LED bulbs that were installed through the Efficient Product Installation Service? | 1) Answer: ____<br>(scale 0-10) | Answer x 10%        | [ASK IF LED BULBS QUANTITY>1 AND IF CODES 1, 2, 3 AT E4] Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred?    | You would have purchased and installed .<br>1) ...exactly the same number of LED bulbs (100%)<br>2) ... fewer LED bulbs (50%)<br>3) You would not have purchased nor installed any LED bulbs (0%) | Answer (%) |
|                    |                                                                                                                                                                                                                                               | 98/99) Don't know/Refused       | EMPTY               |                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                                         | EMPTY      |
|                    | Quantity Score (PA4)                                                                                                                                                                                                                          |                                 | E6                  |                                                                                                                                                                                   | Quantity Score (QS)                                                                                                                                                                               | E6         |

| Previous Algorithm                                  |                                                                                                                                                                                                                                                                                                                |                                                                                        |                        | 2024 Algorithm                                                                                                                                                                                                                                                                                   |                                                                                                                                                                 |                                       |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Question                                            |                                                                                                                                                                                                                                                                                                                | Answer                                                                                 | Score                  | Question                                                                                                                                                                                                                                                                                         | Answer                                                                                                                                                          | Score                                 |
|                                                     | Inconsistency Test                                                                                                                                                                                                                                                                                             | IF E1=100%<br>AND<br>IF E3<70% OR<br>E4<70%                                            | E1=EMP<br>TY           | Inconsistency Test                                                                                                                                                                                                                                                                               | IF E1=100% AND<br>IF E3<75% OR E4<75%                                                                                                                           | E1= EMPTY                             |
|                                                     | Inconsistency Test                                                                                                                                                                                                                                                                                             | IF ABS(E3–E4)<br>≥50%                                                                  | MIN (E3;<br>E4)        | Inconsistency Test                                                                                                                                                                                                                                                                               | IF E4 <> EMPTY AND<br>ABS (E4-E13a) > 50%                                                                                                                       | E4=<br>EMPTY                          |
|                                                     |                                                                                                                                                                                                                                                                                                                |                                                                                        |                        | INTENTION Score: MIN [MEAN (PS; CS; ES); MEAN (PS; CS; ES; TS); MEAN (PS; CS; ES; TS; QS); MEAN (PS; CS; ES; QS)]                                                                                                                                                                                |                                                                                                                                                                 |                                       |
| INFLUENCE                                           |                                                                                                                                                                                                                                                                                                                |                                                                                        |                        |                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                 |                                       |
| E19                                                 | I would like you to rate the influence of the following two factors in your decision to have the energy-efficient products installed in your home.<br><br>a) The installation of energy-efficient products, at no charge, offered by the service<br><br>b) Information or advice provided by the service staff | 1) Answer: ____<br>(scale 0-10)<br><br>97/98/99) Not applicable/<br>Don't know/Refused | MAX<br>(E13a;<br>E13b) | How influential were the following two factors in your decision to have energy efficient products installed in your home? [RANDOMIZE]<br><br>a) The free installation of energy efficient products offered through the service<br><br>b) The information or advice provided by the service staff | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%)<br><br>98/99) Don't know/Refused | MIN (E19a Answer;<br>E19b Answer) (%) |
|                                                     | INFLUENCE Score (PA5): (10–E13) x 10%                                                                                                                                                                                                                                                                          |                                                                                        |                        | INFLUENCE Score (IS): E19                                                                                                                                                                                                                                                                        |                                                                                                                                                                 |                                       |
| Free-Ridership (FR): MEAN (PA1; PA2; PA3; PA4; PA5) |                                                                                                                                                                                                                                                                                                                |                                                                                        |                        | Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                                                                                                                                                                                                                   |                                                                                                                                                                 |                                       |

**Table 2: Cross-Influence – LEDs**

| Previous Algorithm                                                                             |                                                                                                                                                                                                                                                                                       |                                                                                                      |       | 2024 Algorithm                                                                                                                                                                                                                                                      |                           |                                                                                                       |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------|
| Question                                                                                       |                                                                                                                                                                                                                                                                                       | Answer                                                                                               | Score | Question                                                                                                                                                                                                                                                            | Answer                    | Score                                                                                                 |
| Cross-Influence                                                                                |                                                                                                                                                                                                                                                                                       |                                                                                                      |       |                                                                                                                                                                                                                                                                     |                           |                                                                                                       |
| F2                                                                                             | [IF F1=1] Your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home.                                                                                                   | 1) Agree                                                                                             | 1     | Do you agree or disagree that ...<br>[IF F1=1] ...your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home?                                         | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F4                                                                                             | [IF F1=1] Because of your previous participation in another Efficiency Nova Scotia program or Service and what you learned by participating in this program, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home. | 1) Agree                                                                                             | 1     | [IF F1=1] ...because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home? | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F7                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                                     | 1) Agree                                                                                             | 1     | [IF F5=1] ... the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                           | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F8                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to take into account the savings on your energy bill when evaluating different energy-efficient products for your home.                                                               | 1) Agree                                                                                             | 1     | [IF F5=1] ... you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia?                                                          | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| Cross-Influence (CI):<br>IF(F2 OR F6=Agree; 1) + IF(F3 OR F7=Agree; 1) + IF(F4 OR F8=Agree; 1) |                                                                                                                                                                                                                                                                                       |                                                                                                      |       | Cross-Influence (CI):<br>IF(F2 =Agree; 1) + IF (F7=Agree; 1) + IF(F4 OR F8=Agree; 1)                                                                                                                                                                                |                           |                                                                                                       |
| Revised Free-Ridership:                                                                        |                                                                                                                                                                                                                                                                                       | IF CI = 0 or 1: Revised FR = FR<br>IF CI =2: Revised FR = FR*0.75<br>IF CI = 3: Revised FR = FR*0.50 |       | Revised Free-Ridership:                                                                                                                                                                                                                                             |                           | IF CI = 0: Revised FR = FR<br>IF CI = 1: Revised FR = FR*0.75<br>IF CI = 2 OR 3: Revised FR = FR*0.50 |



## EPI – Free-Ridership Algorithm for Smart Thermostats

**Table 3: Free-Ridership – Smart Thermostats**

| Previous Algorithm |  |        |       | 2024 Algorithm                                                                                                                                                                                                               |                                                                                                                                          |                           |
|--------------------|--|--------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Question           |  | Answer | Score | Question                                                                                                                                                                                                                     | Answer                                                                                                                                   | Score                     |
| INTENTION          |  |        |       |                                                                                                                                                                                                                              |                                                                                                                                          |                           |
| Planning           |  |        |       |                                                                                                                                                                                                                              |                                                                                                                                          |                           |
| E7                 |  |        |       | Before learning about the Efficient Product Installation Service, had you already decided to purchase and install smart thermostats in your home?                                                                            | 1) Yes                                                                                                                                   | Use E8                    |
|                    |  |        |       |                                                                                                                                                                                                                              | 2) No                                                                                                                                    | 0%                        |
|                    |  |        |       |                                                                                                                                                                                                                              | 98/99) Don't know/Refused                                                                                                                |                           |
| E8                 |  |        |       | [IF E17=YES] Just to confirm: Have I understood correctly that you had already made the decision to purchase and install smart thermostats in your home before you learned about the Efficient Product Installation Service? | 1) Yes, correct (already made decision)                                                                                                  | 100%                      |
|                    |  |        |       |                                                                                                                                                                                                                              | 2) No, incorrect (not already made decision)                                                                                             | 0%                        |
|                    |  |        |       |                                                                                                                                                                                                                              | 98/99) Don't know/Refused                                                                                                                |                           |
|                    |  |        |       | Planning Score (PS)                                                                                                                                                                                                          |                                                                                                                                          | E7 adjusted with E8       |
| Cost               |  |        |       |                                                                                                                                                                                                                              |                                                                                                                                          |                           |
| E9                 |  |        |       | Without the Efficient Product Installation Service, what is the likelihood you would have paid for the LED smart thermostat, knowing that the cost is about \$140 per thermostat?                                            | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%)                |
|                    |  |        |       |                                                                                                                                                                                                                              |                                                                                                                                          | 98/99) Don't know/Refused |
|                    |  |        |       | Cost Score (CS)                                                                                                                                                                                                              |                                                                                                                                          | E9                        |

| Previous Algorithm |  |        |       | 2024 Algorithm                                                                                                                                                                                            |                                                                                                                                                                                                                              |            |
|--------------------|--|--------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Question           |  | Answer | Score | Question                                                                                                                                                                                                  | Answer                                                                                                                                                                                                                       | Score      |
| Effort             |  |        |       |                                                                                                                                                                                                           |                                                                                                                                                                                                                              |            |
| E10                |  |        |       | Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase smart thermostats at a store and install them in your home?                         | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%)                                                                                     | Answer (%) |
|                    |  |        |       |                                                                                                                                                                                                           | 98/99) Don't know/Refused                                                                                                                                                                                                    | EMPTY      |
|                    |  |        |       | Effort Score (ES)                                                                                                                                                                                         |                                                                                                                                                                                                                              | E10        |
| Timing             |  |        |       |                                                                                                                                                                                                           |                                                                                                                                                                                                                              |            |
| E11                |  |        |       | [IF CODES 1,2,3,4 AT E10] Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your old thermostats with smart thermostats by at least one year? | 1) Definitely would have (0%)<br>2) Probably would have (25%)<br>3) Probably would not have (75%)<br>4) Definitely would not have (100%)                                                                                     | Answer (%) |
|                    |  |        |       |                                                                                                                                                                                                           | 98/99) Don't know/Refused                                                                                                                                                                                                    | EMPTY      |
|                    |  |        |       |                                                                                                                                                                                                           | Timing Score (TS)                                                                                                                                                                                                            | E11        |
| Quantity           |  |        |       |                                                                                                                                                                                                           |                                                                                                                                                                                                                              |            |
| E12                |  |        |       | [ASK IF SMART THERMOSTAT QUANTITY>1 AND IF CODES 1, 2, 3 AT E10] Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred?                    | You would have purchased and installed ....<br>1) ...exactly the same number of smart thermostats (100%)<br>2) ... fewer smart thermostats (50%)<br>5) You would not have purchased nor installed any smart thermostats (0%) | Answer (%) |
|                    |  |        |       |                                                                                                                                                                                                           | 98/99) Don't know/Refused                                                                                                                                                                                                    | EMPTY      |
|                    |  |        |       |                                                                                                                                                                                                           | Quantity Score (QS)                                                                                                                                                                                                          | E12        |



| Previous Algorithm |  |        |       | 2024 Algorithm                                                                                                                                                                                                                                                                           |                                                                                                                                |                                    |
|--------------------|--|--------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Question           |  | Answer | Score | Question                                                                                                                                                                                                                                                                                 | Answer                                                                                                                         | Score                              |
|                    |  |        |       | Inconsistency Test                                                                                                                                                                                                                                                                       | IF E7=100% AND<br>IF E9<75% OR E10<75%                                                                                         | E7=<br>EMPTY                       |
|                    |  |        |       | Inconsistency Test                                                                                                                                                                                                                                                                       | IF E10 <> EMPTY AND ABS<br>(E10-E19a) > 50%                                                                                    | E10=<br>EMPTY                      |
|                    |  |        |       | INTENTION Score: MIN [MEAN (PS; CS; ES); MEAN (PS; CS; ES; TS); MEAN (PS; CS; ES; TS; QS); MEAN (PS; CS; ES; QS)]                                                                                                                                                                        |                                                                                                                                |                                    |
| INFLUENCE          |  |        |       |                                                                                                                                                                                                                                                                                          |                                                                                                                                |                                    |
| E19                |  |        |       | How influential were the following two factors in your decision to have energy efficient products installed in your home? [RANDOMIZE]<br>a) The free installation of energy efficient products offered through the service<br>b) The information or advice provided by the service staff | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%) | MIN (E19a Answer; E19b Answer) (%) |
|                    |  |        |       |                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused                                                                                                      |                                    |
|                    |  |        |       | INFLUENCE Score (IS): E19                                                                                                                                                                                                                                                                |                                                                                                                                |                                    |
|                    |  |        |       | Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                                                                                                                                                                                                           |                                                                                                                                |                                    |

**Table 4: Cross-Influence – DHW Measures and Smart Thermostats**

| Previous Algorithm                                                                             |                                                                                                                                                                                                                                                                                       |                                                                                                  |       | 2024 Algorithm                                                                                                                                                                                                                                                      |                           |                                                                                                       |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------|
| Question                                                                                       |                                                                                                                                                                                                                                                                                       | Answer                                                                                           | Score | Question                                                                                                                                                                                                                                                            | Answer                    | Score                                                                                                 |
| Cross-Influence                                                                                |                                                                                                                                                                                                                                                                                       |                                                                                                  |       |                                                                                                                                                                                                                                                                     |                           |                                                                                                       |
| F2                                                                                             | [IF F1=1] Your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home.                                                                                                   | 1) Agree                                                                                         | 1     | Do you agree or disagree that ...<br>[IF F1=1] ...your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home?                                         | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F4                                                                                             | [IF F1=1] Because of your previous participation in another Efficiency Nova Scotia program or Service and what you learned by participating in this program, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home. | 1) Agree                                                                                         | 1     | [IF F1=1] ...because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home? | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F7                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                                     | 1) Agree                                                                                         | 1     | [IF F5=1] ... the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                           | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F8                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to take into account the savings on your energy bill when evaluating different energy-efficient products for your home.                                                               | 1) Agree                                                                                         | 1     | [IF F5=1] ... you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia?                                                          | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| Cross-Influence (CI):<br>IF(F2 OR F6=Agree; 1) + IF(F3 OR F7=Agree; 1) + IF(F4 OR F8=Agree; 1) |                                                                                                                                                                                                                                                                                       |                                                                                                  |       | Cross-Influence (CI):<br>IF(F2 =Agree; 1) + IF (F7=Agree; 1) + IF(F4 OR F8=Agree; 1)                                                                                                                                                                                |                           |                                                                                                       |
| Revised Free-Ridership:                                                                        |                                                                                                                                                                                                                                                                                       | IF CI = 0: Revised FR = FR<br>IF CI = 1: Revised FR = FR*0.75<br>IF CI = 2: Revised FR = FR*0.50 |       | Revised Free-Ridership:                                                                                                                                                                                                                                             |                           | IF CI = 0: Revised FR = FR<br>IF CI = 1: Revised FR = FR*0.75<br>IF CI = 2 OR 3: Revised FR = FR*0.50 |

## EPI – Free-Ridership Algorithm for DHW Measures

**Table 5: Free-Ridership – Domestic Hot Water Measures**

| Previous Algorithm |                                                                                                                                                                                                                                             |                              |              | 2024 Algorithm                                                                                                                                                                                                             |                                                                                                                                          |                       |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Question           |                                                                                                                                                                                                                                             | Answer                       | Score        | Question                                                                                                                                                                                                                   | Answer                                                                                                                                   | Score                 |
| INTENTION          |                                                                                                                                                                                                                                             |                              |              |                                                                                                                                                                                                                            |                                                                                                                                          |                       |
| Planning           |                                                                                                                                                                                                                                             |                              |              |                                                                                                                                                                                                                            |                                                                                                                                          |                       |
| E13                | Had you already decided to purchase and install low flow showerheads (LFSH) before learning about the Efficient Product Installation Service?                                                                                               | 1) Yes                       | Use E8       | Before learning about the Efficient Product Installation Service, had you already decided to purchase and install < DHW MEASURE > in your home?                                                                            | 1) Yes                                                                                                                                   | Use E14               |
|                    |                                                                                                                                                                                                                                             | 2) No                        | 0%           |                                                                                                                                                                                                                            | 2) No                                                                                                                                    | 0%                    |
|                    |                                                                                                                                                                                                                                             | 98/99) Don't know/Refused    |              |                                                                                                                                                                                                                            | 98/99) Don't know/Refused                                                                                                                |                       |
| E14                | [IF E7=YES] Just to confirm: Before you learned about the Efficient Product Installation Service, you had already made the decision to purchase and install LFSH?                                                                           | 1) Yes                       | 100%         | [IF E13=YES] Just to confirm: Have I understood correctly that you had already made the decision to purchase and install < DHW MEASURE > in your home before you learned about the Efficient Product Installation Service? | 1) Yes, correct (already made decision)                                                                                                  | 100%                  |
|                    |                                                                                                                                                                                                                                             | 2) No                        | 0%           |                                                                                                                                                                                                                            | 2) No, incorrect (not already made decision)                                                                                             | 0%                    |
|                    |                                                                                                                                                                                                                                             | 98/99) Don't know/Refused    |              |                                                                                                                                                                                                                            | 98/99) Don't know/Refused                                                                                                                |                       |
|                    | Planning Score (PA1)                                                                                                                                                                                                                        |                              | E7           | Planning Score (PS)                                                                                                                                                                                                        |                                                                                                                                          | E13 adjusted with E14 |
| Cost               |                                                                                                                                                                                                                                             |                              |              |                                                                                                                                                                                                                            |                                                                                                                                          |                       |
| E15                | If Efficiency Nova Scotia had not installed these LFSH at no charge as part of the Efficient Product Installation Service, how likely would you have been to purchase and pay for those LFSH, knowing that the cost is about \$30 per unit? | 1) Answer: ____ (scale 0-10) | Answer x 10% | Without the Efficient Product Installation Service, what is the likelihood you would have paid for the < DHW MEASURE >, knowing that the cost is about \$xx per unit?                                                      | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%)            |
|                    |                                                                                                                                                                                                                                             | 98/99) Don't know/Refused    | EMPTY        |                                                                                                                                                                                                                            | 98/99) Don't know/Refused                                                                                                                | EMPTY                 |
|                    |                                                                                                                                                                                                                                             |                              |              | Cost Score (CS)                                                                                                                                                                                                            |                                                                                                                                          | E15                   |

| Previous Algorithm |                                                                                                                                                                                                                                     |                              |                     | 2024 Algorithm                                                                                                                                                                     |                                                                                                                                                                                                                        |            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Question           |                                                                                                                                                                                                                                     | Answer                       | Score               | Question                                                                                                                                                                           | Answer                                                                                                                                                                                                                 | Score      |
| Effort             |                                                                                                                                                                                                                                     |                              |                     |                                                                                                                                                                                    |                                                                                                                                                                                                                        |            |
| E16                | If there was no Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LFSH at a store and install them yourself in your home?                                                   | 1) Answer: ____ (scale 0-10) | Answer x 10%        | Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase < DHW MEASURE > at a store and install them in your home?    | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%)                                                                               | Answer (%) |
|                    |                                                                                                                                                                                                                                     | 98/99) Don't know/Refused    | EMPTY               |                                                                                                                                                                                    | 98/99) Don't know/Refused                                                                                                                                                                                              | EMPTY      |
|                    | Cost & Effort Score (PA2)                                                                                                                                                                                                           |                              | MEAN (E9; E10)      | Effort Score (ES)                                                                                                                                                                  |                                                                                                                                                                                                                        | E16        |
| Question           |                                                                                                                                                                                                                                     | Answer                       | Score               | Question                                                                                                                                                                           | Answer                                                                                                                                                                                                                 | Score      |
| Timing             |                                                                                                                                                                                                                                     |                              |                     |                                                                                                                                                                                    |                                                                                                                                                                                                                        |            |
| E17                | [IF E10 ≥ 5] If there was no Efficient Product Installation Service, how likely would you have been to delay by at least one year replacing your showerheads?                                                                       | 1) Answer: ____ (scale 0-10) | (10 – Answer) x 10% | [IF CODES 1,2,3,4 AT E16] Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your < DHW MEASURE > by at least one year? | 1) Definitely would have (0%)<br>2) Probably would have (25%)<br>3) Probably would not have (75%)<br>4) Definitely would not have (100%)                                                                               | Answer (%) |
|                    |                                                                                                                                                                                                                                     | 98/99) Don't know/Refused    | EMPTY               |                                                                                                                                                                                    | 98/99) Don't know/Refused                                                                                                                                                                                              | EMPTY      |
|                    | Timing Score (PA3)                                                                                                                                                                                                                  |                              | E11                 |                                                                                                                                                                                    | Timing Score (TS)                                                                                                                                                                                                      | E17        |
| Quantity           |                                                                                                                                                                                                                                     |                              |                     |                                                                                                                                                                                    |                                                                                                                                                                                                                        |            |
| E18                | [ASK IF LFSH QUANTITY>1] If there was no Efficient Product Installation service, how likely would you have been to purchase and install the [QUANTITY] LFSH that were installed through the Efficient Product Installation Service? | 1) Answer: ____ (scale 0-10) | Answer x 10%        | [ASK IF LFSH QUANTITY>1 AND IF CODES 1, 2, 3 AT E16] Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred?         | You would have purchased and installed ....<br>1) ...exactly the same number of < DHW MEASURE > (100%)<br>2) ... fewer < DHW MEASURE > (50%)<br>5) You would not have purchased nor installed any < DHW MEASURE > (0%) | Answer (%) |
|                    |                                                                                                                                                                                                                                     | 98/99) Don't know/Refused    | EMPTY               |                                                                                                                                                                                    | 98/99) Don't know/Refused                                                                                                                                                                                              | EMPTY      |

| Previous Algorithm                                  |                                                                                                                                                                                                                                                                                                                |                                                                                      |                  | 2024 Algorithm                                                                                                                                                                                                                                                                                   |                                                                                                                                                                 |                                    |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Question                                            |                                                                                                                                                                                                                                                                                                                | Answer                                                                               | Score            | Question                                                                                                                                                                                                                                                                                         | Answer                                                                                                                                                          | Score                              |
|                                                     | Quantity Score (PA4)                                                                                                                                                                                                                                                                                           |                                                                                      | E12              |                                                                                                                                                                                                                                                                                                  | Quantity Score (QS)                                                                                                                                             | E18                                |
|                                                     | Consistency Test                                                                                                                                                                                                                                                                                               | IF E7=100%<br>AND<br>IF E9<70%<br>OR E10<70%                                         | PA1=EMPTY        | Inconsistency Test                                                                                                                                                                                                                                                                               | IF E13=100% AND<br>IF E15<75% OR E16<75%                                                                                                                        | E13=EMPTY                          |
|                                                     | Consistency Test                                                                                                                                                                                                                                                                                               | IF ABS(E9–E10) ≥50%                                                                  | MIN (E9; E10)    | Inconsistency Test                                                                                                                                                                                                                                                                               | IF E16 <> EMPTY AND ABS (E16-E19a) > 50%                                                                                                                        | E16=EMPTY                          |
|                                                     |                                                                                                                                                                                                                                                                                                                |                                                                                      |                  | INTENTION Score: MIN [MEAN (PS; CS; ES); MEAN (PS; CS; ES; TS); MEAN (PS; CS; ES; TS; QS); MEAN (PS; CS; ES; QS)]                                                                                                                                                                                |                                                                                                                                                                 |                                    |
| INFLUENCE                                           |                                                                                                                                                                                                                                                                                                                |                                                                                      |                  |                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                 |                                    |
| E19                                                 | I would like you to rate the influence of the following two factors in your decision to have the energy-efficient products installed in your home.<br><br>a) The installation of energy-efficient products, at no charge, offered by the service<br><br>b) Information or advice provided by the service staff | 1) Answer: ____<br>(scale 0-10)<br><br>97/98/99) Not applicable/ Don't know/ Refused | MAX (E19a; E19b) | How influential were the following two factors in your decision to have energy efficient products installed in your home? [RANDOMIZE]<br><br>a) The free installation of energy efficient products offered through the service<br><br>b) The information or advice provided by the service staff | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%)<br><br>98/99) Don't know/Refused | MIN (E19a Answer; E19b Answer) (%) |
|                                                     | INFLUENCE Score (PA5): (10–E19) x 10%                                                                                                                                                                                                                                                                          |                                                                                      |                  | INFLUENCE Score (IS): E19                                                                                                                                                                                                                                                                        |                                                                                                                                                                 |                                    |
| Free-Ridership (FR): MEAN (PA1; PA2; PA3; PA4; PA5) |                                                                                                                                                                                                                                                                                                                |                                                                                      |                  | Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                                                                                                                                                                                                                   |                                                                                                                                                                 |                                    |

**Table 6: Cross-Influence – DHW Measures and Smart Thermostats**

| Previous Algorithm                                                                             |                                                                                                                                                                                                                                                                                       |                                                                                                  |       | 2024 Algorithm                                                                                                                                                                                                                                                      |                           |                                                                                                       |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------|
| Question                                                                                       |                                                                                                                                                                                                                                                                                       | Answer                                                                                           | Score | Question                                                                                                                                                                                                                                                            | Answer                    | Score                                                                                                 |
| Cross-Influence                                                                                |                                                                                                                                                                                                                                                                                       |                                                                                                  |       |                                                                                                                                                                                                                                                                     |                           |                                                                                                       |
| F2                                                                                             | [IF F1=1] Your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home.                                                                                                   | 1) Agree                                                                                         | 1     | Do you agree or disagree that ...<br>[IF F1=1] ...your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home?                                         | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F4                                                                                             | [IF F1=1] Because of your previous participation in another Efficiency Nova Scotia program or Service and what you learned by participating in this program, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home. | 1) Agree                                                                                         | 1     | [IF F1=1] ...because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home? | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F7                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                                     | 1) Agree                                                                                         | 1     | [IF F5=1] ... the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                           | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F8                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to take into account the savings on your energy bill when evaluating different energy-efficient products for your home.                                                               | 1) Agree                                                                                         | 1     | [IF F5=1] ... you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia?                                                          | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                      | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                        | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| Cross-Influence (CI):<br>IF(F2 OR F6=Agree; 1) + IF(F3 OR F7=Agree; 1) + IF(F4 OR F8=Agree; 1) |                                                                                                                                                                                                                                                                                       |                                                                                                  |       | Cross-Influence (CI):<br>IF(F2 =Agree; 1) + IF (F7=Agree; 1) + IF(F4 OR F8=Agree; 1)                                                                                                                                                                                |                           |                                                                                                       |
| Revised Free-Ridership:                                                                        |                                                                                                                                                                                                                                                                                       | IF CI = 0: Revised FR = FR<br>IF CI = 1: Revised FR = FR*0.75<br>IF CI = 2: Revised FR = FR*0.50 |       | Revised Free-Ridership:                                                                                                                                                                                                                                             |                           | IF CI = 0: Revised FR = FR<br>IF CI = 1: Revised FR = FR*0.75<br>IF CI = 2 OR 3: Revised FR = FR*0.50 |



## APPENDIX XVIII

### EPI Algorithm for Participant Spillover Calculation

Participant spillover was measured using a participant survey. Participants were asked, pursuant to participating in EPI, whether they implemented any additional energy efficiency measures without benefitting from any rebates offered by E1 program components. If participants did have additional measures implemented, they were asked the type of measure and quantity installed. Subsequently, another question was asked to quantify the level of influence the program component had on the participant's decision to implement the additional measures. The value established regarding this level of influence was used to determine the portion of additional savings attributable to the program component.

Then, the level of participant spillover was established by dividing the total amount of additional savings attributable to the program component by the total amount of savings achieved through program component participation by all survey respondents.

Table 1 illustrates the methodology used to calculate the participant spillover level.

**Table 1: Spillover (for Electrical Savings)**

| 2021 Algorithm |                                                                                                                                       |                           |                                                          | 2024 Algorithm                                                                                                                               |                           |                                                          |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------|
| Question       |                                                                                                                                       | Answer                    | Score                                                    | Question                                                                                                                                     | Answer                    | Score                                                    |
| G1             | Since participating in the Efficient Product Installation Service, have you installed any additional efficient products in your home? | 1) Yes                    | CONTINUE                                                 | Since participating in the Efficient Product Installation Service, have you installed any additional energy-efficient products in your home? | 1) Yes                    | CONTINUE                                                 |
|                |                                                                                                                                       | 2) No                     | GO TO G5                                                 |                                                                                                                                              | 2) No                     | GO TO G5                                                 |
|                |                                                                                                                                       | 98/99) Don't know/Refused |                                                          |                                                                                                                                              | 98/99) Don't know/Refused |                                                          |
| G2             | What energy-efficient products have you installed in your home since participating in the Efficient Product Installation Service?     |                           | SO1=SUM<br>(energy savings associated with each upgrade) | What energy-efficient products have you installed in your home since participating in the Efficient Product Installation Service?            | List of products provided | SO1=SUM<br>(energy savings associated with each upgrade) |
| G3             | How many (item) did you purchase and install?                                                                                         |                           |                                                          | How many [INSERT PRODUCT FROM G2] did you purchase and install?                                                                              |                           |                                                          |

| 2021 Algorithm                                                                                               |                                                                                                                                                                                                     |                            |                                                                 | 2024 Algorithm                                                                                                                                              |                                                                                                                                |                       |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Question                                                                                                     |                                                                                                                                                                                                     | Answer                     | Score                                                           | Question                                                                                                                                                    | Answer                                                                                                                         | Score                 |
| G4                                                                                                           | Did you receive an instant rebate at the cashier for the [INSERT PRODUCT FROM G3] you purchased?                                                                                                    | 1) Yes                     | SO2=0 for the measure                                           | Did you receive an instant rebate at the cashier for the [INSERT PRODUCT FROM G2 IF G3>0] you purchased?                                                    | 1) Yes                                                                                                                         | SO2=0 for the measure |
|                                                                                                              |                                                                                                                                                                                                     | 2) No                      | SO2=1                                                           |                                                                                                                                                             | 2) No                                                                                                                          | SO2=1                 |
|                                                                                                              |                                                                                                                                                                                                     | 98/99) Don't know/Refused  |                                                                 |                                                                                                                                                             | 98/99) Don't know/Refused                                                                                                      |                       |
| G5                                                                                                           | Since participating in the Efficient Product Installation Service, have you retired any old appliances in your home?                                                                                | 1) Yes                     | CONTINUE                                                        | Question discontinued                                                                                                                                       |                                                                                                                                |                       |
|                                                                                                              |                                                                                                                                                                                                     | 2) No                      | GO TO G7                                                        |                                                                                                                                                             |                                                                                                                                |                       |
|                                                                                                              |                                                                                                                                                                                                     | 98/99) Don't know/Refused  |                                                                 |                                                                                                                                                             |                                                                                                                                |                       |
| G6                                                                                                           | What appliances have you retired since participating in the Efficient Product Installation Service?                                                                                                 |                            | SO3=SUM (energy savings associated with each retired appliance) | Question discontinued                                                                                                                                       |                                                                                                                                |                       |
| G7                                                                                                           | How many [INSERT RESPONSE IN G6] have you retired?                                                                                                                                                  |                            |                                                                 | Question discontinued                                                                                                                                       |                                                                                                                                |                       |
| G8                                                                                                           | Did you receive a rebate or assistance from a program for the [INSERT APPLIANCE FROM G7] you retired?                                                                                               | 1) Yes                     | SO4=0 for the measure                                           | Question discontinued                                                                                                                                       |                                                                                                                                |                       |
|                                                                                                              |                                                                                                                                                                                                     | 2) No                      | SO4=1                                                           |                                                                                                                                                             |                                                                                                                                |                       |
|                                                                                                              |                                                                                                                                                                                                     | 98/99) Don't know/Refused  |                                                                 |                                                                                                                                                             |                                                                                                                                |                       |
|                                                                                                              | Additional Products and Retirement Savings: SO5 = (SO1 x SO2) + (SO3 x SO4)                                                                                                                         |                            |                                                                 | Additional Products and Retirement Savings: SO5 = (SO1 x SO2)                                                                                               |                                                                                                                                |                       |
| Attribution Level                                                                                            |                                                                                                                                                                                                     |                            |                                                                 |                                                                                                                                                             |                                                                                                                                |                       |
| G5                                                                                                           | How influential was your experience with the Efficient Product Installation Service in your decision to install these additional energy-efficient products or retire these appliances in your home? | 1) Answer: __ (scale 0-10) | SO6=Answer x 10%                                                | How influential was your experience with the Efficient Product Installation Service in your decision to install these additional energy-efficient products? | 1) Very influential (100%)<br>2) Somewhat influential (75%)<br>3) Not very influential (25%)<br>4) Not at all influential (0%) | SO6= Answer (%)       |
|                                                                                                              |                                                                                                                                                                                                     | 98/99) Don't know/Refused  | SO6= EMPTY                                                      |                                                                                                                                                             | 98/99) Don't know/Refused                                                                                                      | SO6 = EMPTY           |
| Final Spillover Level = SUM of (SO5 x SO6) for All Respondents<br>SUM of Program Savings for All Respondents |                                                                                                                                                                                                     |                            |                                                                 | Final Spillover Level = SUM of (SO5 x SO6) for All Respondents<br>SUM of Program Savings for All Respondents                                                |                                                                                                                                |                       |

## APPENDIX XIX

### EPI Jurisdictional Scan Findings

Econoler performed a scan across various jurisdictions throughout Canada and the United States (US) to identify other measures that could be installed by electricians under EPI. This appendix presents the scanned jurisdictions and the measures they include. Measures already included in EPI are in **blue**. Measures not suited for EPI are in **light blue**; those includes measures that require a large amount of time to install, products that are too voluminous to keep in stock, and measures that requires piercing or opening walls or ceilings. Measures that might be added to the EPI offering are in **bold**.

**Table 1: Jurisdictional Scan Findings**

| Jurisdiction                            | Program                                       | Entity Offering the Program | Energy Efficiency Measures                                                                                                                                                                                                                                                                          | Source                                                                                                                                                                                                                                                                  |
|-----------------------------------------|-----------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Canadian Direct-install Programs</b> |                                               |                             |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                         |
| British Columbia                        | Energy Conservation Assistance Program (ECAP) | Fortis BC                   | LED light bulbs<br>Kitchen and bathroom faucet aerators<br>Water-efficient showerheads<br>Exterior door weatherstripping<br>Clothes drying rack or clothesline<br>Some homes may qualify for an ENERGY STAR® certified refrigerator, insulation, an air conditioner (A/C), or an electric heat pump | <a href="https://www.fortisbc.com/rebates/home/free-home-energy-evaluation-and-upgrades">https://www.fortisbc.com/rebates/home/free-home-energy-evaluation-and-upgrades</a>                                                                                             |
|                                         | Energy Conservation Assistance Program        | BC Hydro                    | LED light bulbs and night light<br>High-efficiency showerheads<br>Faucet aerators<br>Door weather stripping<br>Insulating wrap for hot water pipes<br>Clothes drying rack<br><b>Carbon monoxide detectors</b><br>ENERGY STAR® fridge replacement                                                    | <a href="https://www.bchydro.com/powersmart/residential/rebates-programs/savings-based-on-income/free-product-install-and-advice.html">https://www.bchydro.com/powersmart/residential/rebates-programs/savings-based-on-income/free-product-install-and-advice.html</a> |
| Manitoba                                | In-suite Energy Efficiency Program            | Efficiency Manitoba         | <i>Basic Upgrade (Installation by an Ecofitt technician)</i><br>A-line LED bulbs<br>Faucet aerators<br>Showerheads<br>Shower timers<br>Water heater pipe wrap                                                                                                                                       | <a href="https://efficiencymb.ca/in-suite-energy-efficiency-program/">https://efficiencymb.ca/in-suite-energy-efficiency-program/</a>                                                                                                                                   |

| Jurisdiction  | Program                                            | Entity Offering the Program | Energy Efficiency Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Source                                                                                                                                                                                    |
|---------------|----------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                                    |                             | <p>Window insulation kits</p> <p><i>Premium Upgrade (Installation by a certified electrician)</i></p> <p>Smart thermostat</p> <p>Advanced HRV controls</p>                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                           |
| New Brunswick | Enhanced Energy Savings Program (EESP)             | NB Power                    | <p><i>Air Sealing</i></p> <p><i>Insulation</i></p> <p>Basement/Crawlspace Header/Wall Insulation</p> <p>Insulating Exposed Floors or Floors Over Unheated Areas</p> <p>Insulating Exterior Walls</p> <p>Insulating Attics</p> <p>Moisture Barrier Installation Over Dirt Floors in Heated Areas</p> <p><i>Space Heating Upgrades</i></p> <p>Ductless Mini-Split Heat Pump</p> <p>Central Ducted Air Source Heat Pump</p> <p><i>Health and Safety Upgrades</i></p> <p><b>Carbon Monoxide (CO) Detectors</b></p> <p>Bathroom Fans</p> <p>Heat Recovery Ventilation (HRV)</p> | <a href="https://www.saveenergynb.ca/media/cdjnxc33/2024-may-final-english_eesp-guidelines.pdf">https://www.saveenergynb.ca/media/cdjnxc33/2024-may-final-english_eesp-guidelines.pdf</a> |
| Ontario       | Save on Energy™ Energy Affordability Program (EAP) | IESO                        | <p><i>Comprehensive Support</i></p> <p>Energy-efficient refrigerator</p> <p>ENERGY STAR® certified window air conditioner</p> <p>ENERGY STAR® certified LED light bulbs</p> <p>ENERGY STAR® certified dehumidifiers</p> <p>ENERGY STAR® certified freezers</p> <p>Drying line for clothes</p> <p>Smart power strip</p> <p>High-efficiency showerheads (standard and handheld)</p> <p>Faucet aerators (kitchen and bathroom)</p> <p>Additional attic or basement insulation</p> <p>Weatherstripping around doors and windows</p>                                            | <a href="https://saveonenergy.ca/en/Fo-r-Your-Home/Energy-Affordability-Program">https://saveonenergy.ca/en/Fo-r-Your-Home/Energy-Affordability-Program</a>                               |

| Jurisdiction                        | Program                           | Entity Offering the Program                                                      | Energy Efficiency Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Source                                                                                                                              |
|-------------------------------------|-----------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
|                                     |                                   |                                                                                  | <p>Smart thermostat(s)</p> <p>Cold climate air source heat pump</p> <p><i>Energy Savings Kit</i></p> <p>LED light bulbs</p> <p>Weather stripping</p> <p>Handheld showerhead</p> <p>Retractable clothesline</p> <p>Faucet aerators</p> <p>LED night light</p> <p><b>Block heater timer</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                     |
| <b>U.S. Direct-install Programs</b> |                                   |                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                     |
| U.S. Federal                        | Weatherization Assistance Program | Funded by the U.S. Department of Energy (DOE), administrated by local government | <p><b>MECHANICAL MEASURES:</b></p> <p>Clean, tune, repair, or replace heating and/or cooling systems.</p> <p>Install duct and heating pipe insulation.</p> <p><b>Install programmable thermostats and other HVAC controls.</b></p> <p>Repair/replace water heaters.</p> <p><b>Install water heater tank insulation.</b></p> <p><b>Insulate water heating pipes.</b></p> <p>Install solar water heating systems.</p> <p>Install waste heat recovery devices.</p> <p><b>HEALTH AND SAFETY MEASURES:</b></p> <p>Complete combustion appliance safety testing.</p> <p>Repair/replace vent systems to ensure combustion gas draft safely outside.</p> <p>Install mechanical ventilation to ensure adequate indoor air quality.</p> <p>Assess fire hazards. <b>Install smoke and carbon monoxide alarms when needed.</b></p> <p>Evaluate mold/moisture hazards.</p> <p>Perform incidental safety repairs when needed.</p> <p><b>BUILDING SHELL MEASURES:</b></p> <p>Install wall, floor, ceiling, attic, and/or foundation insulation.</p> <p>Complete Blower Door Testing.</p> | <a href="https://www.energy.gov/scep/wap/whole-house-weatherization">https://www.energy.gov/scep/wap/whole-house-weatherization</a> |

| Jurisdiction  | Program                                 | Entity Offering the Program  | Energy Efficiency Measures                                                                                                                                                                                                                                                                                                                                                                                         | Source                                                                                                                                                                                                |
|---------------|-----------------------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                         |                              | Perform air sealing.<br>Repair/replace primary windows/doors.<br>Install storm windows/doors.<br>Install window film/solar screens/window louvers and awnings.<br>Repair minor roof and wall leaks prior to attic or wall insulation.<br><br><i>ELECTRIC BASELOAD MEASURES:</i><br>Install motor controls.<br>Install efficient light sources.<br>Replace refrigerators and freezers with energy efficient models. |                                                                                                                                                                                                       |
| Connecticut   | Residential Home Energy Savings Program | Norwich Public Utilities     | Health and safety check of the house<br>Blower door test<br>Duct blast test<br>Lighting upgrade from incandescent to LED bulbs.<br>Water heating energy-saving measures (low-flow showerheads, faucet aerators, and pipe insulation).<br>Special rebate offers for replacing inefficient home appliances and installing additional attic wall and attic insulation (as applicable).                                | <a href="https://norwichpublicutilities.com/residential/efficiency-programs-rebates/#nav-anchor-to-2">https://norwichpublicutilities.com/residential/efficiency-programs-rebates/#nav-anchor-to-2</a> |
| New Hampshire | Home Energy Assistance                  | New Hampshire Electric Co-op | Air sealing and insulation<br>Programmable thermostats<br>Hot water saving measures (low-flow showerheads, faucet aerators, and pipe insulation)<br>Lighting upgrades<br>Health and safety measures<br>End of life heating systems replacement                                                                                                                                                                     | <a href="https://www.nhec.com/home-energy-assistance/">https://www.nhec.com/home-energy-assistance/</a>                                                                                               |
| Florida       | Neighborhood Weatherization Program     | Tampa Electric               | Free Energy Audit<br>Six energy-efficient LED light bulbs<br>Water heater pipe insulation wrap<br>Low-flow showerheads and aerators<br>Wall plate thermometer<br>Refrigerator coil brush<br>Weather stripping for doors<br>Caulking for windows (when applicable)<br>Air filter whistle<br>Free duct sealing and ceiling insulation                                                                                | <a href="https://www.tampaelectric.com/residential/saveenergy/neighborhoodweatherization/">https://www.tampaelectric.com/residential/saveenergy/neighborhoodweatherization/</a>                       |

| Jurisdiction                            | Program                     | Entity Offering the Program                              | Energy Efficiency Measures                                                                                                                                                                                                                                                                                | Source                                                                                                                                                                                                                                                                                  |
|-----------------------------------------|-----------------------------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Canadian Direct-install Programs</b> |                             |                                                          |                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                         |
| PEI                                     | Instant Rebates             | Efficiency PEI                                           | <b>ENERGY STAR® certified LED Fixtures</b><br><b>Smart Thermostats</b><br>Appliances (Full-size Refrigerators, Washing Machines, Clothes Dryers, Combination Washer/Dryer Units, Dishwashers)<br>Dehumidifiers<br>Toilets<br>Bathroom and Utility Fans<br>Room Air Purifiers<br>Variable Speed Pool Pumps | <a href="https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/instant-rebates-on-energy-efficiency-products">https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/instant-rebates-on-energy-efficiency-products</a> |
| British Columbia                        | Instant Rebates             | BC Hydro                                                 | <b>Smart thermostats</b><br>Lighting control (Dimmer switches, motion sensors, indoor timers, occupancy sensors)<br><b>Smart outlets and switches</b><br>Smart power bars and plugs                                                                                                                       | <a href="https://www.bchydro.com/powersmart/residential/rebates-programs/product-rebates.html">https://www.bchydro.com/powersmart/residential/rebates-programs/product-rebates.html</a>                                                                                                 |
| Ontario                                 | CoolSaver Program           | Toronto Hydro, HydroOne, Alectra Utilities, Hydro Ottawa | Air Conditioner Tune-ups<br><b>Smart Thermostat</b><br>Variable Speed Pool Pumps<br>Dehumidifier Replacement<br>Central Air Conditioner (CAC) Replacement                                                                                                                                                 | <a href="https://saveonenergy.ca/For-Your-Home/CoolSaver">https://saveonenergy.ca/For-Your-Home/CoolSaver</a>                                                                                                                                                                           |
|                                         | Smart Thermostats           | Enbridge Gas                                             | <b>Smart Thermostats</b>                                                                                                                                                                                                                                                                                  | <a href="https://www.enbridgegas.com/residential/rebates-energy-conservation/smart-thermostats">https://www.enbridgegas.com/residential/rebates-energy-conservation/smart-thermostats</a>                                                                                               |
| Newfoundland and Labrador               | Take Charge                 | Newfoundland and Labrador Hydro / Newfoundland Power     | Lighting control (timer, motion sensors, dimmer switches)<br>Smart plugs                                                                                                                                                                                                                                  | <a href="https://takechargenl.ca/residential/rebate-programs/instant-rebates/">https://takechargenl.ca/residential/rebate-programs/instant-rebates/</a>                                                                                                                                 |
| Saskatchewan                            | Energy Efficiency Discounts | SaskPower                                                | LED bulbs and fixtures<br>Lighting control (Dimmer switches, motion sensors, indoor timers, occupancy sensors)<br>Smart thermostats<br><b>Heat reflector panel or roll</b><br><b>Bathroom fans</b>                                                                                                        | <a href="https://www.saskpower.com/power-savings-and-programs/home/programs/energy-efficiency-discounts">https://www.saskpower.com/power-savings-and-programs/home/programs/energy-efficiency-discounts</a>                                                                             |

| Jurisdiction                        | Program                                               | Entity Offering the Program | Energy Efficiency Measures                                                                                                                                                                                                                                                                                                   | Source                                                                                                                                                                                                                                                                                  |
|-------------------------------------|-------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                     |                                                       |                             | Appliances (clothes washers, dishwashers)<br>Hot water saving measures (low-flow showerheads, faucet aerators)<br>Weatherization (door sweep/seal, spray foam insulation, attic and floor batt/roll insulation, wall batt/roll insulation)                                                                                   |                                                                                                                                                                                                                                                                                         |
| <b>U.S. Direct-install Programs</b> |                                                       |                             |                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                         |
| California                          | Multifamily Residential Energy Savings Rebate Program | Pacific Gas & Electric Co   | Domestic Hot Water Loop Controller<br>Heat Pump Water Heater<br>High Performance Circulator Pump<br>Low Flow Shower Head<br>Thermostatic Shower Spout w/ Low Flow Shower Head<br>Ductless Minisplit Heat Pump<br>Gas Fireplace<br>High Efficiency Furnace w/ Variable Speed Motor<br>ENERGY STAR Room AC<br>Smart Thermostat | <a href="https://programs.dsireusa.org/system/program/detail/4257/pg-e-multifamily-residential-energy-savings-rebate-program">https://programs.dsireusa.org/system/program/detail/4257/pg-e-multifamily-residential-energy-savings-rebate-program</a>                                   |
|                                     | Residential Energy Efficiency Rebate Program          | Southern California Edison  | Smart Thermostat<br>Electric Vehicle<br>Home or Business Area Network<br>Electric Portable Power Stations<br>Portable Power Generator                                                                                                                                                                                        | <a href="https://programs.dsireusa.org/system/program/detail/4377/sc-e-residential-energy-efficiency-rebate-program">https://programs.dsireusa.org/system/program/detail/4377/sc-e-residential-energy-efficiency-rebate-program</a>                                                     |
| Michigan                            | Bright Energy Solutions                               | Franklin Energy             | HVAC<br>Central Air Conditioners<br>Mini Split Heat Pump<br>Air-Source Heat Pump<br>Whole Home Dehumidifier<br><br>Appliances<br>Water Heater<br>Dehumidifier<br>Refrigerator<br>Freezer<br>Smart Thermostat<br>Clothes Washer                                                                                               | <a href="https://programs.dsireusa.org/system/program/detail/3947/energy-smart-residential-energy-efficiency-rebate-program-16-municipalities">https://programs.dsireusa.org/system/program/detail/3947/energy-smart-residential-energy-efficiency-rebate-program-16-municipalities</a> |



| Jurisdiction | Program             | Entity Offering the Program | Energy Efficiency Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Source                                                                                                                                                                                                                                                                            |
|--------------|---------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |                     |                             | <p>Electric Clothes Dryer<br/>Heat Pump Clothes Dryer<br/>Room A/C<br/>Inverter Driven Room A/C<br/>Air Purifier<br/>Personal Computer<br/>Monitor<br/>Television<br/>Intelligent Surge Protector</p> <p><i>Weatherization</i><br/>Ceiling Insulation<br/>Attic Hatch Insulation<br/>Wall Insulation<br/>Crawlspace Wall Insulation<br/>Rim Joist Foam Insulation<br/>Windows<br/>Patio Doors<br/>Doors<br/>Door Weatherstripping</p> <p><i>Electric Vehicles</i><br/>Connected EV Charger</p> |                                                                                                                                                                                                                                                                                   |
| Minnesota    | Energy Wise Rebates | Dakota Electric Service     | <p><i>Appliances</i><br/>Dehumidifier<br/>Refrigerator/Freezer Recycling<br/>Electric Clothes Dryer<br/>Electric Water Heater<br/>Heat Pump Water Heater</p> <p><i>Heating and Cooling</i><br/>Central Air Conditioners<br/>Air-Source Heat Pump Tune up<br/>Air-Source Heat Pump Quality Installation</p>                                                                                                                                                                                     | <a href="https://programs.dsireusa.org/system/program/detail/2259/dakota-electric-association-residential-energy-efficiency-rebate-program">https://programs.dsireusa.org/system/program/detail/2259/dakota-electric-association-residential-energy-efficiency-rebate-program</a> |

| Jurisdiction | Program                                       | Entity Offering the Program | Energy Efficiency Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Source                                                                                                                                                                                                                      |
|--------------|-----------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              |                                               |                             | Ductless/Mini-Split Heat Pump<br>Ground-Source Heat Pump<br><br><i>Swimming Pools</i><br>Variable Speed Pool Pump<br>Air-Source Heat Pump Pool Heater<br><br><i>Other</i><br>Light Emitting Diodes (LEDs)<br>Residential LED Yard Light<br>Leaf blower<br>Chainsaw<br>Trimmer or Weed Whip<br>Mower<br>Snow Blower<br>Electric Vehicle Charger<br>Solar Installation                                                                                                                                                                                                                                      |                                                                                                                                                                                                                             |
| Vermont      | Residential Energy Efficiency Rebate Programs | Efficiency Vermont          | Air-to-Water Heat Pumps<br>Ducted Heat Pumps<br>Ductless Heat Pumps<br>Integrated Controls for Ductless Heat Pumps<br>Ground Source Heat Pumps<br>Central Wood Pellet Furnaces & Boilers<br>Wood and Pellet Stoves<br>Clothes Dryers<br>Washer & Dryer Combo Unit<br>Dehumidifiers<br>Heat Pump Water Heaters<br>High-Performance Circulator Pump<br>Smart Thermostats<br>Home Performance with Energy Star<br>LEDs for Indoor Growing<br>LED Replacement Lamps for CFLs<br>DIY Weatherization (weather-stripping, insulation, air sealing, etc.)<br>Window Air Conditioners<br>Virtual Home Energy Visit | <a href="https://programs.dsireusa.org/system/program/detail/2325/residential-energy-efficiency-rebate-programs">https://programs.dsireusa.org/system/program/detail/2325/residential-energy-efficiency-rebate-programs</a> |

# APPENDIX XX

## EPI 2024 Recommendations

This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 EPI evaluation.

| Section           | Recommendations                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | Recommendation #1: To improve the smart thermostat installation rate, explore and implement strategies to reduce the number of participants disconnecting this product due to dissatisfaction. For example, follow-up calls could be conducted, installers could educate more participants on this product, or additional educational material on this product could be shared with participants. |

## APPENDIX XXI

### Green Heat Past Participant Survey Questionnaire

#### HOME ENERGY ASSESSMENT/GREEN HEAT PAST PARTICIPANT SURVEY

**Table 1: Overview of Data Collection Activity**

| Descriptor                      | This Instrument                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instrument Type                 | Web survey                                                                                                                                               |
| Estimated Time to Complete      | 5 min                                                                                                                                                    |
| Target Audience                 | Past participants whose projects generated electrical savings in 2023                                                                                    |
| Expected Number of Completions  | 300 for HEA<br>200 for GH                                                                                                                                |
| Contact List Source             | 2024 HEA Billing Analysis Treatment Group Sample (around 1,000 contacts); and<br>2024 GH Billing Analysis Treatment Group Sample (around 1,000 contacts) |
| Fielding Firm                   | Narrative Research                                                                                                                                       |
| Estimated Timeline for Fielding | Early September – Early October                                                                                                                          |

**Table 2: Research Objectives and Associated Sections**

| Research Objectives          | Section |
|------------------------------|---------|
| Verification and recall      | A       |
| Verification of action taken | B       |
| Demographics                 | I       |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**



## Introduction

We at Narrative Research are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia. Our records indicate that you or your household recently participated in the **<INSERT PROGRAM NAME>** program.

We would appreciate your help in answering a very short survey about this program, it will take perhaps 2 or 3 minutes.

**[IF GH]:** As a reminder, the program provides a rebate for the installation of home heating equipment such as **<INSERT MEASURE >**.

**[IF HEA]:** As a reminder, this program involves having an energy advisor conduct an assessment of your home, including a blower door test, and provide participants with energy efficiency upgrade recommendations. The federal Canada Greener Homes Grant initiative is delivered with Efficiency Nova Scotia through the Home Energy Assessment (HEA) program, so you may instead recall participating in the Greener Homes program.].

### A. Verification and Recall

A1. We understand you participated in the **<INSERT PROGRAM>** program in **<PARTICIPATION YEAR>** for your house located at **<ADDRESS>** **[IF GH, ADD]** by installing a **<INSERT MEASURE>**. Is that correct?

1. Yes **[CONTINUE]**
2. No **[END]**

### B. Verification of Actions Taken

The following questions concern **<IF PROGRAM=HEA>** “the energy efficiency upgrades” **<IF PROGRAM=GH>** “the **<INSERT MEASURE >** installation project” **<FOR ALL>** that you completed through your participation in **<INSERT PROGRAM>** in **<PARTICIPATION YEAR>** for the house located at **<ADDRESS>**

B1. **<IF PROGRAM=HEA>** “Were your energy efficiency upgrades” **<IF PROGRAM=GH>** “Was your **<INSERT MEASURE>**”, **<FOR ALL>** installed as part of a renovation project that involved adding floor area to your home? By adding floor area, we mean that you added an extension to your home, such as a new floor or a new room that was not there before your renovation project.  
**PROGRAM B1 AND B2 AS MANDATORY, ALL OTHER QUESTIONS (EXCEPT A1) WILL BE PROGRAMMED AS OPTIONAL**

1. Yes
2. No

- B2. **<IF PROGRAM=HEA>**, “Were your energy efficiency upgrades” **<IF PROGRAM=GH>** “Was your **<INSERT MEASURE>**” **<FOR ALL>** installed as part of a renovation project that involved heating rooms that were previously not heated or were only minimally heated (for example,. at a temperature lower than 15°C)? Examples of such renovation projects would be that, you finished your basement and started heating it, or you could have changed a sunroom so that it became heated throughout the year whereas it previously was not.
1. Yes, ***the renovation project involved*** heating rooms that were previously not heated/were minimally heated
  2. No ***the renovation project did not involve*** heating rooms that were previously not heated/were minimally heated
- B3. **<IF PROGRAM=HEA OR MEASURE=HEAT PUMP>**Did you have a fireplace or wood stove in your home **<IF PROGRAM=HEA>** “before having your home evaluated by an energy advisor” **<IF PROGRAM=GH>** “before installing your heat pump”? **ACCEPT MULTIPLE ‘YES’ RESPONSE**
1. Yes, a fireplace
  2. Yes, a wood stove
  3. No
- B4. **[IF B3= 1 AND/OR 2]** How, if at all, did usage of your [a. ‘fireplace’ / b. ‘wood stove’] change after you installed your energy efficiency upgrades? Did your usage ...: **[READ – POSE SEPARATELY FOR ‘A’ AND ‘B’, IF 1 AND 2 SELECTED IN B3]**
1. Increase a lot
  2. Increase a little
  3. Stay the same
  4. Decrease a little
  5. Decrease a lot
  6. Did not notice a change
- B5. **[ASK IF PROGRAM=HEA]** Through the **<INSERT PROGRAM>**, have you installed any type of heat pump, including mini-split, central or geothermal?
1. Yes
  2. No
- B6. **[ASK IF B5=1 OR PROGRAM=GH AND MEASURE=HEAT PUMP]** Prior to installing your heat pump, did you already have a working air conditioner in your home? **[DO NOT READ RESPONSES]**
1. Yes
  2. No

**END:** Thank you for completing today’s survey – your help is greatly appreciated.

## APPENDIX XXII

### Green Heat Past Participant Survey Results

**TABLE B1:** Was your Green Heat installed as part of a renovation project that involved adding floor area to your home? By adding floor area, we mean that you added an extension to your home, such as a new floor or a new room that was not there before your renovation project.

| OVERALL %       |     |
|-----------------|-----|
| SAMPLE SIZE (#) | 240 |
| Yes             | 4%  |
| No              | 96% |

**TABLE B2:** Was your Green Heat installed as part of a renovation project that involved heating rooms that were previously not heated or were only minimally heated (for example, at a temperature lower than 15°C)?

Examples of such renovation projects would be that, you finished your basement and started heating it, or you could have changed a sunroom so that it became heated throughout the year whereas it previously was not.

| OVERALL %                                                                                                      |     |
|----------------------------------------------------------------------------------------------------------------|-----|
| SAMPLE SIZE (#)                                                                                                | 240 |
| Yes, the renovation project involved heating rooms that were previously not heated/were minimally heated       | 16% |
| No, the renovation project did not involve heating rooms that were previously not heated/were minimally heated | 84% |

**TABLE B3:** [MEASURE=HEAT PUMP] Did you have a fireplace or wood stove in your home before installing your heat pump?

| OVERALL %         |     |
|-------------------|-----|
| SAMPLE SIZE (#)   | 204 |
| Yes, a fireplace  | 15% |
| Yes, a wood stove | 31% |
| No                | 55% |

**TABLE B4a:** [IF B3=1] How, if at all, did usage of your fireplace change after you installed your energy efficiency upgrades? Did your usage ...:

| OVERALL %               |     |
|-------------------------|-----|
| SAMPLE SIZE (#)         | 30  |
| Increase a lot          | 7%  |
| Increase a little       | 7%  |
| Stay the same           | 30% |
| Decrease a little       | 17% |
| Decrease a lot          | 30% |
| Did not notice a change | 10% |

**TABLE B4b:** [IF B3=2] How, if at all, did usage of your wood stove change after you installed your energy efficiency upgrades? Did your usage ...:

| OVERALL %               |     |
|-------------------------|-----|
| SAMPLE SIZE (#)         | 64  |
| Increase a lot          | 2%  |
| Increase a little       | 6%  |
| Stay the same           | 30% |
| Decrease a little       | 23% |
| Decrease a lot          | 31% |
| Did not notice a change | 8%  |

**TABLE B6:** [MEASURE=HEAT PUMP] Prior to installing your heat pump, did you already have a working air conditioner in your home?

| OVERALL %       |     |
|-----------------|-----|
| SAMPLE SIZE (#) | 204 |
| Yes             | 30% |
| No              | 70% |



## APPENDIX XXIII

### Green Heat Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net electrical energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 Green Heat Corrected Tracked Savings**

| Program Component Results                  | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>Green Heat</b>                          |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 4.519               | GWh  | 4.711                   | GWh  | 4.26%               |
| Gross Peak Demand Savings at the Generator | 3.907               | MW   | 3.915                   | MW   | 0.21%               |
| Net Energy Savings at the Generator        | 2.377               | GWh  | 2.478                   | GWh  | 4.27%               |
| Net Peak Demand Savings at the Generator   | 2.142               | MW   | 2.143                   | MW   | 0.05%               |

As shown in Table 1, differences between the tracked and corrected values are found in the gross and net electrical energy savings as well as the gross and net peak demand savings results. Those differences are mainly caused by corrections made by the Evaluator.

For electrical energy savings:

- › The definition of fully and mainly electrically heated used to allocate savings for mini-split heat pump (MSHP) measures was not consistent with that used in the billing analysis, because fireplaces were considered as a secondary non-electrical heating system that put participants in the mainly electrical category, when they should have been considered fully electrically heated. This explains the most of the difference between the tracked and corrected tracked values.
- › The adjustment of the baseline for some wood fireplace inserts and wood and pellet stoves from a heat pump baseline to an electric resistance baseline according to their primary and secondary heating systems
- › The adjustment for discrepancies between unitary savings and reported electrical energy savings for some wood fireplace inserts and wood and pellet stoves
- › The adjustment from fully electrically heated to mainly electrically heated for some mini-split heat pump measures because a secondary heating system was installed

- 
- › The adjustment of the nominal heating capacity as well as the heating capacity and COP at -15°C used for mini-split heat pumps for some projects, based on values found in the NEEP Cold Climate Air Source Heat Pump Product list

For peak demand savings:

- › The adjustment to the nominal heating capacity used for some mini-split heat pumps, based on values found in the NEEP Cold Climate Air Source Heat Pump Product list.
- › The correction of NTGRs for all three-element water heater and domestic hot water timer measures.



## APPENDIX XXIV

# Green Heat Detailed Methodology and Billing Analysis

### Background

After inconclusive results in 2023, a billing analysis was again conducted for Green Heat as part of the 2024 DSM evaluation to obtain measured electrical energy savings generated through the installation of mini-split heat pumps (MSHPs) and wood or pellet stoves or fireplace inserts. MSHPs are the most significant measures in Green Heat, followed by wood or pellet stoves or fireplace inserts. The 2024 billing analysis served to update the results of the 2017 billing analysis for MSHPs, while it was conducted for the first time for wood or pellet stoves or fireplace inserts since these measure savings were previously estimated using energy modelling as part of the 2013 evaluation. Unlike the billing analysis conducted in 2023, **AMI data**, which started to be progressively available for residential customers in 2020, were used for the 2024 billing analysis to improve the quality of the analysis.

### Methodology

The billing analysis consisted of calculating the change in electrical energy consumption by comparing levels before and after participation in Green Heat for a group of recent participants (treatment group). To account for variations in electrical energy consumption due to factors other than Green Heat participation, the Evaluator selected a control group of Green Heat participants from previous years and deducted the change in electrical energy consumption observed for that group over the same period (difference-in-differences approach). Subtracting the change in control group electrical energy consumption (i.e. a change that is not linked to the program component) from that of the treatment group ensures that **only savings attributable to Green Heat are captured** and avoids capturing other effects that can have an impact on energy consumption (e.g. the COVID-19 pandemic) because both the treatment and control groups are impacted by such effects.

Electrical energy savings are obtained from the AMI data and weather-normalized so they can be compiled and compared. For MSHPs, normalized electrical energy savings are divided by the nominal capacity of installed units to obtain unitary savings as a function of capacity. For wood/pellet stoves/fireplace inserts, unitary savings are presented on a per-unit basis.

The following subsections detail how AMI data were used to calculate electrical energy savings and ultimately unitary savings.

### Selection of the Treatment and Control Groups

The initial treatment group included 1,211 Green Heat participants (1,014 for MSHP measures and 197 for wood/pellet stoves/fireplace inserts) who were selected based on the following criteria:

- › Be mainly electrically heated before Green Heat participation, meaning that the primary heating fuel identified in the tracking sheet was electrical. In addition, for participants who installed a MSHP, have a primary heating system other than a heat pump or thermal storage system before Green Heat participation
- › Have an installation date no later than October 2023 to ensure a full year of post data
- › Have an installation date no earlier than October 2022 to avoid overlap with control group participation

Among the 1,211 participants selected based on these criteria, AMI data were available for 1,101 participants.



The initial control group included a total of 2,810 participants who were selected based on the following criteria:

- › Be mainly electrically heated before Green Heat participation
- › Have an installation date no later than October 2021
- › Have an installation date no earlier than January 2020

Among the 2,810 control group participants selected based on these criteria, AMI data were available for 2,305 participants.<sup>2</sup>

By selecting the control group among a sample of past Green Heat participants, the Evaluator ensured that control group participants had similar characteristics to treatment group participants, as recommended for matched control group approaches in Chapter 8 of the Uniform Methods Project (UMP). The process to match control and treatment participants is further described below.

### AMI Data Preparation

AMI data for treatment group and control group participants were obtained from two sources:

- › Nova Scotia Power (NS Power) for the period between the moment AMI data became available (2020) and November 2023
- › EfficiencyOne for the year 2024 (in May 2023, EfficiencyOne started to have access to AMI data in the NS Power system)

In both cases, AMI data were aggregated on a monthly basis (i.e. only monthly kWh consumption values were available).

Before performing the billing analysis, the Evaluator validated the annual consumption load shapes for each treatment and control group participant to exclude those participants with inconsistent consumption data. Data that matched the following criteria were excluded:

- › Nil consumption or missing data in the study period
- › Very high or very low peaks in the study period
- › Numerous abnormal variations in the consumption pattern (extremely high consumption months followed by close to zero consumption months for instance)

As a result of the above criteria, about 5% of the sample was excluded. The control group remained largely sufficient to have a control match for each treatment group participant.

### Control-Treatment Participant Matching

To determine the best suited control group participant for each treatment group participant, the Evaluator first applied a set of minimum conditions with which to comply:

- › The installation date of the control participant must be at least one year before the installation date of the treatment participant.
- › The weather station must be the same.
- › The measure installed (MSHP or wood/pellet stoves/fireplace insert) must be the same.

---

<sup>2</sup> As it was the case for the treatment group, the Evaluator kept only participants with a high level of confidence in the NS Power data matching in the analysis.

These conditions left treatment participants with more than one potential control participant. The point system presented in Table 1 below was then used to provide a score for each potential control participant. The control participant with the highest score was then considered the ideal match and was assigned to the given treatment participant.

**Table 1: Details on the Point System Used for the Selection of Control Participants**

| Parameters                                                                                  | Points                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average daily consumption of treatment and control candidates after their installation date | <p>Add a maximum of 2 points based on a function of the relative difference between the average daily consumption of treatment and control candidates using a sigmoid function that yields approximately the following points:</p> <ul style="list-style-type: none"> <li>› 2 points if difference is 10%</li> <li>› 1 point if difference is 25%</li> <li>› 0 points if difference is 50% or more</li> </ul> |

It should be noted that each participant had different pre and post-program periods based on when participation in Green Heat occurred. Given this, each treatment group participant was assigned one control group participant, and the dates of the pre and post-periods of each treatment participant were applied to their matched control participant for the next steps of the billing analysis.

### Weather Normalization

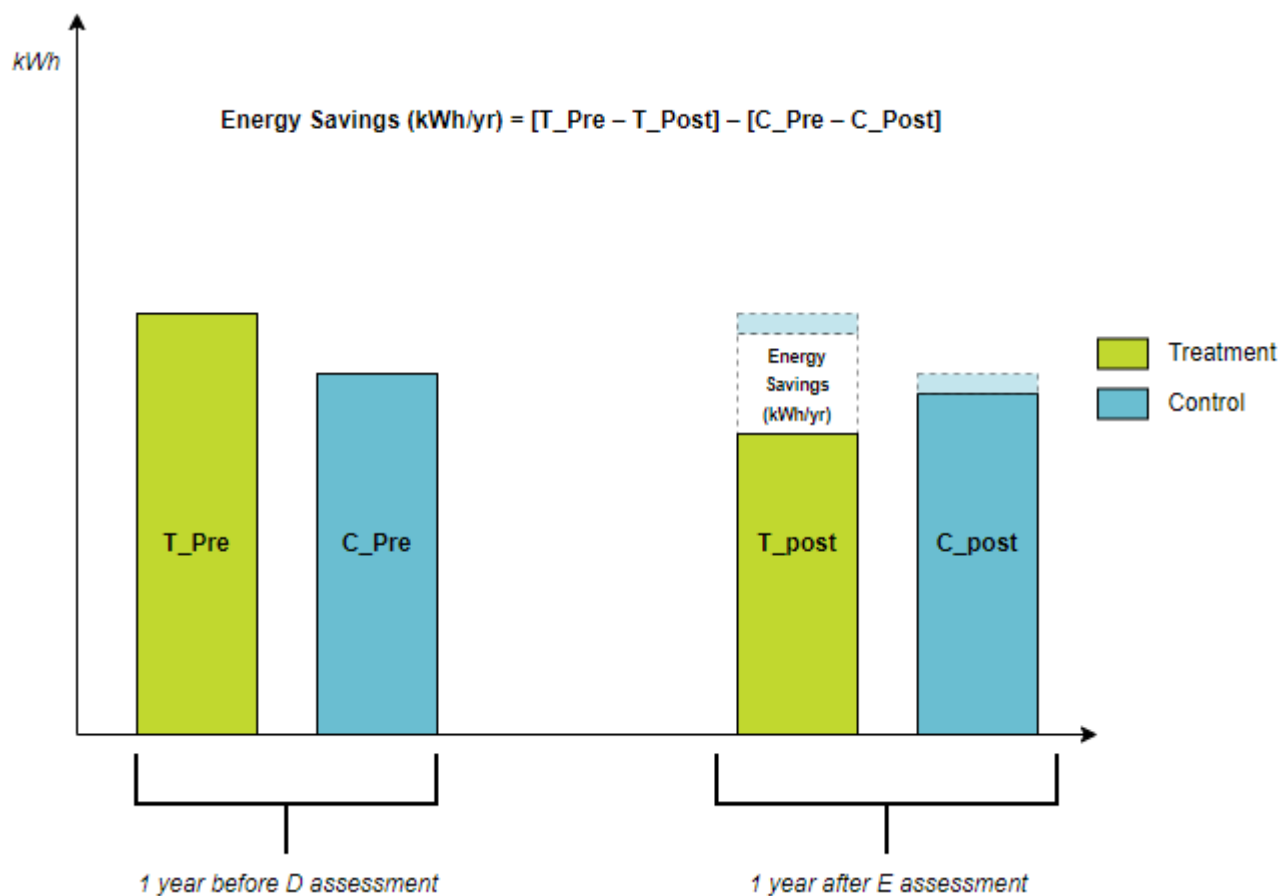
The Evaluator normalized the consumption values obtained from AMI data using normal weather data to obtain annual consumption values that are aligned with a typical meteorological year. A regression was used to determine how consumption related to heating and cooling degree days was associated with the weather station and billing dates of each control and treatment participant. Multiple iterations were made to select the most appropriate balance temperature to calculate the heating and cooling degree days of each control and treatment participant.

Then, the normal heating and cooling degree days were included in each regression to obtain energy consumption during a typical weather year. The Evaluator calculated the normal heating and cooling degree days based on the previous 15 years (2008-2023) for the five weather stations selected for the analysis (Debert, Greenwood, Halifax, Sydney, and Yarmouth).

## Energy Savings Calculation

Figure 1 below illustrates how electrical energy savings were obtained by calculating the difference in the treatment group normalized annual consumption of each participant for the year before and after program participation and deducting the difference observed in the control group normalized annual consumption for the same period as the treatment participant to which the control participant was assigned (difference-in-differences approach).

**Figure 1: Electrical Energy Savings Calculation Using AMI Data**



- › T\_Pre: Normalized annual consumption of the treatment participant for the year before the installation
- › T\_Post: Normalized annual consumption of the treatment participant for the year after the installation
- › C\_Pre: Normalized annual consumption of the assigned control participant for the year before the installation of the assigned treatment participant
- › C\_Post: Normalized annual consumption of the assigned control participant for the year after the installation of the assigned treatment participant

Then, for MSHPs, total energy savings were divided by total installed MSHP capacity to obtain a unitary savings value as a function of MSHP capacity.

For wood/pellet stoves/fireplace inserts, total energy savings were divided by the total number of installed units to obtain a unitary savings value on a per-unit basis.

## Use of Past Participant Survey Results

Given the inconclusive results of 2023 billing analysis, it was hypothesized that some participants included in the billing analysis may have added heated floor area to their home around the same time as their participation in Green Heat (e.g. by building a new heated room or extension or by starting to heat a room or area that was previously not heated, such as a newly finished basement). Such participants would have influenced the results of the billing analysis because they would have increased their consumption following participation (i.e. the additional consumption from added heated floor area would have offset the savings from the Green Heat installation and may even exceed them), which would have lowered overall savings results.

To test this hypothesis, past participants were surveyed to identify and exclude from the analysis those who added heated floor area. Due to limited survey results, this was only possible for part of the treatment group, as described below.

## Detailed Results

### MSHP Measures

Table 2 presents the results of the billing analysis for the Green Heat MSHP measure. Treatment participants who mentioned adding heated floor area as part of their Green Heat renovation project were excluded from the analysis. In Table 2, results of the previous billing analysis (conducted as part of the 2017 evaluation) are presented in between brackets to provide a comparison point.

**Table 2: MSHP Billing Analysis Results**

| Scenario          | Number of Treatment Participants | Average Heating Capacity (Btu/h) | Average Variation in Energy Consumption of Treatment (Tpre-Tpost, kWh) | Average Variation in Energy Consumption of Control* (Cpre-Cpost, kWh) | Average Energy Savings (kWh) | Savings (kWh/Btu/h) | Margin of Error** (kWh/Btu/h) |
|-------------------|----------------------------------|----------------------------------|------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------|---------------------|-------------------------------|
| Fully Electrical  | 99                               | 17,702                           | 2,197                                                                  | 684                                                                   | 1,514<br>[3,336]             | 0.0855<br>[0.179]   | 0.054                         |
| Mainly Electrical | 24                               | 17,509                           | 376                                                                    | 591                                                                   | -215<br>[1,328]              | -0.00123<br>[0.060] | 0.094                         |
| Overall           | 123                              | 17,664                           | 1,842                                                                  | 665                                                                   | 1,177                        | 0.0666              | 0.047                         |

\*The control group participants selected specifically for the treatment participants who did not add heated floor area exhibited some unexpected variations between the fully electrical and mainly electrical groups, which could be due to small sample sizes. The Evaluator therefore chose to use the average variation in energy consumption for all control participants to calculate unitary savings.

\*\*Margins of errors presented in this table are estimates calculated on the ratio of Tpre-Tpost and the modelled savings. The impact of the Cpre-Cpost deduction was not considered in the calculation.



The 2024 average electrical energy savings by capacity decreased significantly compared to the previous evaluation. The addition of control groups and other small changes to the methodology are partially responsible for that, although, even when comparing the variation in energy consumption for the treatment group only, the decrease is notable. Mainly electrical households do not generate any savings; the electrical energy savings are negative but are not statistically significant. Since the billing analysis was based only on electricity consumption, it was not possible to measure non-electrical savings, which does not mean that MSHPs do not generate non-electrical savings. In fact, the Evaluator considers that the most likely reason for seeing no electrical energy savings is that the increase in electricity consumption due to transferring a portion of heating consumption from wood or oil to an electric heat pump cancels out the electricity savings achieved by replacing some electric resistance heating by the heat pump. Therefore, the Evaluator recommends using the new value of 0.0855 kWh/Btu/h for fully electrical households and nil savings for mainly electrical households.

The Evaluator compared the savings measured for Green Heat to those measured for HEA participants who only installed heat pumps. On average, HEA participants who only installed heat pumps saved 2,459 kWh, while Green Heat participants generated 1,177 kWh (the overall value is used for comparison since HEA participants include a mix of fully and mainly electrically heated households). These numbers are not directly comparable because the systems installed in HEA and Green Heat differ. When looking at the savings per capacity installed, they are much closer (0.0760 kWh/Btu/h for HEA versus 0.0666 kWh/Btu/h for Green Heat). Indeed, the average capacity of HEA heat pumps is of 32 kBtu/h for participants who only installed a MSHPs compared to just over 17 kBtu/h for Green Heat.

### Wood or Pellet Stoves or Fireplace Inserts Measures

Wood or pellet stoves or fireplace inserts were analyzed as a single measure. As a starting point, the Evaluator separated the results according to the baseline heating system: ASHP or electric resistance baseline.

The Evaluator refined the analysis by removing all participants who indicated using a wood/pellet stoves/fireplace inserts as a secondary heating system prior to the installation of their new equipment. EfficiencyOne indicated that sometimes participants incorrectly wrote this information in their application form because they were thinking about their new heating systems rather than their pre-existing one and that sometimes participants really did have an existing wood/pellet stove/fireplace insert that either was not safe or could meet air quality standards. To ensure that no participant that was already used a wood/pellet stove/fireplace insert was included in the analysis, the Evaluator excluded all participants that indicated that they had previously used such equipment as a secondary heating system. Doing so increased the savings for the electric resistance baseline, but not for the ASHP baseline possibly because of the small sample size of participants with an ASHP baseline. The Evaluator also attempted to exclude participants who had indicated, as part of the past participant survey, that they had added floor area or heating to existing rooms. However, these participants did not have lower savings than surveyed participants that did not add floor area or heating to existing rooms, and removing them would have excessively reduced the sample size from 71 to 16 participants. Therefore, all treatment group participants who installed wood/pellet stoves/fireplace inserts were included in the analysis.

The Evaluator identified one more variable that has a large impact on the measured savings. When fireplace inserts are excluded from other biomass equipment, the variation in energy consumption in the treatment group increases from 1,647 kWh to 1,926 kWh. Indeed, the 14 wood fireplace inserts included in the analysis only demonstrate average energy savings of 232 kWh. When excluding the fireplace inserts from the analysis, the Evaluator obtains the results presented in Table 3. These results no longer differentiate between the electric resistance and ASHP baselines due to small sample sizes.



**Table 3: Wood and Pellet Stove Billing Analysis Results After Removing Fireplace Inserts**

| Scenario      | Number of Treatment Participants | Average Variation in Energy Consumption of Treatment (Tpre-Tpost, kWh) | Average Variation in Energy Consumption of Control (Cpre-Cpost, kWh) | Average Energy Savings (kWh) | Margin of Error (kWh) |
|---------------|----------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------|-----------------------|
| All Baselines | 71                               | 1,926                                                                  | 465                                                                  | 1,461                        | 1,262                 |

The average electrical energy savings presented in Table 3 are statistically significant since the confidence interval does not include a nil value. The Evaluator believes that this is the most reliable estimate of savings for wood and pellet stoves and should be used to obtain evaluated savings. For fireplace inserts, even though savings are not statistically significant, the Evaluator used 232 kWh for the 2024 evaluation. For future years, the Evaluator recommends considering the removal of fireplace inserts from Green Heat offerings due to their very limited savings.

## Literature review

To put the results of the billing analysis into perspective, the Evaluator conducted a literature review of recent billing analyses and metering studies performed in other jurisdictions for similar energy conservation measures. The Evaluator did not identify any relevant billing analyses or metering studies targeting wood-burning appliances. Regarding MSHPs, one billing analysis and two metering studies were retained and reviewed as they used methodologies and/or results that were relatively comparable to the Evaluator's.

## 2024 Oregon Billing Analysis

This billing analysis<sup>3</sup> conducted in 2024 covered MSHPs installed in Oregon and incentivized by Energy Trust from 2020 to 2022. Energy Trust used an in-house billing analysis tool named the Residential Billing Analysis (REBA) tool. The similarities between Econoler and Energy Trust's methodologies are summarized as follows:

- › Both billing analyses use site-level regression models for weather normalization of each site for pre and post-installation periods.
- › Both use a difference-in-differences approach to evaluate savings whereby the savings attributable to MSHPs correspond to the difference in the average change in annual electricity usage between the treatment and control groups ( $T_{pre} - T_{post} - (C_{pre} - C_{post})$ ).
- › To match the treatment and control groups, both studies use control homes that are in the same geographic area as the treatment homes and that have similar electricity consumption levels.

Energy Trust performed several analyses for sub-samples of their treatment group. One was the presence or not of supplemental heating equipment, which is similar to the Evaluator's fully electric and mainly electric scenarios. The results from both studies for these sub-samples and for the total populations are presented in Table 4 below.

<sup>3</sup> Energy Trust of Oregon, Billing Analysis of Residential Ductless Heat Pump Installations, 2024. Available at: <https://www.energytrust.org/wp-content/uploads/2024/08/FINAL-REBA-DHP-Report-Memo-with-Output-Summaries.pdf>

**Table 4: Econoler and Energy Trust savings results**

| Scenario                           | Number of Participants | Average Savings (kWh) | Sample Description          | Sample N      | Average Evaluated Savings (kWh) |
|------------------------------------|------------------------|-----------------------|-----------------------------|---------------|---------------------------------|
| <b>Econoler Green Heat Results</b> |                        |                       | <b>Energy Trust Results</b> |               |                                 |
| Fully electric                     | 99                     | 1,514                 | W/o supp. Heat              | 628           | 1,494                           |
| Part. electric                     | 24                     | -215                  | W supp. heat                | 159           | 320                             |
| <b>Overall</b>                     | <b>123</b>             | <b>1,177</b>          | <b>Overall</b>              | <b>2,054*</b> | <b>1,032</b>                    |

\*Overall sample size exceeds sum of sub-samples because supplemental heating information was only available for 2022 participants, whereas overall results include participants from 2020-2022.

While the overall savings in both billing analyses are very similar, it should be noted that Oregon has a considerably milder climate than Nova Scotia. For example, the cities of Portland and Halifax have standard heating degree days (base 18°C) of around 2,300 and 4,000 respectively. Monthly average temperatures are between 5°C to 9°C for the months of November to March in Portland compared to -2°C to 6°C for Halifax for the same period. The milder climate has opposing effects:

- › On one hand, winter is shorter and heating loads are lower in Oregon, which may reduce savings.
- › On the other hand, the milder temperatures are favourable for heat pump operation, which can operate at a higher COP for more heating hours.

Assuming all else being equal, it is difficult to estimate which of these effects is more important and whether the expected savings should be higher or lower in Oregon than Nova Scotia.

## 2024 Massachusetts and Connecticut Metering Study

This metering study<sup>4</sup> was conducted in 2024 and covers central heat pumps (CHPs), MSHPs, and ground source heat pumps (GSHPs) installed in Massachusetts and Connecticut between 2021 and 2022. In line with the program offering in those jurisdictions (Mass Save and Energize CT respectively), the study categorizes the results into two installation types:

- › Full displacement (FD) installations whereby the heat pump must be sized to be able to replace the entirety of the existing heating system load hours (whether it is an electric resistance or fossil-fuel appliance). The existing system is still allowed to remain installed as an emergency backup heat source.
- › Partial displacement (PD) installations whereby the heat pump can be sized to meet only part of the heating load.

Guidehouse used on-site heat pump usage and performance data collection at a total of 185 customer homes. Since the performance and consumption of heat pumps are measured in situ, there is no analysis of billing data and no use of a control group.

Green Heat has no requirement regarding the sizing of the heat pump in relation to the building load or the existing heating system. Considering the average installed capacity is around 17 kBtu/h, Econoler considers that most heat pumps installed as part of Green Heat can be considered PD installations (i.e. the existing heating system or a supplemental heating system will still be required to meet part of the heating load hours). Since the Guidehouse savings results are presented in kWh/tonne of installed capacity, Econoler converted Green Heat savings into the same unit. The results are presented in Table 5.

<sup>4</sup> Guidehouse, Massachusetts & Connecticut Heat Pump Metering Study, 2024.

**Table 5: Econoler and Guidehouse Savings Results**

| Scenario                                                                                                                                                                          | Number of Participants | Average Savings (kWh/tonne) | Displacement Type         | Sample         | Electrical Savings (kWh/tonne) |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------------|---------------------------|----------------|--------------------------------|
| <b>Econoler Green Heat Results</b>                                                                                                                                                |                        |                             | <b>Guidehouse Results</b> |                |                                |
| Fully electric                                                                                                                                                                    | 99                     | 1,026                       | n/a                       | -              | -                              |
| Part. electric                                                                                                                                                                    | 24                     | -15                         | n/a                       | -              | -                              |
| <b>Overall</b>                                                                                                                                                                    | <b>123</b>             | <b>799</b>                  | <b>PD</b>                 | <b>&lt;33*</b> | <b>1,075</b>                   |
| *The exact sample size for PD MSHP with electric resistance baseline is unknown, although the sample size for the complete PD MSHP sample (including other fuel baselines) is 33. |                        |                             |                           |                |                                |

The cities of Boston and Halifax have standard heating degree days (base 18°C) of around 3,100 and 4,000 respectively. Monthly average temperatures are between -1°C to 7°C for the months of November to March for Boston compared to -2°C to 6°C for Halifax for the same period.

### 2017 Vermont Metering Study

This metering study<sup>5</sup> was conducted in 2017 and covers cold climate ductless mini-split heat pumps (ccHP) installed in Vermont. The study measured in situ performance and consumption of 77 ccHPs for 65 service accounts beginning in November 2015 and through the 2017 heating season.

Cadmus used on-site ccHP usage and performance data collection; therefore, there is no use of a control group. The baseline heating systems of metered homes were mainly non-electrical systems (propane, fuel oil, or wood-burning heating equipment), with a small share of electric resistance heating. However, Cadmus did not meter the consumption of those systems during the pre-installation period. Instead, they calculated heating savings by assuming the capacity provided by the ccHP would directly offset an equivalent amount of heating capacity otherwise provided by the alternate heating system. This approach resulted in the savings per fuel type presented in Figure 2 below.

**Figure 2: Retrofit Savings per Cold Climate Heat Pump Installed (Cadmus, 2017)**

| Percent of MMBtu Provided by Existing Heating System | Heating System Efficiency Assumptions | Fuel Heat Content Assumptions | Savings | Units                                     |
|------------------------------------------------------|---------------------------------------|-------------------------------|---------|-------------------------------------------|
| 7%                                                   | COP of electric resistance heat = 1   | 3.412 kBtu per kWh            | -1,664  | kWh (Includes Electric Resistance Offset) |
| 25%                                                  | 85%                                   | 91.2 kBtu/gal                 | 69.1    | Gallons of Propane                        |
| 46%                                                  | 78%                                   | 138.8 kBtu/gal                | 91.0    | Gallons of #2 Fuel Oil                    |
| 22%                                                  | 60%                                   | 15.3 MMBtu/cord               | 0.66    | Cords Wood                                |

The Evaluator identified some discrepancies or at least some confusion around how to interpret and compile these savings. The Evaluator was able to reach out to one of the authors of the study. Instead of using the savings as presented, the author recommended relying on the ccHP consumption and supplied heating capacity results, which are also provided in the Cadmus report and should be more reliable. Econoler therefore used these figures to estimate savings for an electric resistance baseline.

<sup>5</sup> Cadmus, Evaluation of Cold Climate Heat Pumps in Vermont, 2017.

Since Green Heat is offered to homes fully or mainly electrically heated, Econoler estimated savings from the Cadmus study for an electric resistance baseline. Cadmus' average ccHP results are 2,085 kWh consumed and 21.4 MMBtu of heat energy delivered during the heating season. Since electric resistance has an efficiency of 100%, the baseline consumption would be 21.4 MMBtu. This converts to 6,272 kWh in consumption, resulting in 4,187 kWh in savings for the heating season. Econoler also added 74 kWh in savings for cooling (provided separately in the Cadmus study), resulting in total annual savings of 4,261 kWh. Considering the average heat pump capacity in the Cadmus study is 17,388 Btu/h, Econoler normalized the savings per Btu/h of installed capacity.

**Table 6: Econoler and Cadmus Savings Results**

| Scenario                           | Sample | Average Savings per Capacity (kWh/Btu/h) | Baseline Heating System | Sample | Electrical Savings (kWh/Btu/h) |
|------------------------------------|--------|------------------------------------------|-------------------------|--------|--------------------------------|
| <b>Econoler Green Heat Results</b> |        |                                          | <b>Cadmus Results</b>   |        |                                |
| Fully electric                     | 99     | 0.0855                                   | Electric resistance     | 77*    | 0.245                          |
| Part. electric                     | 24     | -0.00123                                 | N/A                     | -      | -                              |
| Overall                            | 123    | 0.0666                                   | <b>N/A</b>              | -      | -                              |

\*77 ccHPs were metered, but most of them did not have electric resistance as their baseline heating system. As explained above, the savings were estimated by the Evaluator and not directly measured by Cadmus.

As presented in Table 6, the estimated savings from the Cadmus study are almost triple the savings of the Evaluator. Some factors might explain the higher savings observed in the Cadmus study:

- › The approach is fundamentally different from that used in the Evaluator's billing analysis. Cadmus did not actually measure the pre-installation consumption of the baseline system; it is simply calculated using the ccHP-delivered energy and assumed efficiency of the baseline system. Moreover, the savings are not adjusted by using a control group.
- › The study dates to 2017 and the data are from 2015-2017. At that time, the Evaluator and other jurisdictions found higher savings. While this is counterintuitive considering the efficiency of the appliances themselves is expected to increase as the technology improves over the years, the reduction in savings over time may be explained by behavioural aspects. One aspect that was already highlighted by the Evaluator as a possible explanation is the fact that early heat pump adopters might have been more likely to want to maximize its use, which may have resulted in higher savings. Conversely, early and late majority adopters may not trust the technology as much or may not use it as much (e.g. install a heat pump just for cooling, turn it off because it is too noisy, or favour the supplemental heating system that increases comfort). This was also hypothesized by the Cadmus study author during the discussion with Econoler.

The cities of Burlington and Halifax have standard heating degree days (base 18°C) of around 4,100 and 4,000 respectively. Monthly average temperatures are between -7°C to 4°C for the months of November to March for Burlington compared to -2°C to 6°C for Halifax for the same period.



## Summary of Literature Review Findings

The Evaluator reviewed the aforementioned three studies to compare and put into perspective the savings results of the 2024 Green Heat billing analysis.

- › The 2024 billing analysis conducted in Oregon by Energy Trust was the most comparable to Econoler's work in terms of methodology. It also had very similar overall annual savings results of 1,032 kWh compared to 1,177 kWh for Green Heat.
- › The 2024 metering study conducted in Massachusetts and Connecticut by Guidehouse found savings in the same order of magnitude as Green Heat, albeit slightly higher at 1,075 kWh/tonne of capacity compared to 799 kWh/tonne of capacity for Green Heat.
- › The 2017 metering study conducted in Vermont by Cadmus found savings almost three times higher than those of Green Heat. Some factors may explain this gap, including a fundamentally different approach, metering of heat pumps with higher efficiency, as well as the behavioural patterns of participants which were early adopters of heat pumps.

Given that the electrical energy savings results found in the literature are in the same order of magnitude as those found for Green Heat participants who installed MSHPs, especially for the more recent and complete studies, the literature review reinforces the Evaluator's confidence in the results of the billing analysis.

# APPENDIX XXV

## Green Heat 2024 Recommendations

This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 Green Heat evaluation.

| Section           | Recommendations                                                                                                                                                                          |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | Recommendation #1: In light of their very low savings and considering their low uptake, consider removing wood fireplace inserts and pellet fireplace inserts from the Green Heat offer. |

## APPENDIX XXVI

### HEA Past Participant Survey Questionnaire

## HOME ENERGY ASSESSMENT/GREEN HEAT PAST PARTICIPANT SURVEY

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instrument Type                 | Web survey                                                                                                                                               |
| Estimated Time to Complete      | 5 minutes                                                                                                                                                |
| Target Audience                 | Past participants whose projects generated electrical savings in 2023                                                                                    |
| Expected Number of Completions  | 300 for HEA<br>200 for GH                                                                                                                                |
| Contact List Source             | 2024 HEA Billing Analysis Treatment Group Sample (around 1,000 contacts); and<br>2024 GH Billing Analysis Treatment Group Sample (around 1,000 contacts) |
| Fielding Firm                   | Narrative Research                                                                                                                                       |
| Estimated Timeline for Fielding | Early September – Early October                                                                                                                          |

Table 2: Research Objectives and Associated Sections

| Research Objectives          | Section |
|------------------------------|---------|
| Verification and recall      | A       |
| Verification of action taken | B       |
| Demographics                 | I       |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**



## Introduction

We at Narrative Research are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia. Our records indicate that you or your household recently participated in the **<INSERT PROGRAM NAME>** program.

We would appreciate your help in answering a very short survey about this program, it will take perhaps 2 or 3 minutes.

**[IF GH]:** As a reminder, the program provides a rebate for the installation of home heating equipment such as **<INSERT MEASURE >**.

**[IF HEA]:** As a reminder, this program involves having an energy advisor conduct an assessment of your home, including a blower door test, and provide participants with energy efficiency upgrade recommendations. THE FEDERAL CANADA GREENER HOMES GRANT INITIATIVE IS DELIVERED WITH EFFICIENCY NOVA SCOTIA THROUGH THE HOME ENERGY ASSESSMENT (HEA) PROGRAM, SO YOU MAY INSTEAD RECALL PARTICIPATING IN THE GREENER HOMES PROGRAM.]

### A. Verification and Recall

A1. We understand you participated in the **<INSERT PROGRAM>** program in **<PARTICIPATION YEAR>** for your house located at **<ADDRESS>** **[IF GH, ADD]** BY INSTALLING A **<INSERT MEASURE>**. Is that correct?

1. Yes **[CONTINUE]**
2. No **[END]**

### B. Verification of Actions Taken

The following questions concern **<IF PROGRAM=HEA>** “the energy efficiency upgrades” **<IF PROGRAM=GH>** “the **<INSERT MEASURE >** installation project” **<FOR ALL>** that you completed through your participation in **<INSERT PROGRAM>** in **<PARTICIPATION YEAR>** for the house located at **<ADDRESS>**

B1. **<IF PROGRAM=HEA>** “Were your energy efficiency upgrades” **<IF PROGRAM=GH>** “Was your **<INSERT MEASURE>**”, **<FOR ALL>** installed as part of a renovation project that involved adding floor area to your home? By adding floor area, we mean that you added an extension to your home, such as a new floor or a new room that was not there before your renovation project.  
**PROGRAM B1 AND B2 AS MANDATORY, ALL OTHER QUESTIONS (EXCEPT A1) WILL BE PROGRAMMED AS OPTIONAL**

1. Yes
2. No



- B2. <IF PROGRAM=HEA>, “Were your energy efficiency upgrades” <IF PROGRAM=GH> “Was your <INSERT MEASURE>” <FOR ALL> installed as part of a renovation project that involved heating rooms that were previously not heated or were only minimally heated (for example,. at a temperature lower than 15°C)? Examples of such renovation projects would be that, you finished your basement and started heating it, or you could have changed a sunroom so that it became heated throughout the year whereas it previously was not.
1. Yes, *the renovation project involved* heating rooms that were previously not heated/were minimally heated
  2. No *the renovation project did not involve* heating rooms that were previously not heated/were minimally heated
- B3. <IF PROGRAM=HEA OR MEASURE=HEAT PUMP>Did you have a fireplace or wood stove in your home <IF PROGRAM=HEA> “before having your home evaluated by an energy advisor” <IF PROGRAM=GH> “before installing your heat pump”? **ACCEPT MULTIPLE ‘YES’ RESPONSE**
1. Yes, a fireplace
  2. Yes, a wood stove
  3. No
- B4. **[IF B3= 1 AND/OR 2]** How, if at all, did usage of your [a. ‘fireplace’ / b. ‘wood stove’] change after you installed your energy efficiency upgrades? Did your usage ...: **[READ – POSE SEPARATELY FOR ‘A’ AND ‘B’, IF 1 AND 2 SELECTED IN B3]**
1. Increase a lot
  2. Increase a little
  3. Stay the same
  4. Decrease a little
  5. Decrease a lot
  6. Did not notice a change
- B5. **[ASK IF PROGRAM=HEA]** Through the <INSERT PROGRAM>, have you installed any type of heat pump, including mini-split, central or geothermal?
1. Yes
  2. No
- B6. **[ASK IF B5=1 OR PROGRAM=GH AND MEASURE=HEAT PUMP]** Prior to INSTALLING YOUR HEAT PUMP, DID YOU ALREADY HAVE A WORKING AIR CONDITIONER IN YOUR HOME? **[DO NOT READ RESPONSES]**
1. Yes
  2. No

END: Thank you for completing today’s survey – your help is greatly appreciated.

## APPENDIX XXVII

### HEA Past Participant Survey Results

**Table B1:** Were your energy efficiency upgrades installed as part of a renovation project that involved adding floor area to your home? By adding floor area, we mean that you added an extension to your home, such as a new floor or a new room that was not there before your renovation project.

| OVERALL %              |            |
|------------------------|------------|
| <b>SAMPLE SIZE (#)</b> | <b>483</b> |
| Yes                    | 2%         |
| No                     | 98%        |

**TABLE B2:** Were your energy efficiency upgrades installed as part of a renovation project that involved heating rooms that were previously not heated or were only minimally heated (for example, at a temperature lower than 15°C)? Examples of such renovation projects would be that, you finished your basement and started heating it, or you could have changed a sunroom so that it became heated throughout the year whereas it previously was not.

| OVERALL %                                                                                                      |            |
|----------------------------------------------------------------------------------------------------------------|------------|
| <b>SAMPLE SIZE (#)</b>                                                                                         | <b>483</b> |
| Yes, the renovation project involved heating rooms that were previously not heated/were minimally heated       | 11%        |
| No, the renovation project did not involve heating rooms that were previously not heated/were minimally heated | 89%        |

**TABLE B3:** Did you have a fireplace or wood stove in your home before having your home evaluated by an energy advisor?

| OVERALL %              |            |
|------------------------|------------|
| <b>SAMPLE SIZE (#)</b> | <b>483</b> |
| Yes, a fireplace       | 21%        |
| Yes, a wood stove      | 30%        |
| No                     | 52%        |

**TABLE B4a:** [IF B3=1] How, if at all, did usage of your fireplace change after you installed your energy efficiency upgrades? Did your usage ...:

| OVERALL %               |     |
|-------------------------|-----|
| SAMPLE SIZE (#)         | 101 |
| Increase a lot          | 2%  |
| Increase a little       | 2%  |
| Stay the same           | 40% |
| Decrease a little       | 16% |
| Decrease a lot          | 16% |
| Did not notice a change | 23% |
| Don't know/No answer    | 2%  |

**TABLE B4b:** [IF B3=2] How, if at all, did usage of your wood stove change after you installed your energy efficiency upgrades? Did your usage ...:

| OVERALL %               |     |
|-------------------------|-----|
| SAMPLE SIZE (#)         | 144 |
| Increase a lot          | 3%  |
| Increase a little       | 5%  |
| Stay the same           | 31% |
| Decrease a little       | 28% |
| Decrease a lot          | 22% |
| Did not notice a change | 10% |
| Don't know/No answer    | 1%  |

**TABLE B5:** Through the Home Energy Assessment program, have you installed any type of heat pump, including mini-split, central or geothermal?

| OVERALL %            |     |
|----------------------|-----|
| SAMPLE SIZE (#)      | 483 |
| Yes                  | 57% |
| No                   | 42% |
| Don't know/No answer | 0%  |

**TABLE B6:** [B5=1] Prior to installing your heat pump, did you already have a working air conditioner in your home?

| OVERALL %            |     |
|----------------------|-----|
| SAMPLE SIZE (#)      | 277 |
| Yes                  | 30% |
| No                   | 69% |
| Don't know/No answer | 1%  |

## APPENDIX XXVIII

### HEA Expired Participant Survey Questionnaire

## HOME ENERGY ASSESSMENT EXPIRED PARTICIPANT SURVEY

**Table 1: Overview of Data Collection Activity**

| Descriptor                      | This Instrument                                                           |
|---------------------------------|---------------------------------------------------------------------------|
| Instrument Type                 | Telephone survey                                                          |
| Estimated Time to Complete      | 5-6 minutes                                                               |
| Target Audience                 | Participants with unconverted D assessment whose projects expired in 2023 |
| Expected Number of Completions  | 100                                                                       |
| Contact List Source             | 2023 HEA tracking sheet                                                   |
| Fielding Firm                   | Narrative Research                                                        |
| Estimated Timeline for Fielding | September - October                                                       |

**Table 2: Research Objectives and Associated Sections**

| Research Objectives                        | Section |
|--------------------------------------------|---------|
| Verification and recall                    | A       |
| Upgrades implemented and influence         | B       |
| Reasons for not conducting an E assessment | C       |
| Verification of interest for a visit       | D       |
| Demographics                               | E       |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**



## Introduction

Could I please speak with <INSERT NAME>?

1. Yes **[GO TO INTRODUCTION]**
2. No **[SAY “PERHAPS YOU CAN HELP ME ANYWAY.” GO TO INTRODUCTION]**

Hello, my name is \_\_\_\_\_ calling on behalf of Narrative Research, a Halifax-based survey research company. We are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia. Our records indicate that, as part of the Home Energy Assessment program, in < MONTH / YEAR> an Energy Advisor came to your home located at <ADDRESS> to conduct an energy assessment of your home.

We would appreciate your help in answering questions about this program. The information you provide will be used to help Efficiency Nova Scotia improve the program. Is this a good time for you?

**[IF NEEDED: IN NOVA SCOTIA, THE FEDERAL CANADA GREENER HOMES GRANT INITIATIVE IS CO-DELIVERED WITH EFFICIENCY NOVA SCOTIA THROUGH THE HOME ENERGY ASSESSMENT (HEA) PROGRAM. YOU MAY RECALL PARTICIPATING IN THE GREENER HOMES PROGRAM.]**

**[IF NEEDED: The survey will take about five to six minutes.]**

### A. Verification and Recall

A1. Just to confirm, do you recall having an Energy Advisor from a delivery partner of the Home Energy Assessment program come to your home located at <ADDRESS> to complete a home energy assessment in <MONTH / YEAR>?

1. Yes **[CONTINUE]**
2. No **[END]**
- 98.** Don't know **[END]**
- 99.** Refused **[END]**

A2. And do you recall receiving a Home Energy Assessment report that identified renovations or upgrades that could improve your home's energy efficiency?

1. Yes **[CONTINUE]**
2. No **[END]**
- 98.** Don't know **[END]**
- 99.** Refused **[END]**

A3. After reviewing the report, did you complete any of the recommended renovations or upgrades?

1. Yes **[CONTINUE]**
2. No **[END]**
- 98.** Don't know **[END]**
- 99.** Refused **[END]**

A4. To the best of your knowledge, did your household book a follow-up visit where an Energy Advisor would have come back to your home and performed a final energy assessment to see if you qualified for a rebate?

1. Yes [END]
2. No [CONTINUE]
98. Don't know [END]
99. Refused [END]

A5. Do you still live in the home located at <ADDRESS>?

1. Yes [CONTINUE]
2. No [END]
98. Don't know [END]
99. Refused [END]

## B. Upgrades Implemented and Influence

B1. Which of the following upgrades, if any, did you implement after you received your home energy assessment report? [DO NOT ROTATE - CODE ONE ONLY PER STATEMENT]

[1 = YES, IMPLEMENTED, 2 = NO, NOT IMPLEMENTED, 3 = ALREADY HAD INSTALLED, 4 = THAT UPGRADE WAS NOT SUGGESTED IN THE REPORT, 98 = DON'T KNOW / DON'T REMEMBER, 99 = REFUSED] [READ]

- a. Install any type of heat pump, including mini-split, central or geothermal
- b. Install insulation including attic, ceiling, exterior wall, exposed floor, basement, crawlspace, or foundation insulation
- c. Install new windows, doors or skylights
- d. Install an efficient ventilation system (heat recovery ventilation system)
- e. Install air sealing or draft proofing
- f. Install a heat pump water heater
- g. Install a wood or pellet stove or furnace
- h. Install a smart thermostat
- i. Install solar PV system

B2. [ASK IF B1A=1] Did you apply for a rebate for your heat pump through another program?

1. Yes
2. No
98. Don't know
99. Refused

- B3. **[POSE B3 ONLY IF 'YES' TO ONE OR MORE ITEMS IN B1a-i]** To what extent, if at all, did your home energy assessment report influence your decision to proceed with the upgrades you implemented? Please give your answer on a scale of 0 to 10, where 0 indicates that the home energy assessment “had no influence at all” and 10 indicates that the assessment “had a great deal of influence”.

**[0-10 SCALE WITH END POINT LABELS – RECORD NUMBER]**

## **C. Reasons for Not Conducting an E Assessment**

- C1. Which one of the following best describes the reason why you chose not to have the follow-up visit by an Energy Advisor? **[DO NOT READ, ACCEPT ONE RESPONSE]**

1. Follow-up visit was too difficult to schedule
2. Follow-up visit was too expensive
3. Follow-up visit takes too long
4. I was too busy / I did not have time
5. I don't believe the results of the visit would be useful, relevant or accurate
6. The follow-up visit was unnecessary because the work to save energy was already done
7. Didn't book a follow-up visit because we didn't intend to undertake the recommended upgrades
96. Other [SPECIFY\_\_\_\_\_]
- 98. Don't know [GO TO NEXT SECTION]**
- 99. Refused [GO TO NEXT SECTION]**

- C2. Were there other reasons as well? **[DO NOT READ, ACCEPT ALL RESPONSES]**

1. Follow-up visit was too difficult to schedule
2. Follow-up visit was too expensive
3. Follow-up visit takes too long
4. I was too busy / I did not have time
5. I don't believe the results of the visit would be useful or accurate
6. The follow-up visit is unnecessary because the work to save energy is already done
7. Didn't book a follow-up visit because we haven't completed many of the recommended upgrades
8. No other reason
96. Other [SPECIFY\_\_\_\_\_]
- 98. Don't know**
- 99. Refused**



## **D. Verification of Interest for a Visit**

D1. Would you be interested in having an Energy Advisor again come to your home, for free, to perform an energy assessment of your house?

1. Yes

2. No

**98.** (Don't know)

**99.** (Refused)

**END:** Those are all the questions I have for you. Thank and terminate.

## APPENDIX XXIX

### HEA Expired Participant Survey Results

**TABLE A1:** Just to confirm, do you recall having an Energy Advisor from a delivery partner of the Home Energy Assessment program come to your home located at <ADDRESS> to complete a home energy assessment in <MONTH / YEAR>?

| OVERALL %              |            |
|------------------------|------------|
| <b>SAMPLE SIZE (#)</b> | <b>338</b> |
| Yes                    | 97%        |
| No                     | 2%         |
| Don't know             | 1%         |
| Refused                | 0%         |

**TABLE A2:** [POSE ONLY IF 'YES' TO A1] And do you recall receiving a Home Energy Assessment report that identified renovations or upgrades that could improve your home's energy efficiency?

| OVERALL %                                                                         |            |
|-----------------------------------------------------------------------------------|------------|
| <b>SAMPLE SIZE (#)</b>                                                            | <b>326</b> |
| Yes                                                                               | 95%        |
| No                                                                                | 3%         |
| Don't know                                                                        | 2%         |
| Note: 2 of the 'Yes' respondents in A1 dropped out, not completing this question. |            |

**TABLE A3:** [POSE ONLY IF 'YES' TO A2] After reviewing the report, did you complete any of the recommended renovations or upgrades?

| OVERALL %                                                                         |            |
|-----------------------------------------------------------------------------------|------------|
| <b>SAMPLE SIZE (#)</b>                                                            | <b>309</b> |
| Yes                                                                               | 59%        |
| No                                                                                | 39%        |
| Don't know                                                                        | 1%         |
| Refused                                                                           | 1%         |
| Note: 1 of the 'Yes' respondents in A2 dropped out, not completing this question. |            |

**TABLE A4:** [POSE ONLY IF 'YES' TO A3] To the best of your knowledge, did your household book a follow-up visit where an Energy Advisor would have come back to your home and performed a final energy assessment to see if you qualified for a rebate?

| OVERALL %              |            |
|------------------------|------------|
| <b>SAMPLE SIZE (#)</b> | <b>183</b> |
| Yes                    | 51%        |
| No                     | 46%        |
| Don't know             | 2%         |

**TABLE A5:** [POSE ONLY IF 'NO' TO A4] Do you still live in the home located at <ADDRESS>?

| OVERALL %                                                                                |           |
|------------------------------------------------------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                                                                   | <b>85</b> |
| Yes                                                                                      | 94%       |
| No                                                                                       | 6%        |
| Note: 4 of the 'Yes' respondents in this question dropped out, not completing the survey |           |

**TABLE B1a:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install any type of heat pump, including mini-split, central or geothermal

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 37%       |
| No, not implemented                          | 32%       |
| Already had installed                        | 25%       |
| That upgrade was not suggested in the report | 5%        |
| Don't know/Don't remember                    | 1%        |

**TABLE B1b:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install insulation including attic, ceiling, exterior wall, exposed floor, basement, crawlspace, or foundation insulation

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 54%       |
| No, not implemented                          | 38%       |
| Already had installed                        | 4%        |
| That upgrade was not suggested in the report | 4%        |

**TABLE B1c:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install new windows, doors or skylights

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 28%       |
| No, not implemented                          | 53%       |
| Already had installed                        | 8%        |
| That upgrade was not suggested in the report | 8%        |
| Don't know/Don't remember                    | 4%        |

**TABLE B1d:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install an efficient ventilation system (heat recovery ventilation system)

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 12%       |
| No, not implemented                          | 62%       |
| Already had installed                        | 13%       |
| That upgrade was not suggested in the report | 13%       |

**TABLE B1e:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install air sealing or draft proofing

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 29%       |
| No, not implemented                          | 51%       |
| Already had installed                        | 4%        |
| That upgrade was not suggested in the report | 7%        |
| Don't know/Don't remember                    | 9%        |

**TABLE B1f:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install a heat pump water heater

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 8%        |
| No, not implemented                          | 59%       |
| Already had installed                        | 8%        |
| That upgrade was not suggested in the report | 22%       |
| Don't know/Don't remember                    | 3%        |

**TABLE B1g:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install a wood or pellet stove or furnace

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 8%        |
| No, not implemented                          | 55%       |
| Already had installed                        | 22%       |
| That upgrade was not suggested in the report | 14%       |

**TABLE B1h:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install a smart thermostat

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 16%       |
| No, not implemented                          | 62%       |
| Already had installed                        | 7%        |
| That upgrade was not suggested in the report | 16%       |

**TABLE B1i:** Which of the following upgrades, if any, did you implement after you received your home energy assessment report? Install solar PV system

| OVERALL %                                    |           |
|----------------------------------------------|-----------|
| <b>SAMPLE SIZE (#)</b>                       | <b>76</b> |
| Yes, implemented                             | 8%        |
| No, not implemented                          | 76%       |
| That upgrade was not suggested in the report | 14%       |
| Don't know/Don't remember                    | 1%        |

### TABLE SUMMARY B1A-B1I: Yes, implemented

Which of the following upgrades, if any, did you implement after you received your home energy assessment report?

| OVERALL %       |      |
|-----------------|------|
| SAMPLE SIZE (#) | 76   |
| None            | 5%   |
| 1 of 9          | 33%  |
| 2 of 9          | 34%  |
| 3 of 9          | 17%  |
| 4 of 9          | 9%   |
| 5 of 9          | 0%   |
| 6 of 9          | 0%   |
| 7 of 9          | 1%   |
| 8 of 9          | 0%   |
| 9 of 9          | 0%   |
| MEAN            | 2.0% |

### TABLE B2: [ASK IF B1A=1] Did you apply for a rebate for your heat pump through another program?

| OVERALL %       |     |
|-----------------|-----|
| SAMPLE SIZE (#) | 28  |
| Yes             | 14% |
| No              | 82% |
| Don't know      | 4%  |

**TABLE B3:** [POSE B3 ONLY IF 'YES' TO ONE OR MORE ITEMS IN B1a-i] To what extent, if at all, did your home energy assessment report influence your decision to proceed with the upgrades you implemented? Please give your answer on a scale of 0 to 10, where 0 indicates that the home energy assessment “had no influence at all” and 10 indicates that the assessment “had a great deal of influence”.

| OVERALL %                          |      |
|------------------------------------|------|
| SAMPLE SIZE (#)                    | 72   |
| 10 - had a great deal of influence | 15%  |
| 9                                  | 7%   |
| 8                                  | 10%  |
| 7                                  | 22%  |
| 6                                  | 13%  |
| 5                                  | 13%  |
| 4                                  | 1%   |
| 3                                  | 7%   |
| 2                                  | 4%   |
| 1                                  | 1%   |
| 0 - had no influence at all        | 7%   |
| TOP 2 BOX (% 9-10)                 | 22%  |
| TOP 3 BOX (% 8-10)                 | 32%  |
| TOP 4 BOX (% 7-10)                 | 54%  |
| MEAN                               | 6.2% |

**TABLE C1: FIRST MENTION** Which one of the following best describes the reason why you chose not to have the follow-up visit by an Energy Advisor?

| OVERALL %                                                                                    |     |
|----------------------------------------------------------------------------------------------|-----|
| SAMPLE SIZE (#)                                                                              | 76  |
| I was too busy / I did not have time                                                         | 38% |
| I don't believe the results of the visit would be useful, relevant or accurate               | 12% |
| I was not aware a follow-up visit was necessary/Didn't know about it                         | 11% |
| Unable to contact them for a follow-up visit/No response from them                           | 11% |
| The follow-up visit was unnecessary because the work to save energy was already done         | 9%  |
| Follow-up visit was too expensive                                                            | 7%  |
| Follow-up visit was too difficult to schedule                                                | 5%  |
| Upgrades/renovations not completed yet                                                       | 4%  |
| Didn't book a follow-up visit because we didn't intend to undertake the recommended upgrades | 3%  |
| Other                                                                                        | 1%  |

## Warnings:

**TABLE: MC Set \$C1.** Two or more set variables use conflicting labels for the same data value.

**TABLE C1/C2: TOTAL MENTIONS:** Which one of the following best describes the reason why you chose not to have the follow-up visit by an Energy Advisor? Were there other reasons as well?

| OVERALL %                                                                                    |     |
|----------------------------------------------------------------------------------------------|-----|
| SAMPLE SIZE (#)                                                                              | 76  |
| Follow-up visit was too difficult to schedule                                                | 7%  |
| Follow-up visit was too expensive                                                            | 9%  |
| I was too busy / I did not have time                                                         | 47% |
| I don't believe the results of the visit would be useful, relevant or accurate               | 20% |
| The follow-up visit was unnecessary because the work to save energy was already done         | 9%  |
| Didn't book a follow-up visit because we didn't intend to undertake the recommended upgrades | 22% |
| Unable to contact them for a follow-up visit/No response from them                           | 12% |
| I was not aware a follow-up visit was necessary/Didn't know about it                         | 11% |
| Upgrades/renovations not completed yet                                                       | 4%  |
| Other                                                                                        | 4%  |

**TABLE D1:** Would you be interested in having an Energy Advisor again come to your home, for free, to perform an energy assessment of your house? If you are interested, the Service Organization who came to your house for the initial energy assessment might contact you to schedule a final energy assessment in November.

| OVERALL %             |     |
|-----------------------|-----|
| SAMPLE SIZE (#)       | 76  |
| Yes, am interested    | 53% |
| No, am not interested | 47% |



## APPENDIX XXX

### HEA Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net electrical energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 HEA Corrected Tracked Savings**

| Program Component Results                  | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>HEA</b>                                 |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 42.057              | GWh  | 41.992                  | GWh  | -0.15%              |
| Gross Peak Demand Savings at the Generator | 10.399              | MW   | 10.518                  | MW   | 1.14%               |
| Net Energy Savings at the Generator        | 29.740              | GWh  | 29.552                  | GWh  | -0.63%              |
| Net Peak Demand Savings at the Generator   | 5.352               | MW   | 5.367                   | MW   | 0.28%               |

The differences between the tracked and corrected values are mainly explained by the following corrections made by the Evaluator.

- › **For the differences in gross energy savings:**
  - › Correction of unitary savings for some biomass measures
  - › Correction of the logic used to determine the unitary savings for HPWH (heat pump or electric baseboard baseline heating system)
- › **For the differences in net energy savings:**
  - › Correction of NTGR and/or line loss factors for some participants that had hardcoded values using outdated parameters instead of formulas
  - › A deduction of additional participants for unconverted D assessment spillover reversals
  - › Correction of Green Heat savings deductions. In the 2024 Summary tab of the tracking sheet, EfficiencyOne uses hardcoded values instead of a calculation referencing the tracking sheet; the Green Heat savings deductions correspond to the gross savings at the meter, whereas it should have been net savings at the generator

› **For the differences in demand savings:**

- › The same explanations as for energy savings
- › Correction of formula for biomass measures, which rounded the savings at the kW instead of the W for each participant
- › Correction of some heat pump specifications based on cross-reference with NEEP list.



## APPENDIX XXXI

# HEA Detailed Billing Analysis Methodology and Results

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### Background

After inconclusive results in 2023, a billing analysis was again conducted for HEA as part of the 2024 DSM evaluation to obtain measured electrical energy savings generated through the installation of energy efficiency upgrades. **Instead of calculating overestimation ratios (ORs) to be applied to pre and post-space heating consumption obtained from HOT2000**, as is the case in the current savings calculation approach, **the Evaluator used the savings values obtained through the AMI data to develop adjustment ratios (ARs) that can be directly applied to the modelled savings estimates obtained from HOT2000 using whole home consumption** (not only space heating).

The main reasons for recommending a change in the current savings calculation approach are as follows:

- › A higher proportion of participants use a heat pump for heating since the ORs currently used in the savings calculation were determined. The use of a heat pump instead of electrical baseboards makes it more difficult to isolate space heating consumption as the linear correlation with heating degree days is less significant. With the current savings calculation methodology, space heating consumption needs to be isolated because the ORs are calculated specifically for space heating.
- › The complexity of the HEA savings calculation approach is increasing, and the use of ARs directly applied to the savings value (instead of the D and E assessment consumption values separately) simplifies the calculation.

Unlike the billing analysis conducted in 2023, **AMI data**, which started to be progressively available for residential customers in 2020, were used for the 2024 billing analysis.

### Methodology

To assess the electrical energy savings obtained from HEA energy efficiency upgrades, the billing analysis consisted of calculating the change in electrical energy consumption before (pre) and after (post) participation in HEA for a group of recent participants (treatment group). To account for variations in electrical energy consumption due to factors other than HEA participation, the Evaluator selected a control group and deducted the change in electrical energy consumption observed for that group over the same period. Subtracting the change in control group electrical energy consumption (i.e. a change that is not linked to the program component) from that of the treatment group ensures that **only savings attributable to HEA changes are captured and avoids capturing other effects that can have an impact on energy consumption** (e.g. the COVID-19 pandemic) because both the treatment and control groups are impacted by those effects.

Once the electrical energy savings are obtained from the AMI data, they are normalized and compared with the modelled savings values obtained from HOT2000 to establish average **ARs**.

The following subsections detail how the AMI data were used to calculate the electrical energy savings and ultimately the adjustment ratios.



## Selection of the Treatment and Control Groups

The initial treatment group included 1,803 HEA participants who were selected based on the following criteria:

- › Be 100% electrically heated according to HOT2000 (meaning that the primary heating system is electrical and there is no secondary heating system using other fuels and whose consumption is modelled in HOT2000, although the house can still have a supplementary heating system in place such as a fireplace or wood stove whose consumption is not modelled in HOT2000)
- › Have an E assessment date before September 2023 to ensure a full year of post data
- › Have a D assessment date no earlier than November 2021 to avoid overlap with control group participation
- › Did not install wood/pellet equipment or solar PV as part of their participation in HEA
- › Use HOT2000 version 11.10 or later version

Among the 1,803 participants selected based on these criteria, AMI data were available for 1,322 participants. The main reason is because NS Power account numbers were not available for all participants; hence, EfficiencyOne had to match the names and addresses, which was not conclusive for all participants.<sup>6</sup> In addition, some participants were not NS Power customers.

The initial control group included a total of 1,227 customers who were selected based on the following criteria:

- › Be 100% electrically heated according to HOT2000 (same details as for treatment group above)
- › Have participated in HEA before those in the treatment group, i.e. who had an E assessment date between January 2019 and November 2020
- › Use any HOT2000 version (the version used is not important for control group customers considering that only the post-program participation period is looked at for control group customers and only the consumption listed in their electrical bills is used, not the modelled consumption. This means that the version of HOT2000 used to model control group household consumption has no impact on the analysis. The control group is only used to deduct any change in consumption that is not attributable to HEA from the change observed in the treatment group consumption data.)

Among the 1,227 participants selected based on these criteria, AMI data were available for 1,018 participants.<sup>7</sup>

By selecting the control group among a sample of past HEA participants, the Evaluator ensures that control group participants have similar characteristics to treatment group participants, as recommended for matched control group approaches in Chapter 8 of the Uniform Methods Project (UMP). The process to match control and treatment participants is further described below.

## AMI Data Preparation

AMI data for treatment group and control group participants were obtained from two sources:

- › NS Power for the period between the moment AMI data became available (2020) and November 2023
- › EfficiencyOne for the year 2024 (in May 2023, EfficiencyOne started to have access to AMI data in the NS Power system)

In both cases, the AMI data were aggregated on a monthly basis.

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<sup>6</sup> The Evaluator kept only participants with a high level of confidence in the NS Power data matching in the analysis.

<sup>7</sup> As it was the case for the treatment group, the Evaluator kept only participants with a high level of confidence in the NS Power data matching in the analysis.



Before performing the billing analysis, the Evaluator validated the consumption load shapes for each treatment and control group participant to exclude those participants with inconsistent consumption data. Data that matched the following criteria were excluded:

- › Nil consumption or missing data in the study period
- › Very high or very low peaks in the study period
- › Numerous abnormal variations in the consumption pattern (extremely high consumption months followed by close to zero consumption for instance)

After excluding the data that matched the above criteria, about 5% of the sample was excluded.

Similar criteria were applied to the control group customers, and the sample remained largely sufficient to have a different match for each treatment group participant.

### Control-Treatment Participant Matching

To determine the best suited control group participant for each treatment group participant, the Evaluator first applied a set of minimum conditions with which to comply:

- › The E assessment date of the control participant must be at least one year before the D assessment date of the treatment participant.
- › The weather station must be the same.
- › The heating type (with or without a heat pump) after the E assessment must be the same.

These conditions left treatment participants with more than one potential control participant. The point system presented in Table 1 below was then used to provide a score for each potential control participant. The control participant with the highest score was then considered the ideal match and was assigned to the given treatment participant.

**Table 1: Details on the Point System Used for the Selection of Control Participants**

| Parameters                                                                              | Points                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average annual consumption of treatment and control candidates after their E assessment | Add a maximum of 2 points based on a function of the relative difference between the average annual consumption of treatment and control candidates using a sigmoid function that yields approximately the following points: <ul style="list-style-type: none"><li>› 2 points if difference is 10%</li><li>› 1 point if difference is 25%</li><li>› 0 points if difference is 50% or more</li></ul> |

It should be noted that each participant has different pre and post-program periods based on when participation in HEA occurred. Given this, each treatment group participant was assigned one control group participant, and the dates of the pre and post-periods of treatment participants were applied to the control participants for this match.

### Weather Normalization

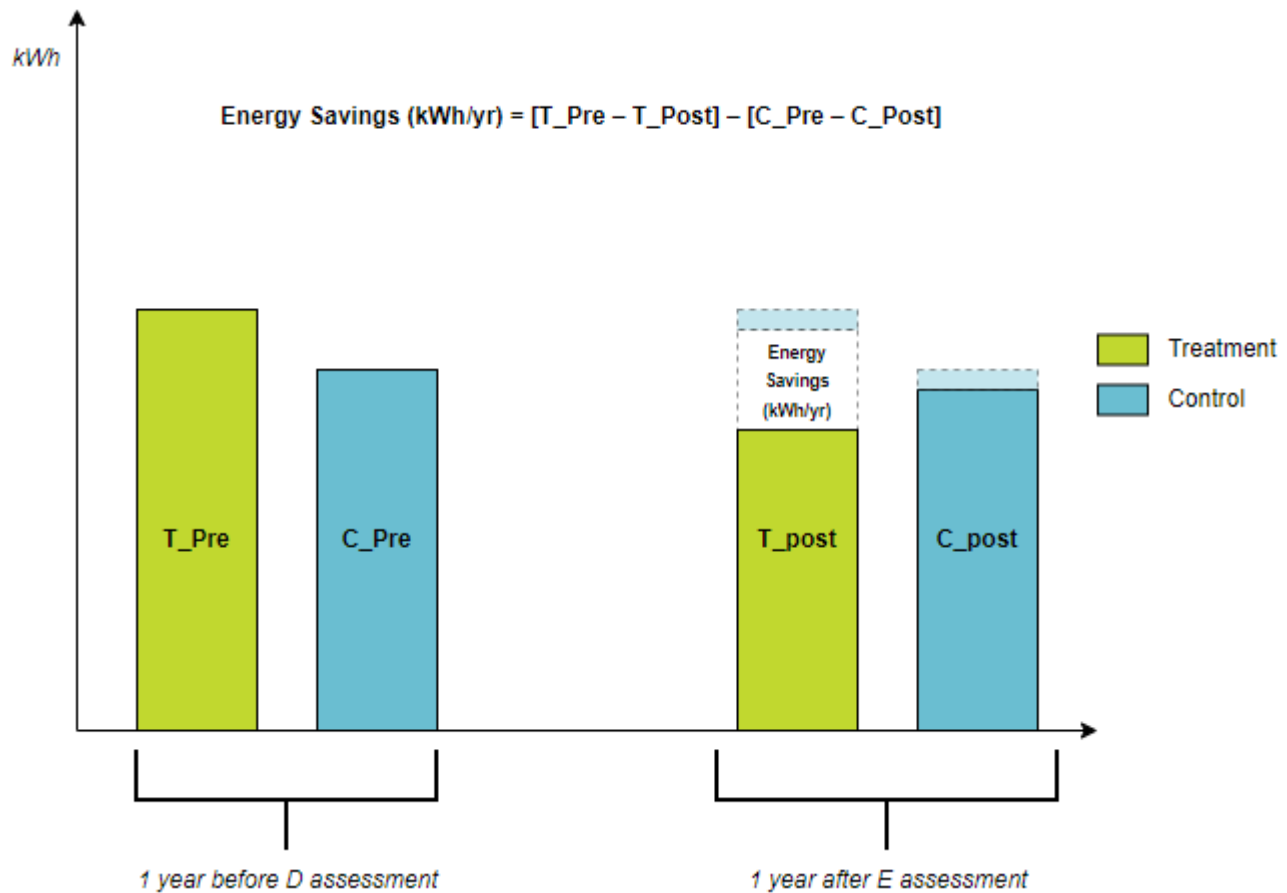
The Evaluator normalized the consumption values obtained from the AMI data using normal weather data to obtain annual consumption values that are aligned with a typical meteorological year. A regression was used to determine how consumption related to heating and cooling degree days was associated with the weather station and billing dates of each control and treatment participant. Multiple iterations were made to select the most appropriate balance temperature to calculate the heating and cooling degree days.

Then, the normal heating and cooling degree days were included in each regression to obtain energy consumption during a typical weather year. The Evaluator calculated the normal heating and cooling degree days based on the previous 15 years (2008-2023) for the five weather stations selected for the analysis (Debert, Greenwood, Halifax, Sydney, and Yarmouth).

### Energy Savings Calculation

Figure 1 below illustrates how energy savings were obtained by calculating the difference in the treatment group normalized annual consumption of each participant for the year before and after program participation and deducting the difference observed in the control group normalized annual consumption for the same period as the treatment participant to which the control participant was assigned.

**Figure 1: Energy Savings Calculation Using AMI Data**



- › T\_Pre: Normalized annual consumption of the treatment participant for the year before the D assessment
- › T\_Post: Normalized annual consumption of the treatment participant for the year after the E assessment
- › C\_Pre: Normalized annual consumption of the assigned control participant for the year before the D assessment of the assigned treatment participant
- › C\_Post: Normalized annual consumption of the assigned control participant for the year after the E assessment of the assigned treatment participant

Then, the energy savings were divided by the savings values obtained from HOT2000 to establish adjustment ratios using the following equation.

$$\text{Adjustment Ratio (AR)} = \frac{\text{Energy Savings}}{\text{Modelled HOT2000 Savings}}$$

$$\text{Modelled HOT2000 Savings} = \text{Total Elec}_D - \text{Total Elec}_E$$

Considering that only participants who implemented modelled measures were included in the treatment group, the ARs are not impacted by the electrical energy savings associated with the installation of wood burning equipment or solar PV systems, which are claimed using prescriptive savings. In addition, no treatment group participants had installed HPWHs, which are also deducted from the calculation and claimed separately using prescriptive savings as presented in the Energy Savings subsection of the HEA evaluation report.

## Detailed Results

Once the main steps of the billing analysis were completed, the Evaluator conducted several analyses to interpret the data. The three scenarios used to establish ORs, associated with the presence of a heat pump or not, remain the most relevant.

The results of the past participant survey were used to remove participants who added heating to existing rooms or floor area. According to survey results, more than one in ten participants declared having added heating or floor area. The analysis of their pre and post-consumption data shows much lower savings than those obtained for participants who did not add heating or floor area, which demonstrates that the addition of heating or floor area has an impact that should be taken into account to avoid capturing an increase in consumption that should not be attributable to the program component.

While analyzing the past participant survey results, Econoler also noticed important variations in some of the pre and post-consumption values of the control group paired with the treatment participants in the survey sample, while the variations were much smaller when looking at the entire control group. Therefore, Econoler concluded that using the average consumption values of the entire control group would be more representative of the average fluctuations in energy consumption that should be deducted from the treatment group.

The following table presents the results from the analysis for each heat pump scenario.

**Table 2: Detailed Results from the Analysis by Heat Pump Scenario**

| Scenario                                                                                   | Sample Size | Pre-consumption (kWh/year) | Post-consumption (kWh/year) | Difference (kWh/year) |
|--------------------------------------------------------------------------------------------|-------------|----------------------------|-----------------------------|-----------------------|
| <b>A participant who registered with a heat pump</b>                                       |             |                            |                             |                       |
| Treatment Group                                                                            | 49          | 20,245                     | 17,014                      | 3,231                 |
| Control Group                                                                              | 341         | 17,479                     | 16,934                      | 545                   |
| <b>A participant who registered without a heat pump and then had one installed</b>         |             |                            |                             |                       |
| Treatment Group                                                                            | 86          | 17,913                     | 14,376                      | 3,537                 |
| Control Group                                                                              | 557         | 15,845                     | 15,423                      | 422                   |
| <b>A participant who registered without a heat pump and who did not have one installed</b> |             |                            |                             |                       |
| Treatment Group                                                                            | 7           | 16,953                     | 14,207                      | 2,746                 |
| Control Group                                                                              | 27          | 17,163                     | 17,041                      | 122                   |

The resulting ARs with their margins of error are presented in the following table. The relatively high margins of error are a result of the high variability in the savings values and the limited sample due to the fact that survey results were used to isolate participants who did not add heating in existing rooms or floor area. Despite that, the Evaluator considers the ARs reliable considering the consumption trends are consistent.

**Table 3: Evaluated Adjustment Ratios by Heat Pump Scenario**

| Scenario                                                                                   | AR   | Margin of Error |
|--------------------------------------------------------------------------------------------|------|-----------------|
| A participant who registered <b>with</b> a heat pump                                       | 1.24 | 57.7%           |
| A participant who registered <b>without</b> a heat pump and who did not have one installed | 0.58 | 13.2%           |
| A participant who registered <b>without</b> a heat pump and then had one installed         | 0.43 | 93.0%           |

## MSHPs Savings

Since the billing analysis was conducted simultaneously for HEA and Green Heat, the Evaluator also compared the MSHP savings measured for Green Heat to those measured for HEA participants who only installed heat pumps (so that savings from other measures such as building envelope improvements would not be considered). On average, HEA participants who only installed heat pumps saved 2,459 kWh, while Green Heat participants saved 1,177 kWh. These numbers are not directly comparable because the systems installed in HEA and Green Heat differ. When looking at the savings per capacity installed, they are much closer (0.0760 kWh/Btu/h for HEA versus 0.0666 kWh/Btu/h for Green Heat). Indeed, the average capacity of HEA heat pumps is 32 kBtu/h for participants who only installed a MSHPs compared to just over 17 kBtu/h for Green Heat.

## Impacts of Billing Analysis Results on Modelled Measure Savings

To get a sense of how the new adjustment ratios and calculation approach impact energy savings for modelled measures in HEA, Table 4 below compares gross electrical energy savings at the meter with and without ratios for all modelled measures for 2024. Overall, the new adjustment ratios and calculation approach are slightly more penalizing than the overestimation ratios and previous calculation approach.

**Table 4: HOT2000 Modelled Measure Gross Electrical Energy Savings at the Meter for 2024**

|                                                                                                                                                                                                                                                                                                                                                                      | Corrected Tracked<br>Energy Savings<br>(Overestimation Ratio) | Evaluated<br>Energy Savings<br>(Adjustment Ratio) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------|
| Gross Energy Savings at the Meter, Without Ratio (GWh)*                                                                                                                                                                                                                                                                                                              | 15.402                                                        | 14.062                                            |
| Gross Energy Savings at the Meter, with Ratio (GWh)                                                                                                                                                                                                                                                                                                                  | 11.684                                                        | 9.200                                             |
| <b>Overall De-rating of HOT2000 Modelled Measures (%)</b>                                                                                                                                                                                                                                                                                                            | <b>24%</b>                                                    | <b>35%</b>                                        |
| *Gross energy savings at the meter without ratios applied differ between corrected tracked and evaluated because of differences in the calculation approach (i.e. the new calculation methodology uses electrical energy consumption of the whole home, whereas the previous methodology used only the electrical energy consumption associated with space heating). |                                                               |                                                   |





## APPENDIX XXXII

### HEA Reporting Requirements

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HEA incentives originate from three sources of funding and are thus reported to different parties via the DSM evaluation and government-funded evaluation. The DSM evaluation is focused on reporting electrical savings funded by electrical DSM funds, while the government-funded evaluation is focused on participation and GHG emission reductions generated from government funding regardless of the type of fuel. To avoid double counting and determine the most appropriate way to report savings, EfficiencyOne developed the equations and rationales presented in Table 1 below.

The equations presented in Table 1 were used in the tracking sheet for all participants who implemented building envelope measures or installed new space heating equipment. The equations were updated in 2019 to better reflect both the energy savings associated to fuel switching (i.e. from fossil fuel space heating energy sources to electrical heat pumps or wood burning equipment) and the distribution of savings between DSM-funded and government-funded programs for households that use multiple energy sources. The incorporation of the Canada Greener Homes Grant in 2021, as a co-funder of energy assessments and measures for both DSM and government funding, has not changed anything in the reporting structure. In 2024, the equations were updated to reflect the change in the overall savings calculation methodology, although no changes were made to the distribution of savings between DSM-funded and government-funded programs itself.

When a fuel switch occurred from a non-electrical heating system in the D assessment to an electrical heating system in the E assessment, electrical savings were capped at 0 kWh and the overall savings, taking into account the increase in electrical consumption, were claimed as non-electrical savings.

The equations reference the following parameters:

- › Total electrical energy consumption ( $\text{Elec\_Consumption}_D$  and  $\text{Elec\_Consumption}_E$ ) obtained from HOT2000 during the D and E assessments
- › Total energy consumption ( $\text{Total\_Consumption}_D$  and  $\text{Total\_Consumption}_E$ ) obtained from HOT2000 during the D and E assessments
- › Savings from wood burning equipment that are not modelled in HOT2000 (wood savings). These savings are reported in either the HEA DSM evaluation report or government-funded evaluation report, or a combination of both depending on the percentage of space heating from electrical sources at the E assessment ( $\text{Percent\_ElecHeating}_E$ ).
- › Savings from HPWHs (HPWH savings). These savings are reported in either the HEA DSM evaluation report or government-funded evaluation report depending on the baseline DHW heating system energy source.

It should be noted that solar PV measures are excluded from these equations. All solar PV measures are claimed in the DSM evaluation report as they offset electricity use.

**Table 1: Reporting Requirements for Different Energy Savings Scenarios<sup>8</sup>**

| Scenarios                                            | 1                                   | 2                                                                                                                                                                                                                                              | 3                                                                                                                                                                                                                                                  | 4                                                                                                                                                                          |
|------------------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Change in Overall Electrical Energy Consumption      | Increase                            | Increase                                                                                                                                                                                                                                       | Decrease                                                                                                                                                                                                                                           | Decrease                                                                                                                                                                   |
| Change in Overall Non-electrical Energy Consumption  | Increase                            | Decrease                                                                                                                                                                                                                                       | Decrease                                                                                                                                                                                                                                           | Increase                                                                                                                                                                   |
| Reporting                                            | N/A                                 | Government-Funded Report                                                                                                                                                                                                                       | DSM and Government-Funded Reports                                                                                                                                                                                                                  | DSM Report                                                                                                                                                                 |
| Equation Used to Calculate DSM Savings               | N/A                                 | $\text{Percent\_ElecHeating}_E * \text{Wood Savings} + \text{HPWH Savings (if baseline DHW = electric)}$                                                                                                                                       | $\text{Electric\_Consumption}_D - \text{Electric\_Consumption}_E + \text{Percent\_ElecHeating}_E * \text{Wood Savings} + \text{HPWH Savings (if baseline DHW = electric)}$                                                                         | $\text{Electric\_Consumption}_D - \text{Electric\_Consumption}_E + \text{Percent\_ElecHeating}_E * \text{Wood Savings} + \text{HPWH Savings (if baseline DHW = electric)}$ |
| Equation Used to Calculate Government-funded Savings | N/A                                 | $\text{Total\_Consumption}_D - \text{Total\_Consumption}_E - (\text{Electric\_Consumption}_D - \text{Electric\_Consumption}_E) + (1 - \text{Percent\_ElecHeating}_E) * \text{Wood Savings} + \text{HPWH Savings (if baseline = non-electric)}$ | $\text{Total\_Consumption}_D - \text{Total\_Consumption}_E - (\text{Electric\_Consumption}_D - \text{Electric\_Consumption}_E) + (1 - \text{Percent\_ElecHeating}_E) * \text{Wood Savings} + \text{HPWH Savings (if baseline DHW = non-electric)}$ | $(1 - \text{Percent\_ElecHeating}_E) * \text{Wood Savings} + \text{HPWH Savings (if baseline DHW = non-electric)}$                                                         |
| Rationale                                            | This situation never occurs in HEA. | These projects are government-funded with no DSM funding.                                                                                                                                                                                      | The savings are included in the appropriate report based on the equations above. DSM savings are subtracted from government-funded savings to avoid double counting.                                                                               | These projects are entirely DSM-funded with no government funding                                                                                                          |

<sup>8</sup> To simplify the equations in Table 1, adjustment ratios are omitted.



## APPENDIX XXXIII

### HEA 2024 Recommendations

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This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 HEA evaluation.

| Section           | Recommendations                                                                                                                                                                   |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | Recommendation #1: In light of their very low savings and considering their low uptake, consider removing wood fireplace inserts and pellet fireplace inserts from the HEA offer. |

## APPENDIX XXXIV

### MHEEP Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 MHEEP Corrected Tracked Savings**

| Program Component Results                       | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|-------------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                                 | Value               | Unit | Value                   | Unit | Value               |
| <b>MHEEP (Excluding Appliance Replacements)</b> |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator           | 0.572               | GWh  | 0.572                   | GWh  | 0.00%               |
| Gross Peak Demand Savings at the Generator      | 0.402               | MW   | 0.419                   | MW   | 4.16%               |
| Net Energy Savings at the Generator             | 0.572               | GWh  | 0.572                   | GWh  | 0.00%               |
| Net Peak Demand Savings at the Generator        | 0.402               | MW   | 0.419                   | MW   | 4.16%               |
| <b>Appliance Replacements</b>                   |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator           | 0.005               | GWh  | 0.006                   | GWh  | 15.90%              |
| Gross Peak Demand Savings at the Generator      | 0.001               | MW   | 0.001                   | MW   | 13.30%              |
| Net Energy Savings at the Generator             | 0.005               | GWh  | 0.006                   | GWh  | 15.90%              |
| Net Peak Demand Savings at the Generator        | 0.001               | MW   | 0.001                   | MW   | 13.30%              |
| <b>MHEEP Total</b>                              |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator           | 0.577               | GWh  | 0.578                   | GWh  | 0.14%               |
| Gross Peak Demand Savings at the Generator      | 0.403               | MW   | 0.420                   | MW   | 4.18%               |
| Net Energy Savings at the Generator             | 0.577               | GWh  | 0.578                   | GWh  | 0.14%               |
| Net Peak Demand Savings at the Generator        | 0.403               | MW   | 0.420                   | MW   | 4.18%               |

For modelled measures, the tracked and corrected electrical energy savings were equal. The higher corrected peak demand savings compared to the value tracked by E1 were due to a change in methodology by the Evaluator to better account for the percentage of electrical space heating and better align with how that percentage is used in energy savings calculations. The change resulted in a mix of upward and downward adjustments, overall resulting in a small upward adjustment. For non-modelled measures, the differences between the tracked and corrected savings are due to incorrect and older unitary savings having been used by E1 for freezer and refrigerator replacements.



## APPENDIX XXXV

### MHEEP 2024 Recommendations

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The Evaluator made no specific recommendation as part of the 2024 MHEEP evaluation.

## APPENDIX XXXVI

### Residential Behaviour: Monthly Savings Approach

While they are not used to claim savings, monthly savings were calculated to observe monthly trends and the ramp-up period in more detail. An equation similar to that of the cumulative approach is used for the monthly approach. For a given month, the DiD model serves to **compare the difference in the average daily consumption between the treatment group and the control group before and after program participation**. The equation is expressed as follows.

$$\text{Monthly Savings} = \left[ (Post\_kWh_{Control,m} - Post\_kWh_{Treat,m}) - (Pre\_kWh_{Control,m} - Pre\_kWh_{Treat,m}) \right] \\ \times Households_{TG,m} \times Nb\_Days_m$$

Where:

- ›  $m$  = A number between 1 and 12 to identify the given month
- ›  $Post\_kWh_{Control,m}$  = The control group's average daily consumption in a given month of the post-program period
- ›  $Post\_kWh_{Treat,m}$  = The treatment group's average daily consumption in a given month of the post-program period
- ›  $Pre\_kWh_{Control,m}$  = The control group's average daily consumption in a given month of the pre-program period
- ›  $Pre\_kWh_{Treat,m}$  = The treatment group's average daily consumption in a given month of the pre-program period
- ›  $Households_{Treat,m}$  = The total number of active participating households in the treatment group in a given month
- ›  $Nb\_Days_m$  = The total number of treatment days in a given month

Table 1 below presents the 2024 monthly electricity savings calculated by the Evaluator for the high, medium and low users. Note that the numbers of active treatment participants in May 2024 differ from those presented in Subsection 29.3 from the report, due to accounts that became inactive or switched to solar between the moment the groups were selected and the launch of the program component.

**Table 1: 2024 Residential Behaviour Evaluated Electricity Monthly Energy Savings**

|                                                 | May<br>2024  | June<br>2024 | July<br>2024 | August<br>2024 | September<br>2024 | October<br>2024 | November<br>2024 | December<br>2024 |
|-------------------------------------------------|--------------|--------------|--------------|----------------|-------------------|-----------------|------------------|------------------|
| <b>Wave 1 – High users</b>                      |              |              |              |                |                   |                 |                  |                  |
| Number of Active Participants (Treatment Group) | 96,709       | 95,965       | 95,283       | 94,463         | 93,948            | 93,296          | 92,680           | 92,268           |
| Attrition Rate (%)                              | 0.7%         | 0.8%         | 0.7%         | 0.9%           | 0.5%              | 0.7%            | 0.7%             | 0.4%             |
| Average Daily Consumption (Treatment kWh/day)   | 34.887       | 30.509       | 32.803       | 31.745         | 26.680            | 34.126          | 45.764           | 64.948           |
| Average Monthly Savings (kWh/Participant)       | -4.16        | 0.230        | 1.91         | 3.62           | 5.05              | 8.79            | 10.19            | 9.08             |
| Percentage of Monthly Savings (%)*              | -0.36%       | 0.02%        | 0.18%        | 0.38%          | 0.56%             | 0.87%           | 0.65%            | 0.48%            |
| Margin of Error (%)**                           | 0.62%        | 0.75%        | 0.81%        | 0.88%          | 0.78%             | 0.65%           | 0.58%            | 0.67%            |
| <b>Total Monthly Savings (kWh)***</b>           | <b>0.000</b> | <b>0.000</b> | <b>0.000</b> | <b>0.000</b>   | <b>0.000</b>      | <b>0.820</b>    | <b>0.944</b>     | <b>0.000</b>     |
| <b>Wave 2 – Medium users</b>                    |              |              |              |                |                   |                 |                  |                  |
| Number of Active Participants (Treatment Group) | 87,909       | 87,290       | 86,701       | 85,946         | 85,418            | 84,850          | 84,271           | 83,903           |
| Attrition Rate (%)                              | 0.6%         | 0.7%         | 0.7%         | 0.9%           | 0.6%              | 0.7%            | 0.7%             | 0.4%             |
| Average Daily Consumption (Treatment kWh/day)   | 19.629       | 18.253       | 20.635       | 20.002         | 17.793            | 20.183          | 24.934           | 33.390           |
| Average Monthly Savings (kWh/Participant)       | 0.816        | 1.67         | 4.59         | 3.59           | 4.08              | 6.9             | 6.51             | 5.14             |
| Percentage of Monthly Savings (%)*              | 0.13%        | 0.30%        | 0.70%        | 0.61%          | 0.73%             | 1.14%           | 0.80%            | 0.53%            |
| Margin of Error (%)**                           | 0.75%        | 0.84%        | 0.98%        | 1.03%          | 0.92%             | 0.81%           | 0.82%            | 0.98%            |
| <b>Total Monthly Savings (kWh)***</b>           | <b>0.000</b> | <b>0.000</b> | <b>0.000</b> | <b>0.000</b>   | <b>0.000</b>      | <b>0.585</b>    | <b>0.000</b>     | <b>0.000</b>     |
| <b>Wave 3 – Low users</b>                       |              |              |              |                |                   |                 |                  |                  |
| Number of Active Participants (Treatment Group) | 52,967       | 52,446       | 51,956       | 51,329         | 50,993            | 50,516          | 50,030           | 49,699           |
| Attrition Rate (%)                              | 0.9%         | 1.0%         | 0.9%         | 1.2%           | 0.7%              | 0.9%            | 1.0%             | 0.7%             |
| Average Daily Consumption (Treatment kWh/day)   | 9.876        | 9.973        | 11.702       | 11.431         | 9.995             | 10.370          | 11.885           | 14.840           |
| Average Monthly Savings (kWh/Participant)       | 1.24         | 0.613        | 0.873        | 1.84           | 1.72              | 1.87            | 2.36             | 5.38             |
| Percentage of Monthly Savings (%)*              | 0.42%        | 0.21%        | 0.24%        | 0.55%          | 0.56%             | 0.60%           | 0.66%            | 1.30%            |
| Margin of Error (%)**                           | 0.71%        | 0.68%        | 0.75%        | 0.79%          | 0.69%             | 0.73%           | 0.86%            | 1.07%            |
| <b>Total Monthly Savings (kWh)***</b>           | <b>0.0</b>   | <b>0.0</b>   | <b>0.0</b>   | <b>0.0</b>     | <b>0.0</b>        | <b>0.0</b>      | <b>0.0</b>       | <b>0.267</b>     |

\*For each month, the percentage of monthly savings is calculated by dividing the average daily savings by the average daily consumption of the control group.

\*\* The margins of error were calculated at a 90% confidence level.

\*\*\* The values indicated in red are not statistically significant, meaning that the results for those months are inconclusive and are considered nil.

As depicted in Figure 1, Figure 2, and Figure 3 below, the evolution of the monthly savings values and their margins of error during the first months of the post-program period illustrate a program ramp-up effect. For most months, the margins of errors include zero savings because of this ramp-up effect, meaning that the average savings values for those three months are uncertain and not statistically significant.

With only eight months since program component launch excluding the winter period, analyses of monthly results are limited. The Evaluator notes that wave 1 (high electricity users) presented the highest kWh savings values per participant for the months of October to December and 0.87% of savings achieved in October. Waves 2 and 3 also indicated good potential with savings percentages of 0.81% and 1.07% in October and December respectively.

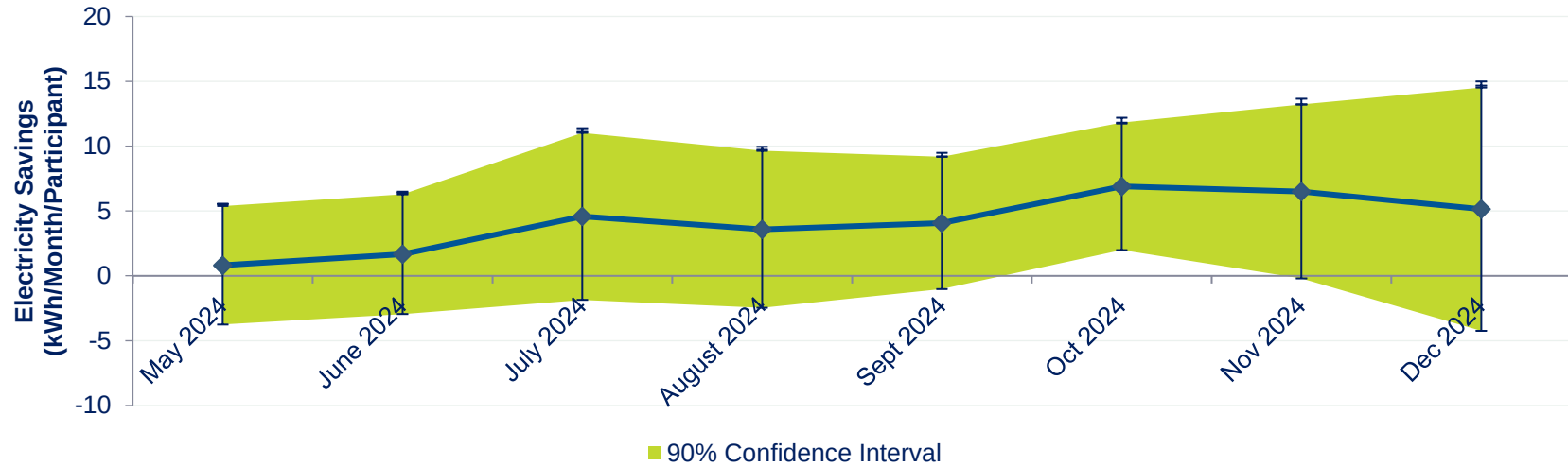
**Figure 1: 2024 High User Monthly Electricity Savings**



Note: When the confidence interval includes values below zero, the savings are not statistically significant, which is the case for all months except for October and November 2024.

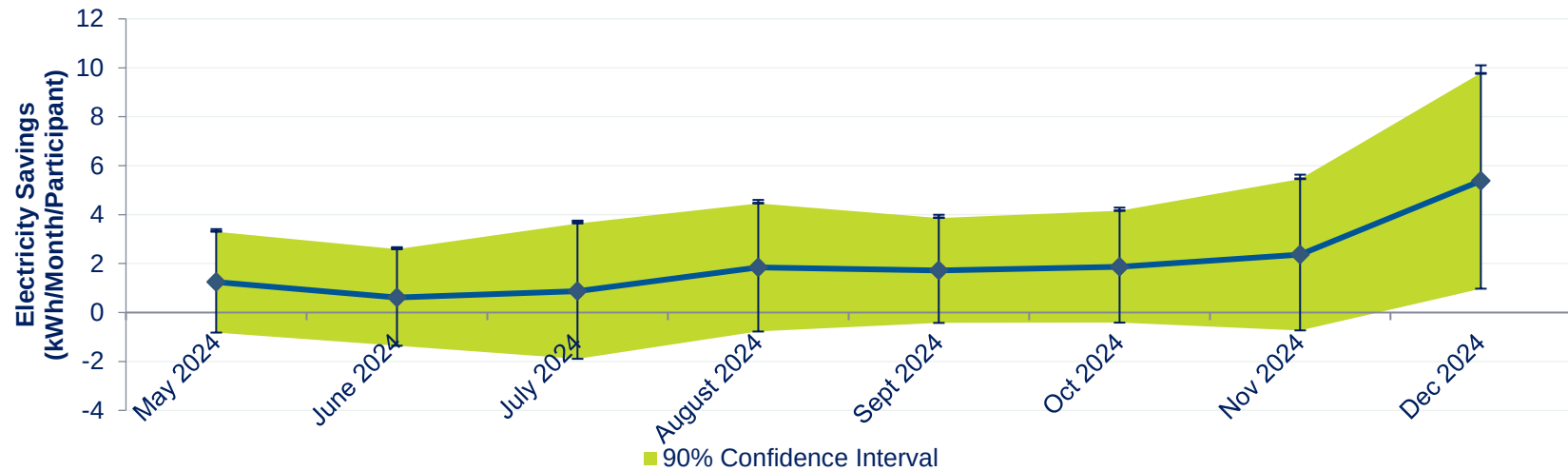


**Figure 2: 2024 Medium User Monthly Electrical Savings**



Note: When the confidence interval includes values below zero, the savings are not statistically significant, which is the case for all months except for October 2024.

**Figure 3: 2024 Low User Monthly Electrical Savings**



Note: When the confidence interval includes values below zero, the savings are not statistically significant, which is the case for all months except for December 2024.

## APPENDIX XXXVII

### Residential Behaviour 2024 Recommendations

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The Evaluator made no specific recommendation as part of the 2024 Residential Behaviour evaluation.



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EfficiencyOne

# EFFICIENT PRODUCT REBATES PROGRAM

Final Report

2024 DSM EVALUATION

March 26, 2025





## ABBREVIATIONS

---

|                 |                                            |
|-----------------|--------------------------------------------|
| <b>BER</b>      | Business Energy Rebates                    |
| <b>BER-AR</b>   | Application Rebates                        |
| <b>BER-IR</b>   | Instant Rebates                            |
| <b>BNI</b>      | Business, non-profit, and institutional    |
| <b>DLC</b>      | DesignLights Consortium                    |
| <b>DR</b>       | Demand response                            |
| <b>DSM</b>      | Demand-side management                     |
| <b>DSM MA</b>   | Demand-side Management Measure Assessment  |
| <b>E1</b>       | EfficiencyOne                              |
| <b>ENS</b>      | Efficiency Nova Scotia                     |
| <b>EUL</b>      | Effective useful life                      |
| <b>EV</b>       | Electric vehicle                           |
| <b>GHG</b>      | Greenhouse gas                             |
| <b>HOU</b>      | Hours of use                               |
| <b>HVAC</b>     | Heating, Ventilation, and Air Conditioning |
| <b>ISRs</b>     | In-service rates                           |
| <b>LED</b>      | Light-emitting diode                       |
| <b>NS Power</b> | Nova Scotia Power                          |
| <b>NSUARB</b>   | Nova Scotia Utility and Review Board       |
| <b>NTGRs</b>    | Net-to-gross ratios                        |
| <b>PCFs</b>     | Peak coincidence factors                   |
| <b>SBES</b>     | Small Business Energy Solutions            |
| <b>VFD</b>      | Variable frequency drive                   |

## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Available Demand Response Capacity</b> | The capacity which is available to NSP to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure the available DR capacity. Available DR capacity is evaluated on a per-participant basis, based on the average demand reduction observed for each event that the participant was scheduled to participate in. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                 |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or load reduction in response to events called by the electric utility (Nova Scotia Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.                                                                                                                                                                                                                                                |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                           |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                                                                                                                                                    |



|                                         |                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equipment life</b>                   | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                |
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global-warming potential is estimated over a timescale of 100 years.                                                                |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                         |
| <b>First-year savings</b>               | The first full year of energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                         |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program regardless of why they participated.                                                                                                                                    |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                      |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems in a building (such as heating and cooling) due to the installation of an energy-efficient measure.                                                                                                                                                               |
| <b>In-service rate</b>                  | The proportion of incentivized products that are installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as LED lamps.                                                   |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.             |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                              |
| <b>Line loss factor</b>                 | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                      |

|                                 |                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Margin of error</b>          | The amount of random sampling error.                                                                                                                                                                                                                                                                                                         |
| <b>Market effects</b>           | The impact of a program on the market (in terms of product availability, practices, and prices) that extends beyond changing program participant behaviours. This includes spillover among non-participants.                                                                                                                                 |
| <b>Net savings</b>              | Energy or peak demand savings that can be reliably attributed to a program. This includes effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                           |
| <b>Net-to-gross ratio</b>       | The ratio of net energy savings to gross energy savings.                                                                                                                                                                                                                                                                                     |
| <b>Non-sampling error</b>       | Errors arising during all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                 |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when Nova Scotia Power's 10-minute reserve is low.                |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                            |
| <b>Random sampling error</b>    | An error in measurement because measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                        |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                           |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                   |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                           |
| <b>Spillover</b>                | Savings attributable to participants who implement the energy efficiency measure(s) introduced by a program after participating in it once, without participating in the program a second time.                                                                                                                                              |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, except the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one-tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                      |





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## EXECUTIVE SUMMARY

This report presents the 2024 demand-side management (DSM) results of the Efficient Product Rebates program administered by EfficiencyOne (E1). This program is comprised of the Business Energy Rebates (BER) program component. Through its Application Rebates (BER-AR) and Instant Rebates (BER-IR) services, BER provides financial incentives in the form of prescriptive rebates or financing to business, non-profit, and institutional (BNI) participants to encourage reductions in electricity consumption and demand.

### Evaluation Approach

The 2024 evaluation was aimed at calculating program component gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided greenhouse gas (GHG) emissions. Table 1 summarizes the types of evaluation conducted for the program component and the corresponding methodology.

**Table 1: Summary of 2024 Efficient Product Rebates Program Evaluation**

| Program Component | Evaluation Type                                                        |         |        | Methodology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------|------------------------------------------------------------------------|---------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | Impact                                                                 | Process | Market |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| BER               | Comprehensive (Instant Rebates)<br><br>Condensed (Application Rebates) | X       | X      | <ul style="list-style-type: none"><li>› Instant Rebates participant survey</li><li>› Instant Rebates interviews with distributors</li><li>› Tracking sheet audit</li><li>› Unitary savings review</li><li>› Effective useful life (EUL) update</li><li>› Calculations using evaluation results</li><li>› Use of adjustment ratio from the BER-AR 2022 evaluation, with corrections to account for modifications to 2024-2025 Demand-side Management Measure Assessment (DSM MA) equations and values</li><li>› GHG emission reduction calculations</li><li>› Use of 2021 free-ridership and 2022 spillover for NTGR for BER-AR</li><li>› Market characterization study</li></ul> |

### Program Performance

Table 2 below presents the participation levels, NTGRs, evaluated gross and net savings at the generator, annual GHG emission reductions, as well EUL values for each service and Efficient Product Rebates as a whole.

**Table 2: Overall 2024 Efficient Product Rebates Participation and Evaluated Savings**

|                                                                                                                                                             | Participation Level |               | Gross Savings |                  | NTGR   | Net Savings |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------|---------------|------------------|--------|-------------|------------------|
|                                                                                                                                                             | Value               | Unit          | Value         | Unit             | Value* | Value       | Unit             |
| Application Rebates                                                                                                                                         |                     |               |               |                  |        |             |                  |
| Energy Savings                                                                                                                                              | 262                 | Projects      | 15.526        | GWh              | 0.74   | 11.489      | GWh              |
| Lifetime Energy Savings                                                                                                                                     |                     |               | 293.685       | GWh              | 0.74   | 217.327     | GWh              |
| Peak Demand Savings                                                                                                                                         |                     |               | 1.721         | MW               | 0.74   | 1.274       | MW               |
| Annual GHG Emission Reductions                                                                                                                              |                     |               | 7,331         | Tonnes of CO2 eq | 0.74   | 5,425       | Tonnes of CO2 eq |
| EUL                                                                                                                                                         |                     |               | 18.9          | Years            |        | 18.9        | Years            |
| Instant Rebates                                                                                                                                             |                     |               |               |                  |        |             |                  |
| Energy Savings                                                                                                                                              | 177,358             | Products sold | 31.327        | GWh              | 0.90   | 28.040      | GWh              |
| Lifetime Energy Savings                                                                                                                                     |                     |               | 442.043       | GWh              | 0.89   | 392.559     | GWh              |
| Peak Demand Savings                                                                                                                                         |                     |               | 5.035         | MW               | 0.89   | 4.472       | MW               |
| Annual GHG Emission Reductions                                                                                                                              |                     |               | 14,792        | Tonnes of CO2 eq | 0.90   | 13,241      | Tonnes of CO2 eq |
| EUL                                                                                                                                                         |                     |               | 14.1          | Years            |        | 14.0        | Years            |
| Total                                                                                                                                                       |                     |               |               |                  |        |             |                  |
| Energy Savings                                                                                                                                              |                     |               | 46.852        | GWh              | 0.84   | 39.529      | GWh              |
| Lifetime Energy Savings                                                                                                                                     |                     |               | 735.728       | GWh              | 0.83   | 609.885     | GWh              |
| Peak Demand Savings                                                                                                                                         |                     |               | 6.756         | MW               | 0.85   | 5.746       | MW               |
| Annual GHG Emission Reductions                                                                                                                              |                     |               | 22,124        | Tonnes of CO2 eq | 0.84   | 18,666      | Tonnes of CO2 eq |
| EUL                                                                                                                                                         |                     |               | 15.7          | Years            |        | 15.4        | Years            |
| * The average NTGR values presented in the total correspond to the ratios of net savings to gross savings for both Application Rebates and Instant Rebates. |                     |               |               |                  |        |             |                  |

Efficient Product Rebates was aimed at achieving 39.747 GWh in net electrical energy savings and 5.107 MW in net peak demand savings at the generator for 2024. The program nearly reached the planned net electrical energy savings, falling short by less than 1%, and exceeded the peak demand savings target by 13%. Instant Rebates was the largest contributor to total program net energy and peak demand savings.

The following subsections present evaluation results at the program component level.

## BER Findings and Recommendations

This subsection presents the key findings and recommendations from the 2024 BER evaluation.

**2024 BER-Finding:** BER net electrical energy savings almost reached the target of 39.747 GWh, falling short by less than 1%, and exceeded the planned net peak demand savings of 5.107 MW by 13%.



**2024 BER-Finding:** In 2024, Instant Rebates participation decreased by 26% with fewer measures rebated. In 2024, Application Rebates participation increased with 18% more participating businesses and with net savings per participant also increasing by 16% compared to 2023. Overall, BER gross electrical energy savings and peak demand savings decreased by 2% and 9% respectively compared to 2023 levels. This was mainly due to the decrease in Instant Rebates savings generated by LED linear lamps and LED linear fixtures.

**2024 BER-Finding:** Overall satisfaction with Instant Rebates is high among both participants and distributors with reported average satisfaction ratings of 9.1 and 8.3 out of 10 respectively.

**2024 BER-Finding:** The Instant Rebates free-ridership algorithm was updated in 2024 and the overall free-ridership levels established in the 2024 evaluation ranged between 8% and 15%, which represent a decrease from the 2022 evaluation.

**2024 BER-Finding:** Both evaluated net electrical energy savings and peak demand savings were identical to the values tracked by E1 for Application Rebates. Evaluated net electrical energy and peak demand savings were both 4% and 6% higher respectively than tracked results for Instant Rebates.

**2024 BER-Finding:** The fixture market has transitioned to LED, with non-LED options now rare. They report 100% LED stock for linear and high-bay fixtures and 99% for outdoor fixtures. Manufacturers no longer supply non-LED alternatives, and this market share is expected to remain stable without E1 incentives.

**2024 BER-Finding:** Most purchases rebated through BER-IR are for new construction or products at the end of their useful life, which validates the use of a replace-on-burnout baseline for this program component.

**2024 BER-Finding:** The market evaluation results indicate that the market practice for BNI fixtures is LED technology, indicating that an update to the baseline for fixtures sold through BER-IR is imminent.

**Recommendation #1:** Undertake additional research to further validate the market evaluation results to establish, no later than Q3, when the LED baseline for BER-IR LED fixtures should take effect. Research should focus on the potential risk of the fixture market rebounding from reducing or removing the Instant incentives in the Nova Scotia market.

**2024 BER-Finding:** The LED market practice baseline for BNI fixtures also applies to new construction projects incented through BER-AR.

**Recommendation #2:** Review the eligibility criteria for LED lighting in new construction projects in BER-AR given evidence that LEDs are the baseline for this market.

**2024 BER-Finding:** Distributors reported that most of their fixture stock is DLC Premium or DLC Standard, with a small portion being non-certified. They expect the market to remain certified even without E1 incentives, though this should be monitored.

**Recommendation #3:** In line with Recommendation #1, research should also investigate the efficiency level of an LED baseline for LED fixtures.

**2024 BER-Finding:** Distributors still carry a small percentage of non-LED lamps for a subset of customers. They forecast this share to diminish even more over the next two years as more fixtures are replaced with LEDs.



**Recommendation #4:** The current non-LED baseline for lamps should be maintained for BER-IR and reassessed in 2026. Given trends, E1 should plan for a baseline change starting in 2027.

**2024 BER-Finding:** Lighting retrofit opportunities remain for early replacements and particularly in some subsectors where capital funding is limited, like institutional and government buildings and to a lesser extent property management companies.

**Recommendation #5:** Plan for a shift in the product offer for LED fixtures from BER-IR to BER-AR to capture remaining retrofit opportunities once LED baseline is adopted for BER-IR.

**Recommendation #6:** Focus efforts on BER-AR to target market laggards for early replacement retrofits of their lighting.

**Recommendation #7:** A LED baseline should also be applied to the EUL of LED fixtures rebated through BER-AR and SBES to reflect the fact that existing fixtures would have been replaced with LED fixtures at the end of their life. The baseline should consider the proportion of projects targeted for early replacement versus replace on burn-out as well as an estimated remaining EUL.

**2024 BER-Finding:** Distributors report that control products continue to evolve.

**Recommendation #8:** Analyze opportunities for increasing interest around controlled lighting products.

**2024 BER-Finding:** There is an increase in multi-wattage and multi-voltage fixture products available on the market.

For these products, the tracked wattage may not necessarily be the wattage used for all applications.

**Recommendation #9:** Ensure that multi-wattage products are identified in the tracking sheet. Update applications for BER-AR and SBES to identify multi-wattage products and confirm the wattage being used. Select the middle wattage (i.e. not the lowest or highest) as the tracked wattage when information is not available from the participant.

## Program Tracked and Evaluated Savings

Table 3 below compares E1 tracked electrical energy and peak demand savings to evaluated savings at the generator. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both electrical energy savings and peak demand savings. Furthermore, the NTGRs are also presented and correspond to the rounded averages obtained by dividing net savings by gross savings, which explains why the NTGR values are different from those presented in the other sections.



**Table 3: Comparison of 2024 Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                                                            |                       | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                                                            |                       | Value         | Unit |       | Value       | Unit |                  |
| BER                                                                                                                                                                                                        | Energy Savings        |               |      |       |             |      |                  |
|                                                                                                                                                                                                            | Tracked Savings by E1 | 47.777        | GWh  | 0.81  | 38.557      | GWh  | 103%             |
|                                                                                                                                                                                                            | Evaluation Results    | 46.852        | GWh  | 0.84  | 39.529      | GWh  |                  |
|                                                                                                                                                                                                            | Peak Demand Savings   |               |      |       |             |      |                  |
|                                                                                                                                                                                                            | Tracked Savings by E1 | 6.752         | MW   | 0.81  | 5.479       | MW   | 105%             |
|                                                                                                                                                                                                            | Evaluation Results    | 6.756         | MW   | 0.85  | 5.746       | MW   |                  |
| *Different NTGRs were established for Application Rebates and Instant Rebates. The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for both services. |                       |               |      |       |             |      |                  |

Evaluated net electrical energy and peak demand savings established through this evaluation were both 3% and 5% respectively higher than those calculated in the 2024 tracking sheet. The differences are attributed to updates to the unitary savings values and NTGRs for Instant Rebates.

## INTRODUCTION

EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight of its DSM activities is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electricity DSM activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs, three business, non-profit, and institutional (BNI) programs, and one demand response (DR) program that are marketed to Nova Scotians through the ENS franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2024 DSM program portfolio

This evaluation report relates to the Efficient Product Rebates program that is comprised of Business Energy Rebates (BER) program component. Table 4 below lists the Efficient Product Rebates program component and the type of evaluations conducted for 2024. A comprehensive impact evaluation involves reviewing the following four key elements: (1) the baseline definition; (2) the savings calculation methodology; (3) the values of the parameters used to calculate savings; and (4) NTGRs. A condensed impact evaluation involves using some or all of the previous year's impact evaluation parameters such as unitary savings values, adjustment ratios, installation rates, and net-to-gross ratios (NTGRs) to provide evaluated results.

**Table 4: Types of Evaluations Conducted for Each Program Component, 2024**

| Program                   | Program Component | 2023    |        |                                      |
|---------------------------|-------------------|---------|--------|--------------------------------------|
|                           |                   | Process | Market | Impact                               |
| Efficient Product Rebates | BER               | X       | X      | Comprehensive (IR)<br>Condensed (AR) |

For each program, the Evaluator prepared a DSM evaluation report presenting key findings, electrical first-year and lifetime energy savings, peak demand savings, and avoided greenhouse gas (GHG) emissions.<sup>1</sup>

<sup>1</sup> Unless specified otherwise, electrical energy savings refer to first-year energy savings rather than lifetime energy savings throughout this report.

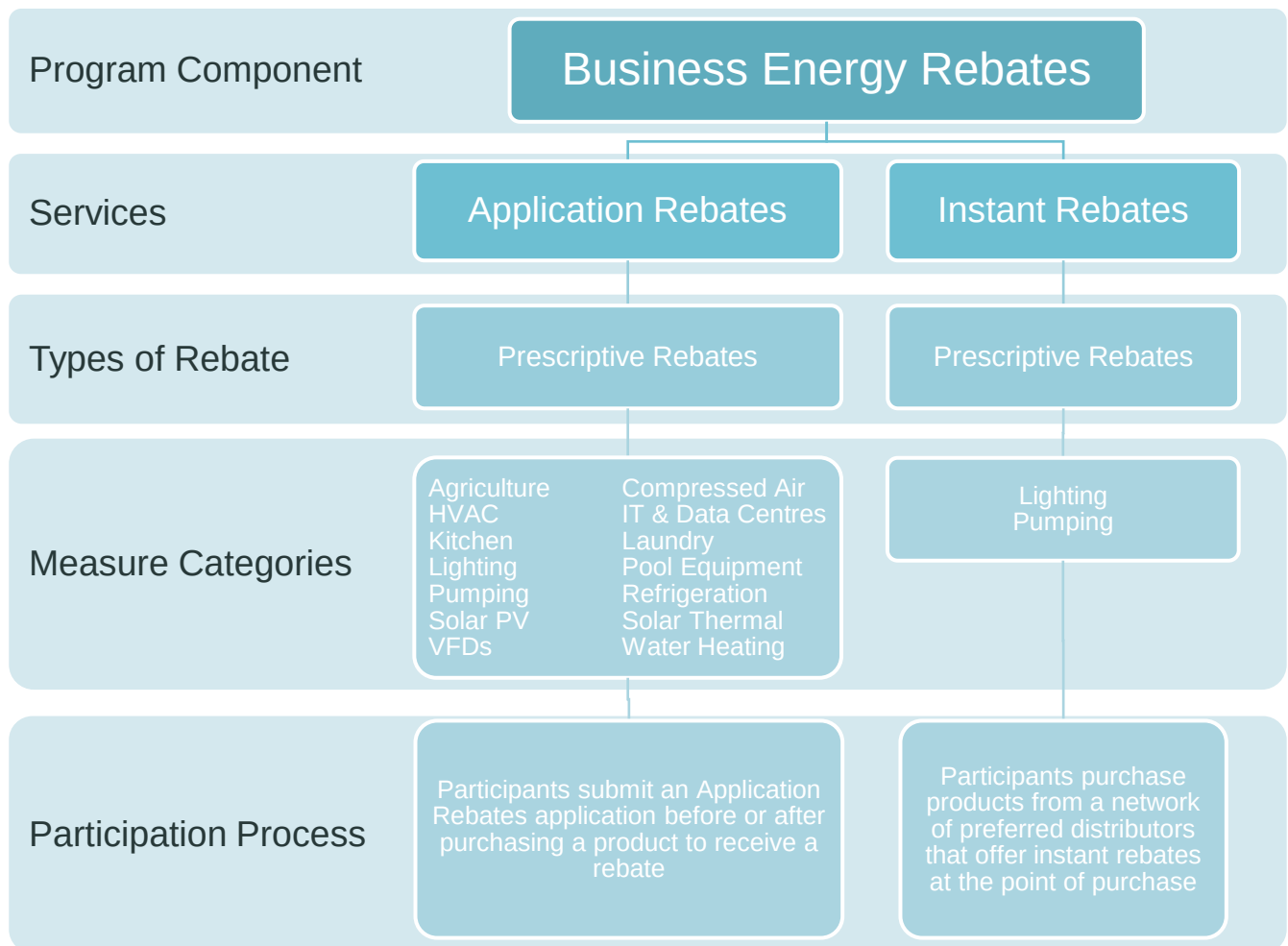
# 1 BER Overview

This section describes Business Energy Rebates (BER) program component, follows up on past evaluation recommendations, and presents participation history.

## 1.1 BER Description

BER provides financial incentives in the form of prescriptive rebates or financing to business, non-profit, and institutional (BNI) participants to foster reductions in electricity consumption and peak demand. All businesses, non-profits, and institutions in Nova Scotia are eligible. Figure 1 presents an overview of the program component.

Figure 1: BER Overview



The term prescriptive rebate refers to a particular rebate value that is calculated prior to a participant purchasing an eligible measure. If a given measure or technology demonstrates energy savings potential, a corresponding rebate value is applied to the purchase price of the measure or technology.

Measures offered through BER must meet specific criteria including minimum efficiency/efficacy values as well as industry standards such as ENERGY STAR® certified performance levels or those established by the DesignLights Consortium (DLC) and the National Electrical Manufacturers Association.



Rebates offered through BER are delivered through two services, the Application Rebates (AR) service and the Instant Rebates (IR) service. Instant Rebates reaches a greater number of participants and offers quick and convenient access to BER but is limited in tracking participant details. Conversely, Application Rebates allows for better project-level control since more participant details are provided to E1. All BER technologies are available through Application Rebates, while only certain lighting and pumping technologies are eligible through Instant Rebates.

Instant Rebates is delivered through a network of participating distributors in the Province of Nova Scotia. These distributors play a key role in promoting Instant Rebates to end users. Distributors also provide customer services for measures that are only eligible through Application Rebates by sharing their expertise and assisting with completing applications. Two new participating distributors were added in 2024, bringing the total to 17.

In an effort to increase participation, E1 increased rebate amounts and caps on select lighting measures for four lighting categories in May 2024 in both Application Rebates and Instant Rebates.

BER was aimed at achieving 39.747 GWh in net electrical energy savings and 5.107 MW in net peak demand savings at the generator in 2024.

## **1.2 Follow-up on Past Evaluation Report Recommendations**

No recommendations were made for BER in 2023.

## **1.3 Participation History**

### **BER Application Rebates**

In 2024, 15,644 units were rebated through 262 projects that were implemented by 199 unique participants<sup>2</sup> under Application Rebates. Figure 2 below illustrates how Application Rebates participation has evolved since 2015. The number of participating businesses increased in 2024 with 18% more participating businesses compared to 2023. This increase in participants correlated to a 15% increase in the number of completed Application Rebates projects. Finally, the gross electrical energy savings achieved per participant increased by 16%.

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<sup>2</sup> The number of unique participants in Application Rebates corresponds to the number of businesses that participated in the service.

**Figure 2: Overview of Participation in Application Rebates, 2016-2024**

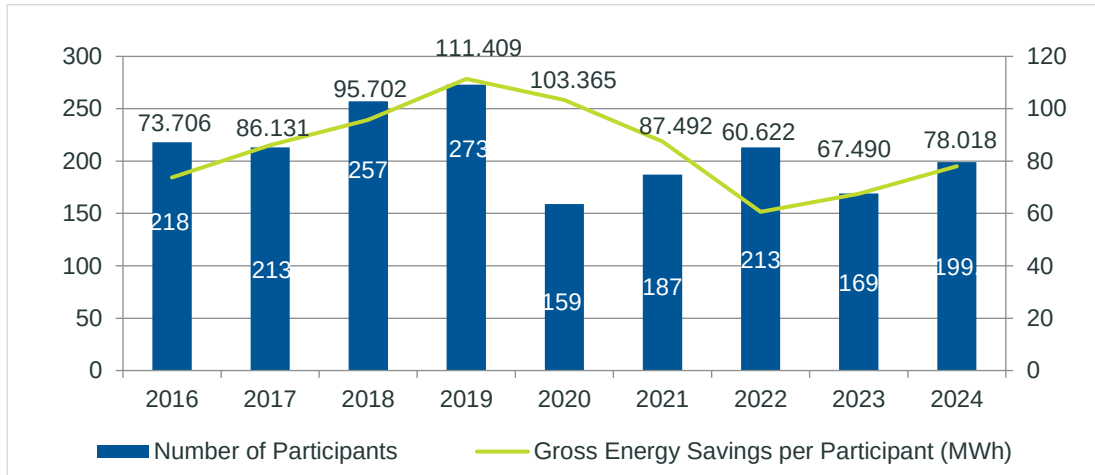
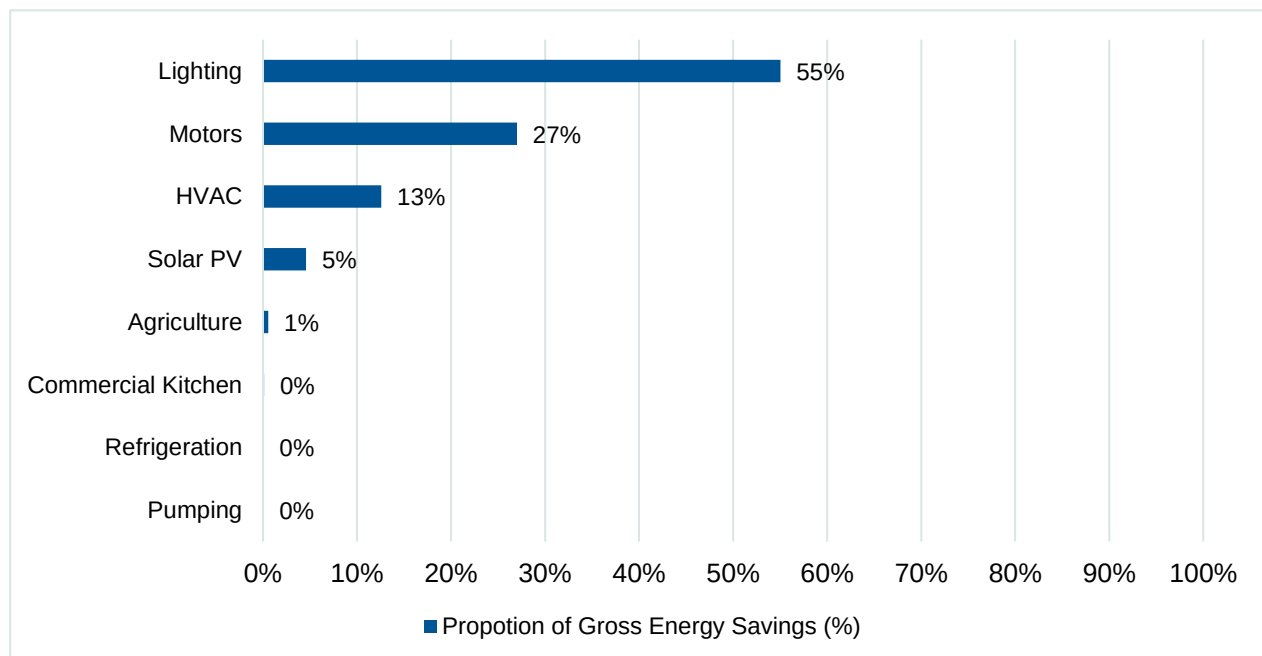


Figure 3 below illustrates the distribution of gross electrical energy savings among Application Rebates measure categories. The lighting and motor measure categories accounted for most Application Rebates savings (82% in total). The motors category saw the greatest increase in savings, generating 27% of total program savings compared to less than 10% in 2023. This was largely due to one large project that generated 2.998 GWh in electrical energy savings. The commercial kitchen, refrigeration, and pumping measure categories each accounted for less than 1% of total savings. The IT and data centre, water heating, pool, compressed air, and laundry measure categories are not included in Figure 3 since no projects in those measure categories were submitted in 2024.

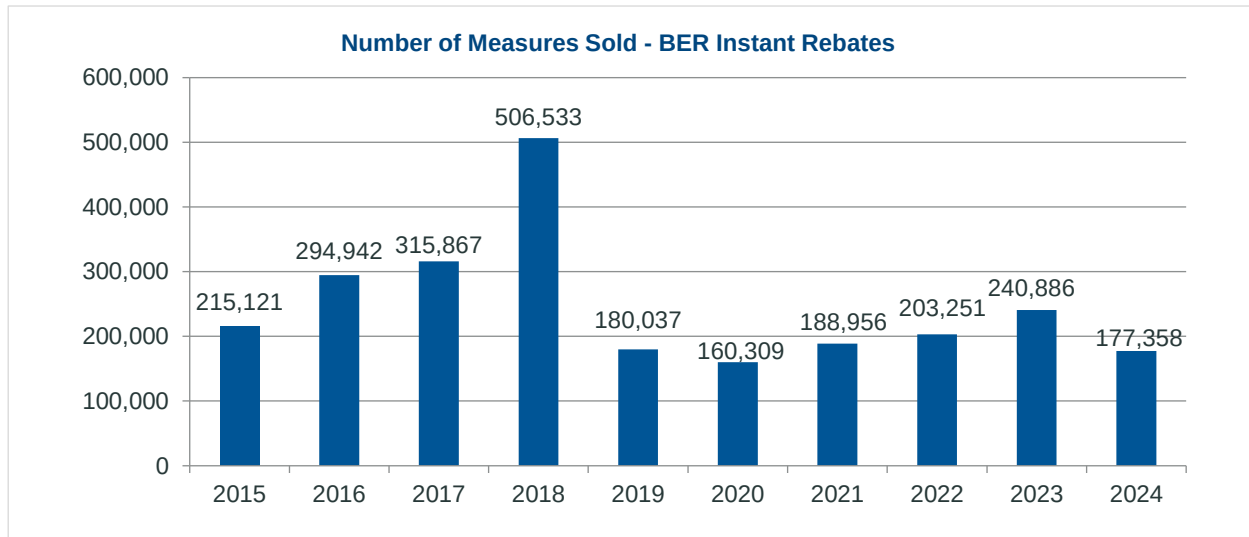
**Figure 3: Distribution of 2024 Application Rebates Gross Electrical Energy Savings by Measure Category**



## BER Instant Rebates

While participant information tracking has improved in the past few years and the tracking sheet indicates the total number of measures rebated through the service, the available data collected by distributors do not allow determining the number of unique Instant Rebates participants, leading to the participation metric being the number of measures rebated. As outline in Figure 4 below, 177,358 measures were rebated through Instant Rebates in 2024, a 26% decrease compared to 2023 levels.

**Figure 4: Instant Rebates Measures Rebated, 2015-2024**



As outlined in Figure 5 below, participation levels decreased for the three main lighting measures in 2024, with LED linear lamps having the largest decrease of 41% compared to 2023. While LED linear fixtures also decreased by 10%, levels for all other measures, i.e. occupancy/motion sensors, circulator pumps, and LED directional and architectural fixtures, each increased by slightly less than 30%.

**Figure 5: Instant Rebates Measures Rebated, 2023-2024**

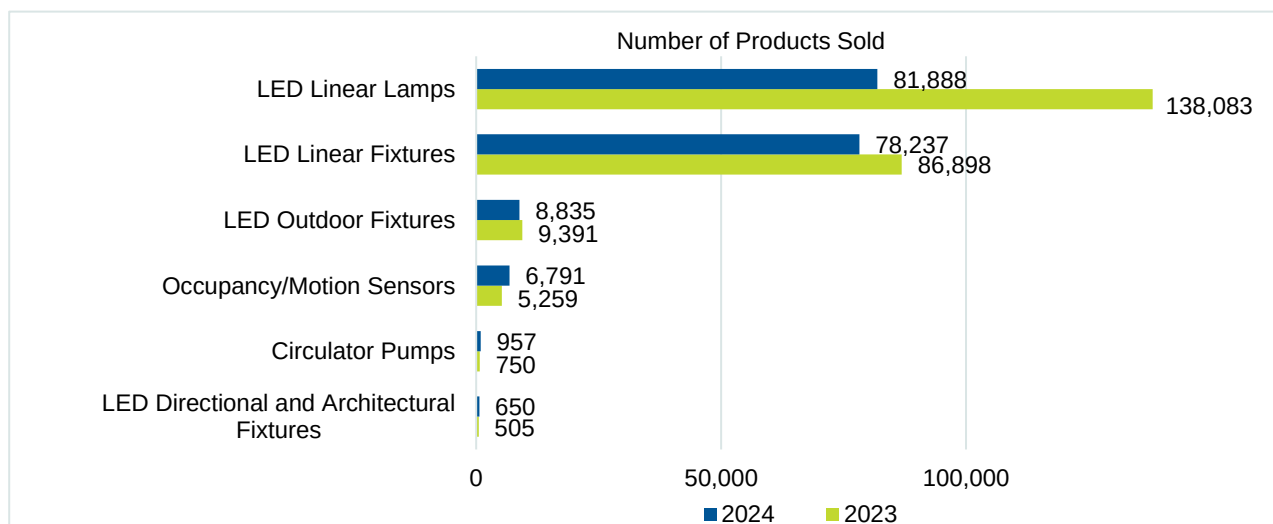
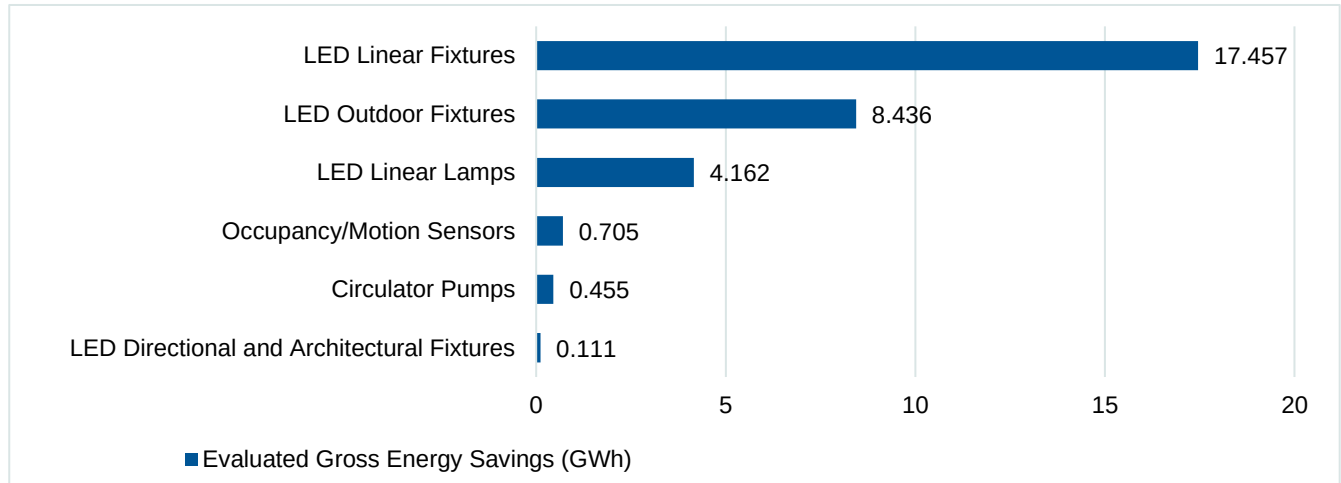


Figure 6 below provides an overview of the distribution of Instant Rebates gross electrical energy savings among pumping and lighting measures. In 2024, LED linear fixtures generated the largest share of gross savings (56%) followed by LED outdoor fixtures (27%) and LED linear lamps (13%).

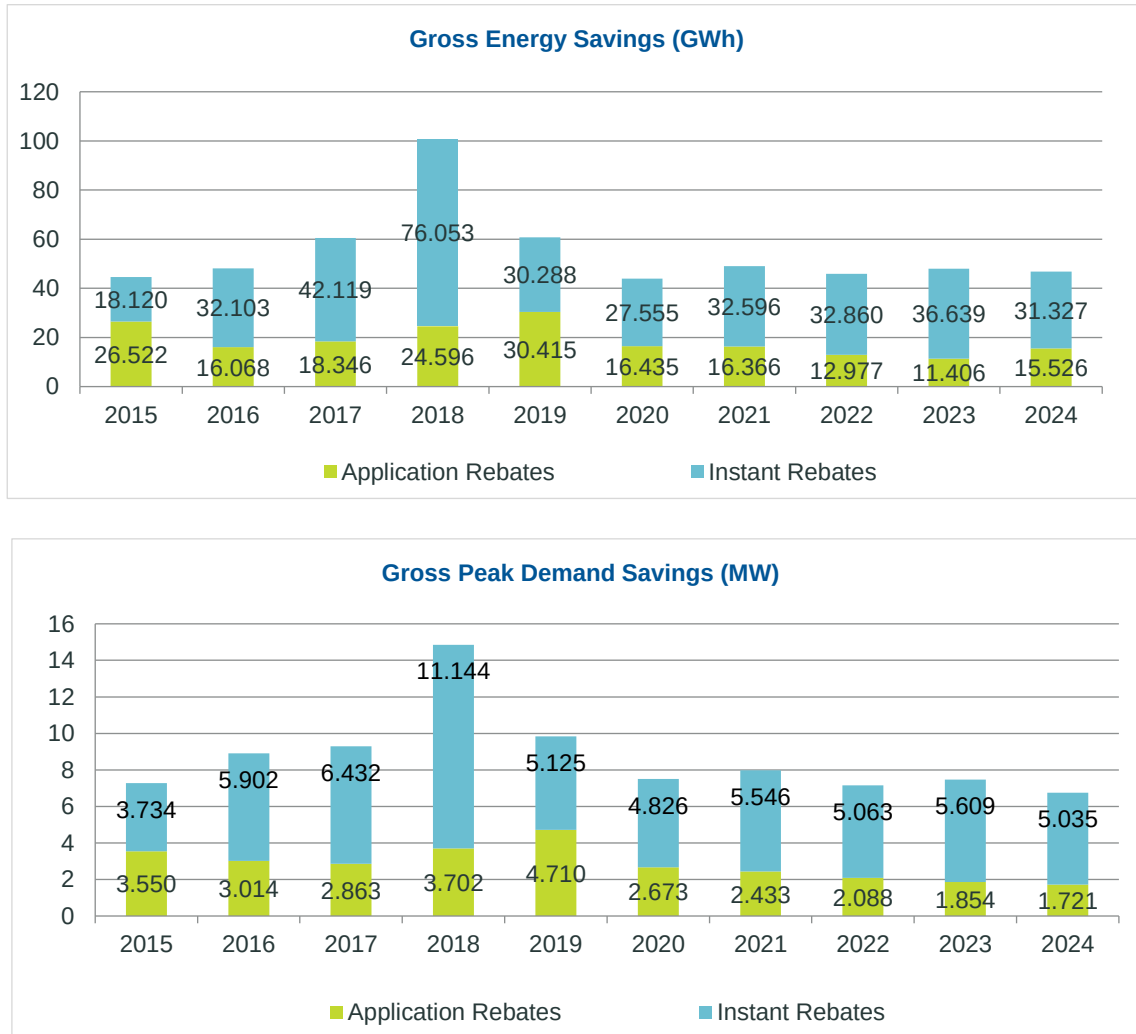
**Figure 6: Distribution of 2024 Instant Rebates Gross Savings by Measure**



## BER Overall

As presented in Figure 7 below, BER generated a total of 46.852 GWh in gross electrical energy savings at generator in 2024, which represents a 2% decrease compared to 2023 results. In 2024, gross peak demand savings totalled 6.756 MW for Application Rebates and Instant Rebates, representing a 9% decrease from 2023. This was mainly due to the decrease in Instant Rebates savings generated by LED linear lamps and LED linear fixtures.

**Figure 7: Evolution of BER Gross Savings, 2015-2024**





## 2 BER Evaluation Approach

The 2024 BER-AR evaluation included a condensed impact evaluation, while the BER-IR evaluation included a comprehensive impact evaluation as well as a process evaluation and market evaluation. The main objectives of the 2024 BER evaluation were as follows:

- › Collect information on participant and distributor perspectives
- › Calculate gross and net BER results (for both AR and IR), namely first-year and lifetime electrical energy savings, peak demand savings, as well as avoided GHG emissions
- › Analyze the evolution of the BNI lighting market

The Evaluator identified key research questions aimed at achieving these objectives. Table 5 below outlines the evaluation objectives and maps them to the Evaluator's research questions, methods, and sample sizes (n). Each method is described further below.

**Table 5: 2024 BER Evaluation Approach**

| Evaluation Objectives                                           | Research Questions                                                                                                                                                                                                                                                                                                                                                                         | Methodology                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Collect information on participant and distributor perspectives | <ul style="list-style-type: none"> <li>› How do participants become aware of BER-IR?</li> <li>› What is the level of satisfaction with BER-IR among participants and distributors?</li> <li>› What works well and what are the key challenges for BER-IR?</li> <li>› How could E1 improve BER-IR?</li> </ul>                                                                               | <ul style="list-style-type: none"> <li>› Instant Rebates participant survey</li> <li>› Distributor interviews</li> </ul>                                                                                                                                                                                                                                                           |
| Calculate gross results                                         | <ul style="list-style-type: none"> <li>› Are the data in the tracking sheet complete, accurate, and consistent?</li> <li>› What are the formulas and savings parameters for the top 10 BER-AR measures?</li> <li>› What are the unitary savings for BER-IR measures?</li> <li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li> </ul> | <ul style="list-style-type: none"> <li>› Tracking sheet audit</li> <li>› Unitary savings review</li> <li>› Use of adjustment ratio from the BER-AR 2022 evaluation, with corrections to account for modifications to the 2024-2025 Demand-side Management Measure Assessment (DSM MA)<sup>3</sup> equations and values</li> <li>› Calculations using evaluation results</li> </ul> |
| Calculate net results                                           | <ul style="list-style-type: none"> <li>› What is the free-ridership level for BER-IR for 2024?</li> <li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li> <li>› What are the net GHG emission reductions in CO<sub>2</sub> eq?</li> </ul>                                                                                               | <ul style="list-style-type: none"> <li>› Use of 2021 free-ridership and 2022 spillover for NTGR for BER-AR</li> <li>› Instant Rebates participant survey</li> <li>› Distributor interviews</li> <li>› Calculations using evaluation results</li> <li>› GHG emission reduction calculations</li> </ul>                                                                              |

<sup>3</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all necessary parameters to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the evaluations conducted during the last two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.

| Evaluation Objectives                            | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Methodology                                                                                                                                                       |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analyze the evolution of the BNI lighting market | <ul style="list-style-type: none"> <li>› How has the BNI lighting market evolved in Nova Scotia since 2021?</li> <li>› To what extent are LED products available in Nova Scotia compared to non-LED products? How has this changed since 2021?</li> <li>› Why do distributors still carry non-LED products and for which markets?</li> <li>› What is the outlook for the commercial lighting baseline?</li> <li>› What are the implications of an updated baseline for E1's BNI lighting programs given different project types (i.e. BER-IR, BER-AR, and SBES retrofit projects, BER-AR new construction projects)?</li> </ul> | <ul style="list-style-type: none"> <li>› Instant Rebates participant survey</li> <li>› Distributor interviews</li> <li>› Market characterization study</li> </ul> |

## Instant Rebates Participant Survey

In November 2024, Narrative Research conducted a telephone survey with a total of 50 Instant Rebates participants. The average length of the survey was 14 minutes. The questionnaire is presented in Appendix I, and complete survey results are outlined in Appendix II. Since it is not possible to obtain a complete list of Instant Rebates participants due to the nature of this service, the margin of error is calculated using a conservative assumption that the service population is infinite. Drawing a random sample of 50 from an infinite population yields a margin of error of 11.8% at a 90% confidence level. Although the margin of error is higher than the  $\pm 10\%$  target, the Evaluator finds it acceptable for the purpose of this evaluation.

## Instant Rebates Interviews with Distributors

In November 2024, Narrative Research conducted ten interviews with Instant Rebates participating distributors. Interviews lasted between 35 and 65 minutes, with an average length of 47 minutes. Participants were recruited from a list of distributors provided by E1 and were given an incentive of \$100 to participate. Interviews took place over the phone between October 23 and November 25, 2024. The aim of the interviews was to collect information on distributor perspectives regarding the service and market evolution. The list of distributors was provided by E1, and the Evaluator confirmed the decision-maker by verifying that the person interviewed was the most knowledgeable about stocking and supplying specific products eligible for rebates under the service. The methodology used to identify the decision-maker was consistent with previous market evaluations. The guide used for the interviews is presented in Appendix III.

## Tracking Sheet Audit

Prior to performing the savings calculation review, the Evaluator performed an audit of the final 2024 tracking sheets to ensure they were complete and the entered data were consistent. The detailed protocols used for the Application Rebates and Instant Rebates tracking sheet audits and the results obtained are presented in Appendix IV and Appendix V respectively.

## Unitary Savings Review

As part of the 2024-2025 DSM MA activities and based on the results of both a literature review and a tracking sheet data review, the Evaluator reviewed the equations, parameters, and assumptions used to establish savings values for ten BER measures and established unitary savings values for the new variable frequency drive (VFD) for non-HVAC (Heating, Ventilation, and Air Conditioning) applications measures offered under Application Rebates. The 2024-2025 DSM MA was then updated accordingly.



## Effective Useful Life Update

As part of the 2024-2025 DSM MA update activities, the Evaluator also reviewed the effective useful life (EUL) values for all measure categories and recalculated the EUL values of lighting measures for which baseline changes are anticipated during the measure lifetimes.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated first-year and lifetime energy savings as well as peak demand savings as per the calculation methodologies presented in Section 4 and Section 5 below.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for BER, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using NS Power data.

### Note on Margin of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>4</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>5</sup>

As part of the condensed BER-AR evaluation, no data-collection activities warranted the calculation of margins of error.

For BER-IR, the Evaluator calculated the margins of error for free-ridership levels. The margins of error are listed alongside results in the applicable sections below. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary.

## Market Characterization Study

The Evaluator completed a market evaluation in 2024 to assess the state of the lighting market and review whether any baselines for BNI lighting products should be recommended for update. The analysis and recommendations from the market evaluation account for the different approaches in the programs targeting BNI lighting. BER-IR uses a standard practice baseline given the rebate is provided at the time of sale. Therefore, the stocking practices of distributors and availability of LED versus non-LED technologies have a direct link to the BER-IR baseline. By contrast, for BER-AR and SBES, which are primarily retrofit programs, the baseline is calculated as the difference between the existing technology performance and the performance of the measure and assumes early replacement. For BER-AR and SBES retrofit projects, the stocking practices of distributors also have an impact on measure lifetimes.

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<sup>4</sup> Precision refers to how reproducible a set of measurements is. However, it does not consider how close the measured values are to the true values; this would refer to accuracy.

<sup>5</sup> As part of this evaluation, the confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.



## 3 Process Evaluation for Instant Rebates

This section summarizes the findings obtained during the Instant Rebates participant survey and interviews conducted with Instant Rebates distributors.

### 3.1 Participant Awareness and Decision to Purchase

#### Instant Rebates Participants

Of all IR survey participants (n=50), six in 10 said they purchased energy efficient products (that were available for IR) for their own organization (60%), while nearly four in 10 (38%) either said they purchased the products for a customer/project outside of their organization or that they are contractors.

Most contractors (89%) said that they or someone else in their organization usually makes the decision to buy efficient products rather than standard products. One in 20 (5%) indicated that both they and the customer make the decision together, and the same proportion (5%) said it is someone else who makes the decision.

Among participants who purchased efficient products for their organization and those who said it is either they or someone else in their organization who makes the decision to purchase efficient products (n=47), one-third (32%) said the main activity of their organization is electrical contracting/installation. This was followed by one in eight saying the main activity of their organization is residential (13%), and one in ten (11%) identifying the main activity as manufacturing/industrial. Among these same participants, 81% stated that they had not considered any other alternative LED lighting products to the efficient products they purchased. Among those who did consider alternative products (n=7), two participants said they considered standard LED lighting, and one participant said they considered fluorescent lighting. Those who considered alternatives to linear or outdoor fixtures (n=6) cited standard/incandescent halogen bulbs, LED tubes, and low-pressure sodium lamps as options.

About four in ten participants (43%) said energy efficiency was the single most important reason they purchased efficient products over standard products. This was followed by one in eight (13%) doing so for cost savings. One in 10 cited either the availability of other alternatives (11%), ENS program incentives (9%) or the lifespan of efficient products (9%). When asked for the second most important reason, one in four (26%) cited energy efficiency, one in five (19%) said cost savings, and one in eight said either better lighting (13%) or the lifespan of efficient products (13%). One in 10 (9%) said updating their equipment was the second most important reason, with a few citing a range of other factors.

Half (52%) of surveyed participants said their distributor recommended the efficient product to them, while four in 10 (40%) said their distributor did not.

For 74% of surveyed participants, distributors are the primary source of awareness about rebates available from BER. Online sources were second (9%), while word of mouth, past experience with another ENS program, and contractors were each mentioned by 4% of participants.

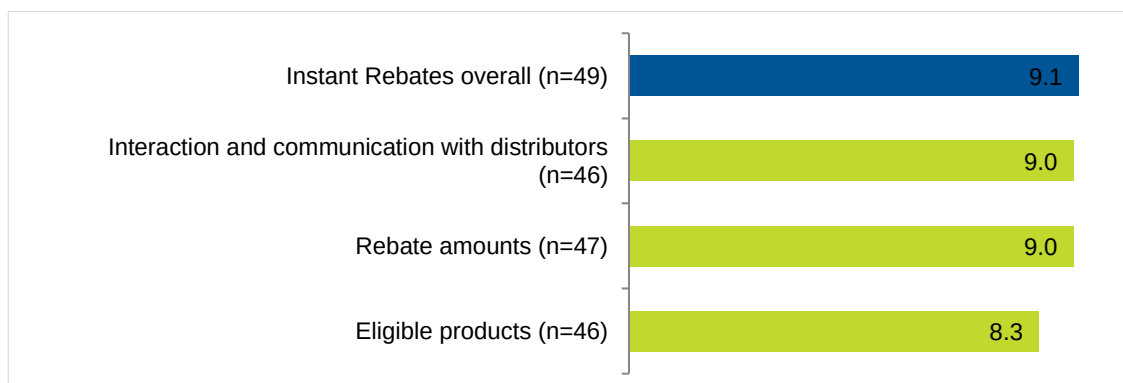
## 3.2 Participant Satisfaction

### Instant Rebates Participants

Participants were asked about their level of satisfaction with different service elements on a ten-point scale where 1 means “Not at all satisfied” and a 10 means “Completely satisfied”. Overall, Instant Rebates received an average satisfaction score of **9.1**, which indicates that the vast majority of participants (94%) are highly satisfied with the service. Considering the interaction and communication they had with distributors, eight in 10 participants (82%) said they were highly satisfied (scores from 8 to 10), while fewer than one in 10 (8%) said they were moderately satisfied (scores from 5 to 7) and only one in 50 (2%) said they were unsatisfied (scores from 1 to 4). Similarly, eight in 10 participants (82%) said they were highly satisfied with rebate amounts, one in 10 (12%) was moderately satisfied, and none (0%) was unsatisfied. The satisfaction score for Instant Rebates eligible products, although the lowest among the service elements, remains relatively strong with 68% of participants saying they were highly satisfied, 20% saying they were moderately satisfied, and just 4% saying they were dissatisfied.

Among those who were unsatisfied with the interaction and communication they had with distributors (n=5), two attributed their score to a lack of communication with and availability of distributors, and one cited slow communication and having distributors that were less knowledgeable about Instant Rebates. Among the few (n=6) only moderately satisfied with the rebate amounts, most (five) said the rebates were too low or they expected higher rebate amounts. One cited the absence of rebates on some products as a reason for their dissatisfaction.

**Figure 8: 2024 Participant Satisfaction with Instant Rebates (10-point Scale)**



Note: Mean score of ratings on a scale of 1 to 10, where 1 means “Not at all satisfied” and 10 means “Completely satisfied”. Excludes “Don’t know” responses.

The majority of participants (66%) had no suggestions for improving Instant Rebates. However, suggestions included increasing rebates (10%), more instant rebates (preferred over mail-in, 8%), simplifying the paperwork (8%), making more measures eligible for rebate (6%), and/or better marketing/awareness (6%).

### 3.3 Distributor Satisfaction with Instant Rebates

Distributors (n=10) were asked to express their level of satisfaction with various aspects of Instant Rebates using a 10-point scale where 1 means “Not at all satisfied” and 10 means “Very satisfied”.

Satisfaction with the service overall is high, with an average score of 8.3 out of 10. Seven distributors rated their satisfaction between 8 and 10, while all three others provided a score ranging from 5 to 7. For the three distributors with lower satisfaction, their dissatisfaction with Instant Rebates primarily stems from questioning the benefits of the service given the maturity of LED lighting technology and the reduced availability of non-LED as alternative products (see Section 7 below).

Satisfaction with the service support and communications provided by E1 is very high with an average score of 9.3 out of 10. All distributors provided a satisfaction rating between 8 and 10.

In general, distributors were also pleased with rebate processing, tracking, and reporting, with an average satisfaction score of 8.4 out of 10. Seven distributors rated a high score of 9 or 10, while the others provided scores of 4, 6, and 7. Dissatisfaction stems from the time-intensive administration requirements, including having to manually review sale entries for accuracy. Table 6 presents the average satisfaction ratings provided by distributors for each assessed aspect.

**Table 6: 2024 Distributor Satisfaction with Instant Rebates (10-point Scale)**

|                                                   | Distributors |             |
|---------------------------------------------------|--------------|-------------|
|                                                   | Mean*        | Sample Size |
| Overall Service                                   | 8.3          | 10          |
| Service Support and Communications provided by E1 | 9.3          | 10          |
| Rebate Processing, Tracking, and Reporting        | 8.4          | 10          |

\* Scale: 1 = Not at all satisfied; 10 = Very satisfied

### 3.4 Service Influence on Distributors

Similar to 2022, distributors of LED linear fixtures, LED linear lamps, and LED outdoor fixtures were questioned about the different strategies employed to sell each of these product categories in 2024. The promotion of Instant Rebates was a key sales tactic across lighting categories. In addition, a good number of distributors actively encouraged customers to purchase LED products and promoted those products in their marketing. These strategies were far more common for LED fixtures than for LED lamps. Many also reduced the price of qualifying LED products either through a discount or bundled pricing. While distributors increased their stock and assortment of LED fixtures in 2024 to support sales, this was not a strategy used for LED linear lamps. Finally, four distributors conducted training workshops on LED outdoor fixtures for their contractor customers.

It should be noted that distributor’s sales strategies were implemented in the context of very limited non-LED alternatives and therefore caution should be used in interpreting results (for further details see Section 7). When asked about whether they actively encouraged or promoted customers to purchase LED fixtures instead of less efficient products, several distributors noted unaided that while they promote LED products, they don’t stock non-LED alternatives “...we have promoted the products but not over less efficient technologies...”.

The main reported strategies are highlighted in Table 7.

**Table 7: 2024 Distributor Sales Strategies Used for Qualifying LED Products**

| Distributor Sales Strategies                                                                                              | Number of Distributors Using the Strategy (n=10) |                  |                      |
|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------|----------------------|
|                                                                                                                           | LED Linear Fixtures                              | LED Linear Lamps | LED Outdoor Fixtures |
| Promote the E1 rebate in any way                                                                                          | 10                                               | 8                | 10                   |
| Encourage customers to purchase LED products instead of less efficient products/upsell customers to purchase LED products | 10                                               | 6                | 9                    |
| Promote LED products over less efficient products in your marketing/<br>promote LED products in your marketing            | 7                                                | 6                | 9                    |
| Reduce the price of qualifying LED products                                                                               | 7                                                | 5                | 6                    |
| Increase the stock or assortment of LED products                                                                          | N/A                                              | 1                | 8                    |
| Increase the variety of LED products                                                                                      | 6                                                | N/A              | N/A                  |
| Increase the stock of LED products                                                                                        | 7                                                | N/A              | N/A                  |
| Conduct training workshops on LED products for contractor customers                                                       | N/A                                              | 0                | 4                    |

Other sales strategies used in 2024 for LED linear fixtures included bundled pricing by manufacturers, purchase raffles, increased sales outreach to customers, sales bonuses or raffles for staff, and store displays. Specific strategies used to sell LED outdoor fixtures included store displays, bundled discounts, and in-store raffles for customers. Distributors did not invest additional efforts on selling LED linear lamps in 2024 due to increased customer interest in fixtures over lamps. Only one distributor mentioned having had a store display to increase their sales of LED linear lamps. Of note, one distributor mentioned looking at incorporating lighting recommendations when conducting energy audits for their customers to increase their sales of LED lighting products.

Distributors' desire for increased sales and profits had the greatest influence on their sales strategy choices for qualifying LED products, closely followed by product quality or value. The incentives offered by E1 were also an important influence in each lighting category, although it was the most important for LED Outdoor Fixtures, where more distributors rated this factor as "Very influential". The distributors' policies and desire to support sustainability closely follows. The influence of ENS's educational, promotional, and marketing efforts and support was minimal in determining how to increase the sales of qualifying LED lighting products in 2024. A summary of ratings is provided in Table 8.

**Table 8: 2024 Influences on Distributors' Sales Strategies**

|                                                                                      | Very/Somewhat Influential (n=10) |                  |                      |
|--------------------------------------------------------------------------------------|----------------------------------|------------------|----------------------|
|                                                                                      | LED Linear Fixtures              | LED Linear Lamps | LED Outdoor Fixtures |
| Your company's interest in increasing your sales and profits                         | 10                               | 10               | 9                    |
| Quality or value of LED products                                                     | 10                               | 7                | 10                   |
| Incentives offered by E1                                                             | 8                                | 8                | 9                    |
| Your company's policies and desire to support sustainability                         | 8                                | 7                | 9                    |
| Educational, promotional and marketing efforts and support provided or driven by ENS | 4                                | 2                | 4                    |





A small majority of distributors reported that they would have used the same sales approach for LED fixtures in the absence of the program. Conversely, a similar majority reported that for linear lamps their sales strategy would have likely differed in the absence of the program.

### 3.5 Distributor Successes and Challenges with Instant Rebates

While distributors were not asked specifically about strengths and successes associated with Instant Rebates, two distributors mentioned that they appreciate program staff attention, responsiveness to feedback, engagement with distributors, and communications, and they would like to see this continued.

Four distributors experienced challenges related to Instant Rebates in 2024, although there were no consistencies in the types of issues reported. Challenges with the service (each mentioned by one distributor) included the administrative burden and additional staffing costs associated with the tracking and reporting functions, a difficult onboarding process with unclear instructions and limited assistance from E1 in guiding new service delivery partners, losing sales to retailers participating in Instant Savings, and disqualifying customers who run their small business out of their homes from participating in Instant Rebates.

Very few suggestions were provided for service improvement. Three distributors questioned the service's relevance given the widespread adoption of many LED products. As such, they would like to see Instant Rebates explore new ways to incentivize energy efficiency, including offering rebates on electric vehicle (EV) chargers and smart lighting technologies (e.g. dimmers). Other recommendations on Instant Rebates included increasing social media advertising as well as moving to a mail-in rebate offering to reduce the administrative burden on distributors and gain greater control over who receives the rebates (i.e. ensuring end users benefit from the rebate rather than contractors).

#### 2024 BER Participant and Distributor Perspective Highlights

- › The majority of Instant Rebate survey participants purchased energy efficient products for their own organization, while fewer purchased the products for a customer/project outside of their organization or are contractors.
- › The primary factors influencing Instant Rebate participants to purchase energy efficient products were to improve energy efficiency and help with cost savings.
- › Participant satisfaction with the Instant Rebate service is very high, with an overall satisfaction rating of 9.1.
- › Participant satisfaction with the interaction and communication with distributors as well as the rebate amounts is also very high (both receiving average ratings of 9.0).
- › Increasing rebates, improving the number of instant rebates (instead of switching to a mail-in offering), and simplifying the paperwork are the most cited participant suggestions to improve the Instant Rebate service.
- › Distributors deployed several sales strategies to promote LED products and were influenced by Instant Rebates in their decision to do so. The two most used strategies were promoting the E1 rebate and encouraging customers to purchase LED products instead of less efficient products.
- › Distributors reported high levels of satisfaction with Instant Rebates overall, the support and communications provided by E1, and rebate processing, tracking, and reporting, with average ratings of 8.3, 9.3, and 8.4 respectively on a 10-point scale. The main points of dissatisfaction for a few of the distributors were the burden and costs of administering the service and the perception that incentivizing certain LED lighting products no longer contributes to product adoption.
- › Distributor suggestions to improve Instant Rebates included expanding eligibility to other energy saving technologies (e.g. EV chargers, dimmers), increasing social media advertising, and switching to a mail-in rebate offering.





## 4 Impact Evaluation for Application Rebates

The objectives of the 2024 Application Rebates impact evaluation were to determine gross and net electrical energy and peak demand savings.

### 4.1 Tracking Sheet Audit

To ensure service results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The results obtained from the tracking sheet audit are presented in Appendix IV. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 4.2 Gross Savings

Gross savings refer to changes in energy consumption resulting from actions taken by participants regardless of their reasons for participating.<sup>6</sup> For each Application Rebates project, E1 tracks annual gross savings using the equations defined in the most up-to-date BER CIRx Screening Tool (version 1.6), an E1 tool presenting the savings calculation methodologies, assumptions, and equipment parameters specific to each project.

#### 4.2.1 Adjustment Ratios

The Evaluator applied adjustment ratios to the tracked gross savings to determine evaluated gross savings. These ratios were established using 2022 project review results, with the exception of the lighting measure category for which the ratio was not updated in 2022; instead, values established in the 2021 evaluation were applied. All those ratios are documented in the 2024-2025 DSM MA.

As part of the 2023 Custom Retrofit evaluation, the Evaluator developed adjustment ratios to be applied to solar PV projects. These adjustment ratios are based on observed discrepancies between modelled savings and measured savings and are meant to be applied to modelled electrical energy savings estimates as part of the initial energy savings calculations separate from the standard adjustment ratios based on project review findings. For projects modelled in RETScreen Expert, the adjustment ratio is 0.942. For projects modelled in PVWatts, the adjustment ratio is 1.101. These solar PV adjustment ratios were not applied by E1 in 2024. Moving forward, E1 is encouraged to apply these adjustment ratios to solar PV projects to more accurately represent savings.

#### 4.2.2 Interactive Effects

Interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling; these are considered in the gross savings standard equation presented in the BER CIRx Screening Tool. For BER, interactive effects only apply to indoor lighting projects. The interactive effects factors for the commercial sector are based on the same interactive effects as in previous years, as detailed in the 2024-2025 DSM MA. Based on site visit observations during a previous evaluation, the Evaluator ensured that E1 used the correct interactive effects factors for visited projects. When applicable, the Evaluator adjusted the interactive effects factor based on the BER CIRx Screening Tool value that most accurately corresponded to site observations. Lighting interactive effects adjustments are included in the adjustment ratio applied in the 2024 evaluation and are presented in Subsection 4.2.1 above.

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<sup>6</sup> Definition adapted from National Renewable Energy Laboratory, The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices, September 2014, p. 3.

### 4.2.3 Effective Useful Life

As part of the 2024-2025 DSM MA activities, the Evaluator reviewed the EUL values used in the calculations of electrical energy savings that are expected to persist over time. In 2024, for LED linear fixtures, LED linear lamps, LED outdoor fixtures, and LED directional and architectural fixtures, EUL values were slightly adjusted as a result of hours of use (HOU) value updates. For all other Application Rebates measures, the EUL values established in the 2021 evaluation remained valid for the 2024 evaluation.

The tracked and evaluated EUL values are presented in Table 9.

**Table 9: Updated BER AR EUL Values**

| Measure                                                              | Tracked EUL | Evaluated EUL |
|----------------------------------------------------------------------|-------------|---------------|
| <b>LED Linear Fixtures</b>                                           |             |               |
| 1 x 4 Luminaires                                                     | 11.6        | 11.9          |
| 2 x 2 Luminaires and Retrofit Kits                                   | 11.6        | 11.9          |
| 2 x 4 Luminaires and Retrofit Kits                                   | 11.6        | 11.9          |
| Linear Ambient and Low-bay Luminaires                                | 11.6        | 11.9          |
| High-bay Luminaires                                                  | 23.3        | 23.8          |
| Troffers                                                             | 20.9        | 21.4          |
| <b>LED Linear Lamps</b>                                              |             |               |
| 2-foot Replacement Lamps                                             | 11.6        | 11.9          |
| 3-foot Replacement Lamps                                             | 11.6        | 11.9          |
| 4-foot Replacement Lamps                                             | 11.6        | 11.9          |
| 8-foot Replacement Lamps                                             | 11.6        | 11.9          |
| U-bend Lamps                                                         | 11.6        | 11.9          |
| <b>LED Outdoor Fixtures</b>                                          |             |               |
| Outdoor Full-cut-off Wall-mounted Area Luminaires                    | 17.1        | 17.4          |
| Flood and Spot Luminaires                                            | 17.1        | 17.4          |
| Fuel Pump Canopy Luminaires                                          | 11.4        | 11.6          |
| LED Replacements for High-intensity Discharge Lamps                  | 11.4        | 11.6          |
| Non-cut-off and Semi-cut-off Wall-mounted Area Luminaires            | 22.8        | 23.2          |
| Pole/Arm-mounted Area Luminaires                                     | 13.7        | 13.9          |
| Pole/Arm-mounted Decorative Luminaires                               | 22.8        | 23.2          |
| Parking Garage Luminaires                                            | 22.8        | 23.2          |
| Case Lighting for Sign Retrofit Applications                         | 11.6        | 11.9          |
| <b>LED Directional and Architectural Fixtures</b>                    |             |               |
| Track or Mono-point Directional Luminaires, LED Wall Wash Luminaires | 11.6        | 11.9          |
| <b>Other LED Lighting</b>                                            |             |               |
| Refrigerated Case Luminaires                                         | 16.3        | 16.6          |
| <b>HVAC</b>                                                          |             |               |
| Air-source Heat Pumps Greater Than or Equal to 65,000 Btu/hr         | 15          | 20            |
| <b>Solar PV</b>                                                      |             |               |
| Solar Photovoltaic Panels                                            | 22.4        | 30            |

The evaluated equivalent EUL values are applied to each measure gross and net first-year electrical energy savings to obtain gross and net lifetime electrical energy savings. As a result, the weighted average EUL value for gross and net savings is equal to 18.9 years (see Subsections 4.2.4 and 4.3.4 below).

## 4.2.4 Evaluated Gross Savings

The savings achieved for each Application Rebates measure category are presented in Table 10 below. Both energy and peak demand savings were revised by applying the adjustment ratios discussed in Subsection 4.2.1 above.

The savings at the generator were calculated using a line loss factor that accounts for electricity losses occurring between the generator and the meter. This value is a weighted average of the line loss factors provided by NS Power for each rate code and the corresponding energy savings listed in the final 2024 tracking sheet.<sup>7</sup> The line loss factors correspond to the values submitted to the NSUARB as part of the 2014 Cost of Service Study Progress Update.<sup>8</sup>

**Table 10: Evaluated 2024 Application Rebates Gross Energy and Peak Demand Savings**

| Measure Category                                         | Agriculture   | Commercial Kitchen | HVAC          | Lighting      | Motors        | Pumping       |
|----------------------------------------------------------|---------------|--------------------|---------------|---------------|---------------|---------------|
| <b>Energy Savings</b>                                    |               |                    |               |               |               |               |
| Tracked Gross Energy Savings                             | 0.082         | 0.017              | 1.814         | 8.011         | 3.904         | 0.008         |
| Adjustment Ratio on Energy Savings                       | 1.002         | 1.000              | 1.002         | 0.993         | 1.000         | 1.000         |
| Gross Energy Savings – at the Meter (GWh)                | 0.082         | 0.017              | 1.818         | 7.955         | 3.904         | 0.008         |
| <b>Line Loss Factor</b>                                  | <b>1.0840</b> | <b>1.0712</b>      | <b>1.0755</b> | <b>1.0690</b> | <b>1.0823</b> | <b>1.0901</b> |
| Gross Energy Savings – at the Generator (GWh)            | 0.089         | 0.019              | 1.955         | 8.504         | 4.225         | 0.009         |
| <b>Effective Useful Life (years)</b>                     | <b>15.0</b>   | <b>12.0</b>        | <b>17.6</b>   | <b>20.3</b>   | <b>15.0</b>   | <b>15.0</b>   |
| Gross Lifetime Energy Savings – at the Generator (GWh)   | 1.328         | 0.222              | 34.448        | 172.547       | 63.374        | 0.129         |
| <b>Peak Demand Savings</b>                               |               |                    |               |               |               |               |
| Tracked Gross Peak Demand Savings – at the Meter (MW)    | 0.021         | 0.003              | 0.401         | 1.058         | 0.265         | 0.001         |
| Overall Adjustment Ratio on Peak Demand Savings          | 1.039         | 1.000              | 1.000         | 0.841         | 1.000         | 1.000         |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>     | <b>0.021</b>  | <b>0.003</b>       | <b>0.401</b>  | <b>0.890</b>  | <b>0.265</b>  | <b>0.001</b>  |
| Line Loss Factor                                         | 1.1044        | 1.0824             | 1.1088        | 1.0795        | 1.0885        | 1.1003        |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b> | <b>0.024</b>  | <b>0.003</b>       | <b>0.444</b>  | <b>0.960</b>  | <b>0.289</b>  | <b>0.001</b>  |

<sup>7</sup> For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed.

<sup>8</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

## Evaluated 2024 Application Rebates Gross Energy and Peak Demand Savings (Continued)

| Measure Category                                              | Refrigeration | Solar PV      | Total for All Categories |
|---------------------------------------------------------------|---------------|---------------|--------------------------|
| <b>Energy Savings</b>                                         |               |               |                          |
| Tracked Energy Savings (GWh)                                  | 0.010         | 0.663         | 14.509                   |
| Adjustment Ratio                                              | 1.000         | 1.000         | 0.996                    |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>0.010</b>  | <b>0.663</b>  | <b>14.456</b>            |
| Line Loss Factor                                              | 1.0583        | 1.0798        | 1.0740                   |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>0.010</b>  | <b>0.716</b>  | <b>15.526</b>            |
| Effective Useful Life (years)                                 | 15.0          | 30.0          | 18.9                     |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.155</b>  | <b>21.481</b> | <b>293.685</b>           |
| <b>Peak Demand Savings</b>                                    |               |               |                          |
| Tracked Demand Savings (MW)                                   | 0.001         | -             | 1.748                    |
| <b>Adjustment Ratio</b>                                       | <b>1.000</b>  | <b>N/A</b>    | <b>0.904</b>             |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.001</b>  | <b>-</b>      | <b>1.581</b>             |
| Line Loss Factor                                              | 1.0595        | N/A           | 1.0888                   |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.001</b>  | <b>-</b>      | <b>1.721</b>             |

No differences were identified between tracked and evaluated gross savings.

As presented in Table 11 below, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>9</sup> for GHG emissions generated by electricity production to Application Rebates gross savings.

**Table 11: Evaluated 2024 Application Rebates Gross GHG Emission Reductions**

|                                                                                             | Total         |
|---------------------------------------------------------------------------------------------|---------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>15.526</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2         |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>7,331</b>  |

## 4.3 Net Savings

The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to a service, by estimating the NTGR. More precisely, the NTGR is established by considering the effects that positively or negatively affect energy savings, namely free-ridership and spillover.

<sup>9</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024), and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

### 4.3.1 Free-ridership

In the case of Application Rebates, free-ridership occurs when participants would have still implemented energy efficiency measures in the absence of the service. The free-ridership level was assessed during the 2021 evaluation using a self-report approach that involved asking participants a set of questions during a telephone survey. Since no data collection aimed at updating the free-ridership level was conducted in 2024, the Evaluator used the 2021 free-ridership level.

Table 12 outlines the free-ridership level used for the 2024 Application Rebates evaluation.

**Table 12: 2024 Application Rebates Free-ridership**

| Measure Category | Average Free-ridership Level | Margin of Error |
|------------------|------------------------------|-----------------|
| All              | 26%                          | 6.6%            |

### 4.3.2 Spillover

For Application Rebates, spillover occurs when participants implement eligible energy efficiency measures due to influence from previously participating in the service without having received any kind of additional support.

The last data collection for Application Rebates spillover was conducted in the 2021 evaluation, and found that the spillover level was zero, hence a spillover level of 0% was used for the 2024 evaluation.

### 4.3.3 Net-to-gross Ratio Calculation

The NTGR is calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Spillover})$$

Using the free-ridership and spillover levels established for Application Rebates, the Evaluator calculated the NTGR value as presented in Table 13.

**Table 13: 2024 Application Rebates NTGR**

| Measure Category | Free-ridership | Spillover | NTGR |
|------------------|----------------|-----------|------|
| All              | 26%            | 0%        | 0.74 |

### 4.3.4 Evaluated Net Savings

Net savings are defined as the changes in energy use attributable specifically to Application Rebates. Net savings were estimated by applying the above NTGR to the evaluated gross savings as illustrated in the following equation.

$$\text{Net Savings} = \text{Evaluated Gross Savings} \times NTGR$$

Detailed results are presented in Table 14 below. The net energy savings resulted in 5,425 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions.

**Table 14: Evaluated 2024 Application Rebates Net Energy and Peak Demand Savings**

| Measure Category                                            | Agriculture  | Commercial Kitchen | HVAC          | Lighting       | Motors        | Pumping      |
|-------------------------------------------------------------|--------------|--------------------|---------------|----------------|---------------|--------------|
| <b>Energy Savings</b>                                       |              |                    |               |                |               |              |
| Gross Energy Savings – at the Meter (GWh)                   | 0.082        | 0.017              | 1.818         | 7.955          | 3.904         | 0.008        |
| NTGR                                                        | 0.74         | 0.74               | 0.74          | 0.74           | 0.74          | 0.74         |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>0.060</b> | <b>0.013</b>       | <b>1.345</b>  | <b>5.887</b>   | <b>2.889</b>  | <b>0.006</b> |
| Line Loss Factor                                            | 1.0840       | 1.0712             | 1.0755        | 1.0690         | 1.0823        | 1.0901       |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>0.066</b> | <b>0.014</b>       | <b>1.447</b>  | <b>6.293</b>   | <b>3.126</b>  | <b>0.006</b> |
| Effective Useful Life (years)                               | 15.0         | 12.0               | 17.6          | 20.3           | 15.0          | 15.0         |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.983</b> | <b>0.164</b>       | <b>25.492</b> | <b>127.685</b> | <b>46.896</b> | <b>0.096</b> |
| <b>Peak Demand Savings</b>                                  |              |                    |               |                |               |              |
| Gross Peak Demand Savings – at the Meter (MW)               | 0.021        | 0.003              | 0.401         | 0.890          | 0.265         | 0.001        |
| NTGR                                                        | 0.74         | 0.74               | 0.74          | 0.74           | 0.74          | 0.74         |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>0.016</b> | <b>0.002</b>       | <b>0.296</b>  | <b>0.658</b>   | <b>0.196</b>  | <b>0.000</b> |
| Line Loss Factor                                            | 1.1044       | 1.0824             | 1.1088        | 1.0795         | 1.0885        | 1.1003       |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>0.017</b> | <b>0.002</b>       | <b>0.329</b>  | <b>0.711</b>   | <b>0.214</b>  | <b>0.000</b> |

## Evaluated 2024 Application Rebates Net Energy and Peak Demand Savings (Continued)

| Measure Category                                            | Refrigeration | Solar PV      | Grand Total    |
|-------------------------------------------------------------|---------------|---------------|----------------|
| <b>Energy Savings</b>                                       |               |               |                |
| Gross Energy Savings – at the Meter (GWh)                   | 0.010         | 0.663         | 14.456         |
| NTGR                                                        | 0.74          | 0.74          | 0.74           |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>0.007</b>  | <b>0.491</b>  | <b>10.698</b>  |
| Line Loss Factor                                            | 1.0583        | 1.0798        | 1.0740         |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>0.008</b>  | <b>0.530</b>  | <b>11.489</b>  |
| Effective Useful Life (years)                               | 15.0          | 30.0          | 18.9           |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>0.115</b>  | <b>15.896</b> | <b>217.327</b> |
| <b>Peak Demand Savings</b>                                  |               |               |                |
| Gross Peak Demand Savings – at the Meter (MW)               | 0.001         | -             | 1.581          |
| NTGR                                                        | 0.74          | N/A           | 0.74           |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>0.000</b>  | <b>-</b>      | <b>1.170</b>   |
| Line Loss Factor                                            | 1.0595        | N/A           | 1.0888         |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>0.000</b>  | <b>-</b>      | <b>1.274</b>   |

No differences were identified between tracked and evaluated net savings.

## 4.4 Realization Rate

Table 15 below compares the electrical energy and peak demand savings established through the 2024 Application Rebates evaluation to those outlined in the 2024 tracking sheet. It also includes the realization rates, representing the ratio of evaluated net savings to tracked net savings, for both electrical energy savings and peak demand savings. Realization rates were 100% for both electrical energy and demand savings.

**Table 15: Comparison of 2024 Application Rebates Tracked and Evaluated Savings at the Generator**

|                                                                                                                                   | Gross Savings |      | NTGR | Net Savings |      | Realization Rate |
|-----------------------------------------------------------------------------------------------------------------------------------|---------------|------|------|-------------|------|------------------|
|                                                                                                                                   | Value         | Unit |      | Value       | Unit |                  |
| Energy Savings                                                                                                                    |               |      |      |             |      |                  |
| Tracked Savings by E1                                                                                                             | 15.526        | GWh  | 0.74 | 11.489      | GWh  | 100%             |
| Evaluation Results                                                                                                                | 15.526        | GWh  | 0.74 | 11.489      | GWh  |                  |
| Peak Demand Savings                                                                                                               |               |      |      |             |      |                  |
| Tracked Savings by E1                                                                                                             | 1.721         | MW   | 0.74 | 1.274       | MW   | 100%             |
| Evaluation Results                                                                                                                | 1.721         | MW   | 0.74 | 1.274       | MW   |                  |
| The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for Application Rebates. |               |      |      |             |      |                  |



## 5 Impact Evaluation for Instant Rebates

The objectives of the 2024 Instant Rebates impact evaluation were to determine gross and net electrical energy and peak demand savings.

### 5.1 Tracking Sheet Audit

To ensure program service results were reliably compiled, the Evaluator first performed a tracking sheet audit to verify the completeness and consistency of the data submitted by E1. The results obtained from the tracking sheet audit are presented in Appendix V. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 5.2 Gross Savings

For Instant Rebates, gross savings refer to changes in energy consumption resulting from actions taken by participants regardless of their reasons for participating.<sup>10</sup> Since the identification of eligible measures for participants is performed at the point of sale (as opposed to on site), information on participants as well as individual project operating conditions and old equipment parameters are not fully detailed in the tracking sheet. Hence, E1 estimates savings based on a set of assumptions specific to each measure type. Energy and peak demand savings are calculated for each data entry; the equations used for lighting measures include baseline wattages, the actual wattages of efficient measures, ballast factors where applicable, interactive effects factors, peak coincidence factors (PCFs), and in-service rates (ISRs), while unitary savings values are used for occupancy and motion sensors as well as circulator pump measures.

The equations, their parameters, as well as the EUL values used in the 2024 evaluation were reviewed as part of the 2024-2025 DSM MA update.

Detailed descriptions of the savings calculations are presented in the 2024-2025 DSM Measure Assessment.

#### 5.2.1 In-service Rates

Research indicates that a percentage of measures purchased through rebate programs might be stored by customers for later use. As part of the 2024-2025 DSM Measure Assessment activities, the Evaluator maintained the ISR of 85% for LED linear lamps and the ISR of 100% for fixtures, occupancy and motion sensors, as well as circulator pumps, which were established in the 2016 evaluation based on a literature review.

#### 5.2.2 Energy Savings

As part of the 2024-2025 DSM MA update, the Evaluator reviewed the equation parameters such as the hours of use (HOU) used to determine the energy savings of measures eligible under Instant Rebates. In 2024, for LED linear fixtures, LED linear lamps, LED outdoor fixtures, and LED directional and architectural fixtures, HOU values were updated based on 2021-2023 BER-AR and SBES values. The unitary energy savings values for occupancy/motion sensors were also updated in 2024. The tracked and evaluated HOU values and unitary energy savings values are presented in Table 16 and Table 17 below respectively.

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<sup>10</sup> Definition adapted from National Renewable Energy Laboratory, *The Uniform Methods Project, Chapter 23: Estimating Net Savings: Common Practices*, September 2014, p. 3.



**Table 16: Instant Rebates Tracked and Evaluated HOU Values**

| Measure                                                              | Tracked Annual HOU (hours/year) | Evaluated Annual HOU (hours/year) |
|----------------------------------------------------------------------|---------------------------------|-----------------------------------|
| <b>LED Linear Fixtures</b>                                           |                                 |                                   |
| 1 x 4 Luminaires                                                     | 4,300                           | 4,209                             |
| 2 x 2 Luminaires and Retrofit Kits                                   | 4,300                           | 4,209                             |
| 2 x 4 Luminaires and Retrofit Kits                                   | 4,300                           | 4,209                             |
| Linear Ambient and Low-bay Luminaires                                | 4,300                           | 4,209                             |
| Troffers                                                             | 4,300                           | 4,209                             |
| <b>LED Linear Lamps</b>                                              |                                 |                                   |
| 2-foot Replacement Lamps                                             | 4,300                           | 4,209                             |
| 3-foot Replacement Lamps                                             | 4,300                           | 4,209                             |
| 4-foot Replacement Lamps                                             | 4,300                           | 4,209                             |
| 8-foot Replacement Lamps                                             | 4,300                           | 4,209                             |
| U-bend Lamps                                                         | 4,300                           | 4,209                             |
| <b>LED Outdoor Fixtures</b>                                          |                                 |                                   |
| Outdoor Full-cut-off Wall-mounted Area Luminaires                    | 4,380                           | 4,317                             |
| Flood and Spot Luminaires                                            | 4,380                           | 4,317                             |
| Non-cut-off and Semi-cut-off Wall-mounted Area Luminaires            | 4,380                           | 4,317                             |
| <b>LED Directional and Architectural Fixtures</b>                    |                                 |                                   |
| Track or Mono-point Directional Luminaires, LED Wall Wash Luminaires | 4,300                           | 4,209                             |

**Table 17: Instant Rebates Tracked and Evaluated Unitary Energy Savings Values for Occupancy/Motion Sensors**

| Parameter                         | Type of Occupancy Sensor |                                | Tracked Value [kWh/year] | Updated Value [kWh/year] |
|-----------------------------------|--------------------------|--------------------------------|--------------------------|--------------------------|
| Unitary Energy Savings (kWh/year) | Interior                 | Remote Ceiling or Wall-mounted | 201                      | 100                      |
|                                   |                          | Fixture Mounted or Wall Switch | 117                      |                          |
|                                   | Exterior                 |                                | 118                      | 134                      |

### 5.2.3 Peak Demand Savings

As part of the 2024-2025 Measure Assessment activities, the Evaluator reviewed the peak coincidence factor (PCF) of 60% for indoor lighting measures. This percentage constitutes the weighted average PCF of all indoor lighting measures installed in 2022 through Application Rebates and Small Business Energy Solutions (SBES) – another BNI program component of E1 – since no participant-specific information was available for Instant Rebates. In 2024, this value was maintained for indoor lighting measures, while a PCF of 100% was used for outdoor measures and circulator pumps since they are assumed to be in operation during the peak demand period. The unitary peak demand savings values for occupancy/motion sensors were also reviewed and updated in 2024. The tracked and evaluated values are presented in Table 18.

**Table 18: Instant Rebates Tracked and Evaluated Unitary Peak Demand Savings Values for Occupancy/Motion Sensors**

| Parameter                       | Type of Occupancy Sensor |                                | Tracked Value [W] | Updated Value [W] |
|---------------------------------|--------------------------|--------------------------------|-------------------|-------------------|
| Unitary Peak Demand Savings (W) | Interior                 | Remote Ceiling or Wall-mounted | 37.6              | 26.3              |
|                                 |                          | Fixture Mounted or Wall Switch | 21.9              |                   |
|                                 | Exterior                 |                                | 31.1              | 35.3              |

### 5.2.4 Interactive Effects

Interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling; these are taken into account in the gross unitary savings equation presented in the 2024 tracking sheet. The interactive effects factors for the commercial sector are based on the same interactive effects as in previous years, as detailed in the 2024-2025 DSM MA.

## 5.2.5 Effective Useful Life

As part of the 2024-2025 DSM Measure Assessment activities, the Evaluator reviewed the EUL values used in the calculations of electrical energy savings that are expected to persist over time. In 2024, for LED linear fixtures, LED linear lamps, LED outdoor fixtures, and LED directional and architectural fixtures, EUL values were slightly adjusted as a result of the HOU value updates. For all other Instant Rebates measures, the EUL values established in the 2021 evaluation remained valid for the 2024 evaluation.

The tracked and evaluated EUL values are presented in Table 19.

**Table 19: Instant Rebates Tracked and Evaluated EUL Values**

| Measure                                                              | Tracked EUL (years) | Evaluated EUL (years) |
|----------------------------------------------------------------------|---------------------|-----------------------|
| <b>LED Linear Fixtures</b>                                           |                     |                       |
| 1 x 4 Luminaires                                                     | 11.6                | 11.9                  |
| 2 x 2 Luminaires and Retrofit Kits                                   | 11.6                | 11.9                  |
| 2 x 4 Luminaires and Retrofit Kits                                   | 11.6                | 11.9                  |
| Linear Ambient and Low-bay Luminaires                                | 11.6                | 11.9                  |
| Troffers                                                             | 20.9                | 21.4                  |
| <b>LED Linear Lamps</b>                                              |                     |                       |
| 2-foot Replacement Lamps                                             | 11.6                | 11.9                  |
| 3-foot Replacement Lamps                                             | 11.6                | 11.9                  |
| 4-foot Replacement Lamps                                             | 11.6                | 11.9                  |
| 8-foot Replacement Lamps                                             | 11.6                | 11.9                  |
| U-bend Lamps                                                         | 11.6                | 11.9                  |
| <b>LED Outdoor Fixtures</b>                                          |                     |                       |
| Outdoor Full-cut-off Wall-mounted Area Luminaires                    | 17.1                | 17.4                  |
| Flood and Spot Luminaires                                            | 17.1                | 17.4                  |
| Non-cut-off and Semi-cut-off Wall-mounted Area Luminaires            | 22.8                | 23.2                  |
| <b>LED Directional and Architectural Fixtures</b>                    |                     |                       |
| Track or Mono-point Directional Luminaires, LED Wall Wash Luminaires | 11.6                | 11.9                  |

The evaluated equivalent EUL values are applied to the gross and net first-year electrical energy savings of each measure to obtain gross and net lifetime electrical energy savings. As a result, the weighted average EUL values for gross and net savings differ (see Subsections 5.2.6 and 5.3.3 below). The gross weighted average EUL value is equal to 14.1 years.



## 5.2.6 Evaluated Gross Savings

The energy and peak demand savings associated with Instant Rebates were calculated using the unitary savings values (including baseline wattages, the actual wattages of efficient measures, ballast factors where applicable, interactive effects factors, PCFs, and ISRs for lighting measures) from the 2024-2025 DSM Measure Assessment. The savings at the generator were calculated using weighted average line loss factors determined based on the distribution of the rate code spending of other BNI programs in 2024. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>11</sup>

The total savings established for each measure type are presented in Table 20 below.

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<sup>11</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

**Table 20: Evaluated 2024 Instant Rebates Gross Energy and Peak Demand Savings**

| Measure Category                                                                                                                                                                                               | LED Linear Fixtures | LED Linear Lamps | LED Outdoor Fixtures | LED Directional and Architectural Fixtures | Outdoor Motion Sensors | Indoor Occupancy/ Motion Sensors | Circulator Pumps | Total for All Measures |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------------|----------------------|--------------------------------------------|------------------------|----------------------------------|------------------|------------------------|
| Number of Units                                                                                                                                                                                                | 78,237              | 81,888           | 8,835                | 650                                        | 256                    | 6,535                            | 957              | 177,358                |
| <b>Energy Savings</b>                                                                                                                                                                                          |                     |                  |                      |                                            |                        |                                  |                  |                        |
| Tracked Gross Energy Savings – at the Meter (GWh)                                                                                                                                                              | 17.806              | 4.718            | 7.913                | 0.100                                      | 0.034                  | 0.654                            | 0.427            | 31.653                 |
| Adjustment Ratio on Energy Savings                                                                                                                                                                             | 1.000               | 1.000            | 1.000                | 1.000                                      | 1.000                  | 1.000                            | 1.000            | -                      |
| In-service Rate                                                                                                                                                                                                | 1.000               | 0.850            | 1.000                | 1.000                                      | 1.000                  | 1.000                            | 1.000            | -                      |
| Interactive Effects Factor*                                                                                                                                                                                    | 0.920               | 0.973            | 1.000                | 1.040                                      | 1.000                  | 0.959                            | 1.000            | -                      |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                               | <b>16.375</b>       | <b>3.904</b>     | <b>7.913</b>         | <b>0.104</b>                               | <b>0.034</b>           | <b>0.627</b>                     | <b>0.427</b>     | <b>29.384</b>          |
| Line Loss Factor                                                                                                                                                                                               | 1.0661              | 1.0661           | 1.0661               | 1.0661                                     | 1.0661                 | 1.0661                           | 1.0661           | -                      |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                           | <b>17.457</b>       | <b>4.162</b>     | <b>8.436</b>         | <b>0.111</b>                               | <b>0.037</b>           | <b>0.668</b>                     | <b>0.455</b>     | <b>31.327</b>          |
| Effective Useful Life (years)                                                                                                                                                                                  | 11.9                | 11.9             | 20.1                 | 11.9                                       | 10.0                   | 10.0                             | 15.0             | -                      |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                  | <b>207.744</b>      | <b>49.522</b>    | <b>169.576</b>       | <b>1.324</b>                               | <b>0.366</b>           | <b>6.681</b>                     | <b>6.829</b>     | <b>442.043</b>         |
| <b>Peak Demand Savings</b>                                                                                                                                                                                     |                     |                  |                      |                                            |                        |                                  |                  |                        |
| Tracked Gross Demand Savings – at the Meter (MW)                                                                                                                                                               | 4.230               | 1.121            | 1.833                | 0.024                                      | 0.008                  | 0.186                            | 0.066            | 7.468                  |
| Adjustment Ratio on Demand Savings                                                                                                                                                                             | 1.000               | 1.000            | 1.000                | 1.000                                      | 1.000                  | 1.000                            | 1.000            | -                      |
| In-service Rate                                                                                                                                                                                                | 1.000               | 0.850            | 1.000                | 1.000                                      | 1.000                  | 1.000                            | 1.000            | -                      |
| Peak Coincidence Factor                                                                                                                                                                                        | 0.60                | 0.60             | 1.00                 | 0.60                                       | 1.00                   | 0.60                             | 1.000            | -                      |
| Interactive Effects Factor                                                                                                                                                                                     | 0.851               | 0.884            | 1.000                | 1.000                                      | 1.000                  | 0.868                            | 1.000            | -                      |
| <b>Total Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                           | <b>2.160</b>        | <b>0.506</b>     | <b>1.833</b>         | <b>0.014</b>                               | <b>0.008</b>           | <b>0.097</b>                     | <b>0.066</b>     | <b>4.684</b>           |
| Line Loss Factor                                                                                                                                                                                               | 1.0750              | 1.0750           | 1.0750               | 1.0750                                     | 1.0750                 | 1.0750                           | 1.0750           | -                      |
| <b>Total Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                       | <b>2.322</b>        | <b>0.544</b>     | <b>1.971</b>         | <b>0.015</b>                               | <b>0.009</b>           | <b>0.104</b>                     | <b>0.071</b>     | <b>5.035</b>           |
| *The interactive effects factors for LED linear fixtures and LED linear lamps were drawn from the 2024-2025 DSM MA, adjusted by the proportions of LED recessed lamps and fixtures in the 2024 tracking sheet. |                     |                  |                      |                                            |                        |                                  |                  |                        |

Figure 9 below compares the tracked and evaluated gross energy savings, and Figure 10 further below compares the tracked and evaluated gross peak demand savings.

The slight differences between evaluated gross electrical energy savings and tracked savings were due to updated HOU for all LED measures and to updated unitary electrical energy savings for occupancy/motion sensors. Evaluated peak demand savings were almost identical to tracked values.

**Figure 9: 2024 Instant Rebates Tracked and Evaluated Gross Energy Savings at the Generator**

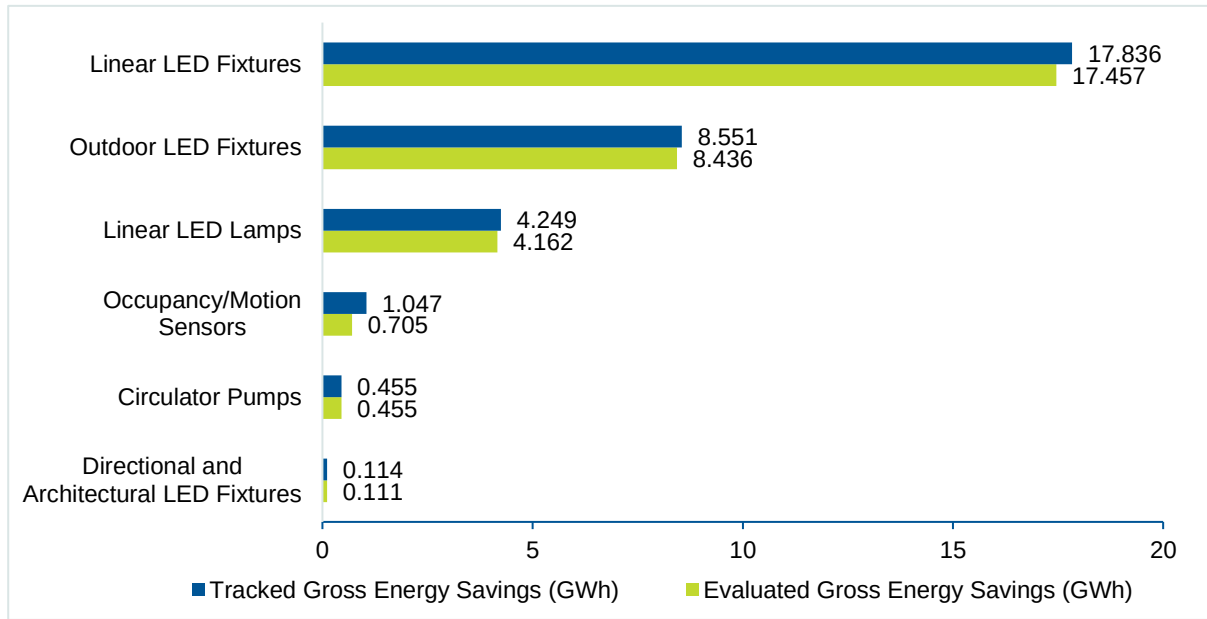
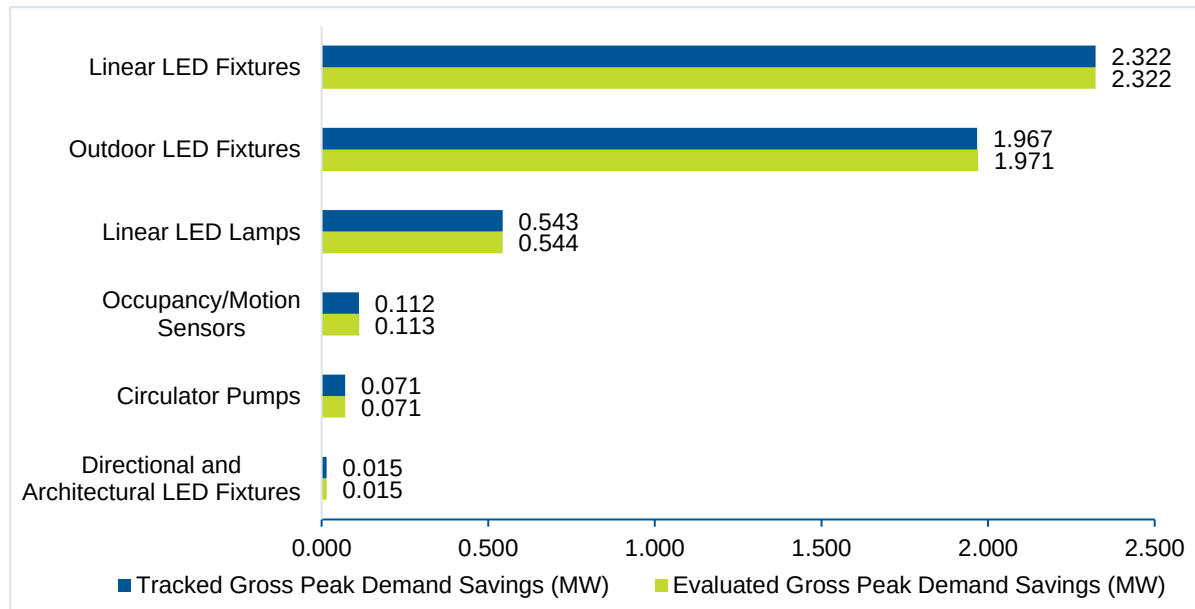


**Figure 10: 2024 Instant Rebates Tracked and Evaluated Gross Peak Demand Savings at the Generator**



As presented in Table 21, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>12</sup> for GHG emissions generated by electricity production to Instant Rebates gross savings.

**Table 21: Evaluated 2024 Instant Rebates Gross GHG Emission Reductions**

|                                                                                             | Total         |
|---------------------------------------------------------------------------------------------|---------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>31.327</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2         |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>14,792</b> |

## 5.3 Net Savings

The Evaluator determined the net energy savings, i.e. the electrical energy savings that can be reliably attributed to a service, by estimating the NTGR. In the case of Instant Rebates, the NTGR is established by considering free-ridership.

### 5.3.1 Free-ridership

For Instant Rebates, free-ridership corresponds to the proportion of savings attributed to natural market trends. Thus, the free-ridership assessment is aimed at estimating the level of sales of energy efficient products that would have occurred in a market that evolved naturally, i.e. without service influence. To do so, a self-report approach that involved asking both participants and distributors sets of questions during telephone interviews was used. Participants were asked if they would have paid for the full cost of the products they bought and if they would have been of the exact same efficiency level and the same number of products. In addition, distributor influence was considered to capture midstream service influences on aspects like product promotion and stocking.

The algorithms used to assess participant free-ridership and distributor influence were updated in 2024 as part of the NTGR review. Both algorithms are presented in Appendix VI.

Free-ridership was assessed during the 2024 evaluation for the three main lighting measures:

- › LED linear fixtures
- › LED linear lamps
- › LED outdoor fixtures

These three categories represent 95% of all gross energy savings generated by Instant Rebates. They were selected because they were the best-selling product categories in 2024.

<sup>12</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024), and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

The Evaluator calculated the free-ridership level for each measure category, the results of which are presented in Table 22 below. The overall free-ridership levels take into account both the free-ridership levels obtained through the participant survey and the distributor influence levels measured through the distributor interviews. While average distributor influence levels are presented in the table for informational purposes, the average values were not used in the calculations of overall free-ridership levels; instead, the specific values obtained for each distributor were applied to each corresponding participant free-ridership value. First, free-ridership was calculated for each participant. Then, the distributor-specific influence value was applied to this such that the overall free-ridership level for each participant is the participant free-ridership level multiplied by (100% - Distributor influence level %); higher levels of distributor influence correspond to lower overall free-ridership levels.

**Table 22: 2024 Instant Rebates Free-ridership**

| Measure Category                                       | Average Distributor Influence Level<br>(from distributor interviews) | Free-ridership Level<br>(from participant survey) | Overall Free-ridership Level | Margin of Error |
|--------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------|------------------------------|-----------------|
| LED Linear Fixtures                                    | 63%                                                                  | 16%                                               | <b>8%</b>                    | 3.7%            |
| LED Linear Lamps                                       | 59%                                                                  | 24%                                               | <b>15%</b>                   | 4.1%            |
| LED Outdoor Fixtures                                   | 61%                                                                  | 28%                                               | <b>15%</b>                   | 5.8%            |
| Sample sizes: n=10 distributors and n=50 participants. |                                                                      |                                                   |                              |                 |

The overall free-ridership levels obtained for each measure category range between 8% and 15%.

In 2022, overall free-ridership levels were 14% for LED linear fixtures, 27% for LED linear lamps, and 18% for LED outdoor fixtures. For all three measure categories, the overall free-ridership levels decreased in 2024 due to adjustments made to the application of both the intention score (which averages participants' cost, efficiency planning, quantity, and timing scores) and the influence score (which reflects the distributors' impact) in the free-ridership algorithm. Specifically, the 2024 update gave equal weight to both the intention and influence scores while the influence score only represented 20% to 33% of the weight in 2022. This adjustment made to the algorithm combined with influence scores in 2024 being overall lower<sup>13</sup> than intention scores resulted in decreased free-ridership levels. Additionally, lower free-ridership levels can also be attributed to the increased incentives offered in 2023 and 2024.

### 5.3.2 Net-to-gross Ratio

The NTGR is calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership})$$

As presented in Table 23, the NTGRs for the main measure categories were established using the free-ridership levels outlined in Subsection 5.3.1 above. For the other measures sold through Instant Rebates, a NTGR of 1.00 was used.

<sup>13</sup> A "low" influence score means that the program had higher influence on customer decisions to install efficient lighting. "Low" corresponds to low free-ridership levels. Similarly, "low" intention scores correspond to low free-ridership levels.



**Table 23: 2024 Instant Rebates NTGRs**

| Measure              | Free-ridership | NTGR |
|----------------------|----------------|------|
| LED Linear Fixtures  | 8%             | 0.92 |
| LED Linear Lamps     | 15%            | 0.85 |
| LED Outdoor Fixtures | 15%            | 0.85 |
| Other Measures       | 0%             | 1.00 |

### 5.3.3 Evaluated Net Savings

Net savings are defined as the changes in energy use that are specifically attributable to Instant Rebates. Net savings were estimated by applying the overall NTGR presented above to evaluated gross savings as exemplified in the following equation.

$$\text{Net Savings} = \text{Evaluated Gross Savings} \times \text{NTGR}$$

Net energy savings were first calculated separately for each measure category because NTGRs differed from one measure category to another.

Table 24 below presents the calculation details. The net energy savings resulted in 13,241 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions.

**Table 24: Evaluated 2024 Instant Rebates Net Energy and Peak Demand Savings**

| Measure Category                                            | LED Linear Fixtures | LED Linear Lamps | LED Outdoor Fixtures | LED Directional and Architectural Fixtures | Outdoor Motion Sensors | Indoor Occupancy /Motion Sensors | Circulator Pumps | Total for All Measures |
|-------------------------------------------------------------|---------------------|------------------|----------------------|--------------------------------------------|------------------------|----------------------------------|------------------|------------------------|
| <b>Energy Savings</b>                                       |                     |                  |                      |                                            |                        |                                  |                  |                        |
| Gross Energy Savings – at the Meter (GWh)                   | 16.375              | 3.904            | 7.913                | 0.104                                      | 0.034                  | 0.627                            | 0.427            | 29.384                 |
| NTGR                                                        | 0.92                | 0.85             | 0.85                 | 1.00                                       | 1.00                   | 1.00                             | 1.00             | -                      |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>15.065</b>       | <b>3.318</b>     | <b>6.726</b>         | <b>0.104</b>                               | <b>0.034</b>           | <b>0.627</b>                     | <b>0.427</b>     | <b>26.302</b>          |
| Line Loss Factor                                            | 1.0661              | 1.0661           | 1.0661               | 1.0661                                     | 1.0661                 | 1.0661                           | 1.0661           | -                      |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>16.061</b>       | <b>3.537</b>     | <b>7.171</b>         | <b>0.111</b>                               | <b>0.037</b>           | <b>0.668</b>                     | <b>0.455</b>     | <b>28.040</b>          |
| Effective Useful Life (years)                               | 11.9                | 11.9             | 20.1                 | 11.9                                       | 10.0                   | 10.0                             | 15.0             | -                      |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>191.124</b>      | <b>42.094</b>    | <b>144.140</b>       | <b>1.324</b>                               | <b>0.366</b>           | <b>6.681</b>                     | <b>6.829</b>     | <b>392.559</b>         |
| <b>Peak Demand Savings</b>                                  |                     |                  |                      |                                            |                        |                                  |                  |                        |
| Gross Peak Demand Savings – at the Meter (MW)               | 2.160               | 0.506            | 1.833                | 0.014                                      | 0.008                  | 0.097                            | 0.066            | 4.684                  |
| NTGR                                                        | 0.92                | 0.85             | 0.85                 | 1.00                                       | 1.00                   | 1.00                             | 1.00             | -                      |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>1.987</b>        | <b>0.430</b>     | <b>1.558</b>         | <b>0.014</b>                               | <b>0.008</b>           | <b>0.097</b>                     | <b>0.066</b>     | <b>4.160</b>           |
| Line Loss Factor                                            | 1.0750              | 1.0750           | 1.0750               | 1.0750                                     | 1.0750                 | 1.0750                           | 1.0750           | -                      |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>2.137</b>        | <b>0.462</b>     | <b>1.675</b>         | <b>0.015</b>                               | <b>0.009</b>           | <b>0.104</b>                     | <b>0.071</b>     | <b>4.472</b>           |

## 5.4 Realization Rate

Table 25 compares total tracked and evaluated savings for Instant Rebates. It also includes the realization rates, representing the ratio of evaluated net savings to tracked net savings, for both electrical energy savings and peak demand savings.

**Table 25: Comparison of 2024 Instant Rebates Tracked and Evaluated Savings at the Generator**

|                                                                                                                                 | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|---------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                 | Value         | Unit |       | Value       | Unit |                  |
| Energy Savings                                                                                                                  |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                           | 32.251        | GWh  | 0.84  | 27.068      | GWh  | 104%             |
| Evaluation Results                                                                                                              | 31.327        | GWh  | 0.90  | 28.040      | GWh  |                  |
| Peak Demand Savings                                                                                                             |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                           | 5.031         | MW   | 0.84  | 4.205       | MW   | 106%             |
| Evaluation Results                                                                                                              | 5.035         | MW   | 0.89  | 4.472       | MW   |                  |
| * The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for Instant Rebates. |               |      |       |             |      |                  |

The evaluated net electrical energy and peak demand savings were respectively 4% and 6% higher than the values tracked by E1. While HOU values were slightly decreased as part of the 2024 evaluation, the increases in both unitary energy and peak demand savings for indoor (fixture-mounted or wall-switch) and outdoor occupancy/motion sensors along with the updated increase to NTGRs for LED linear fixtures, LED linear lamps, and LED outdoor fixtures resulted in evaluated savings exceeding the tracked values.

## 6 Overall BER Results

As outlined in Figure 11, BER nearly reached the planned net electrical energy savings, falling short by less than 1%, and exceeded the peak demand savings target by 13%

**Figure 11: 2024 BER Targets and Evaluated Savings**

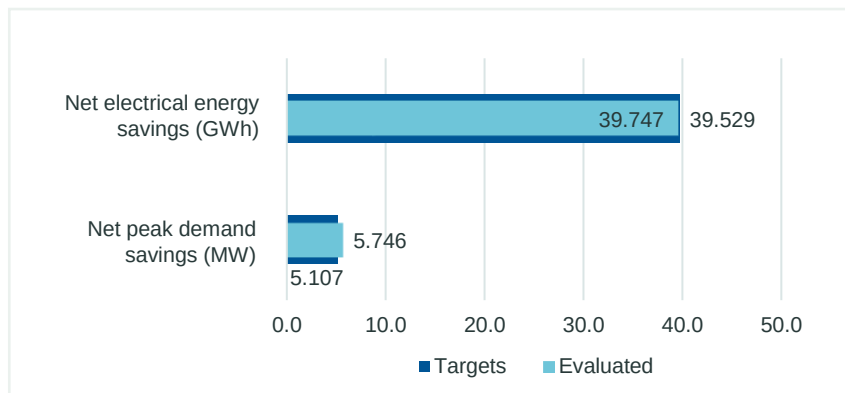


Table 26 compares the savings tracked by E1 to the 2024 evaluated savings for BER along with the corresponding realization rates.

**Table 26: Comparison of 2024 BER Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                                                            | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                                                            | Value         | Unit |       | Value       | Unit |                  |
| Energy Savings                                                                                                                                                                                             |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                                                                      | 47.777        | GWh  | 0.81  | 38.557      | GWh  | 103%             |
| Evaluation Results                                                                                                                                                                                         | 46.852        | GWh  | 0.84  | 39.529      | GWh  |                  |
| Peak Demand Savings                                                                                                                                                                                        |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                                                                      | 6.752         | MW   | 0.81  | 5.479       | MW   | 105%             |
| Evaluation Results                                                                                                                                                                                         | 6.756         | MW   | 0.85  | 5.746       | MW   |                  |
| *Different NTGRs were established for Application Rebates and Instant Rebates. The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for both services. |               |      |       |             |      |                  |

The evaluated net electrical energy and peak demand savings established through this evaluation were respectively 3% and 5% higher than the values calculated in the 2024 tracking sheet. For the most part, the differences are attributed to unitary savings value and NTGR updates for Instant Rebates.

## 7 BER Market Evolution

E1 has been active in the LED market of the BNI sector through BER since 2010. Market evolution assessments were completed as part of the 2017, 2018, 2019, and 2021 evaluations, the results of which served to analyze key market indicators and present a technology diffusion curve illustrating the market adoption of LED lighting in the Nova Scotia BNI sector. The aim of this section is to update the data collected as part of previous evaluations and provide up-to-date insights regarding the market evolution of LED lighting in Nova Scotia. Given that the LED market is rapidly evolving, regularly monitoring barriers to LED adoption is important to enable E1 to adapt the BER offer, if needed.

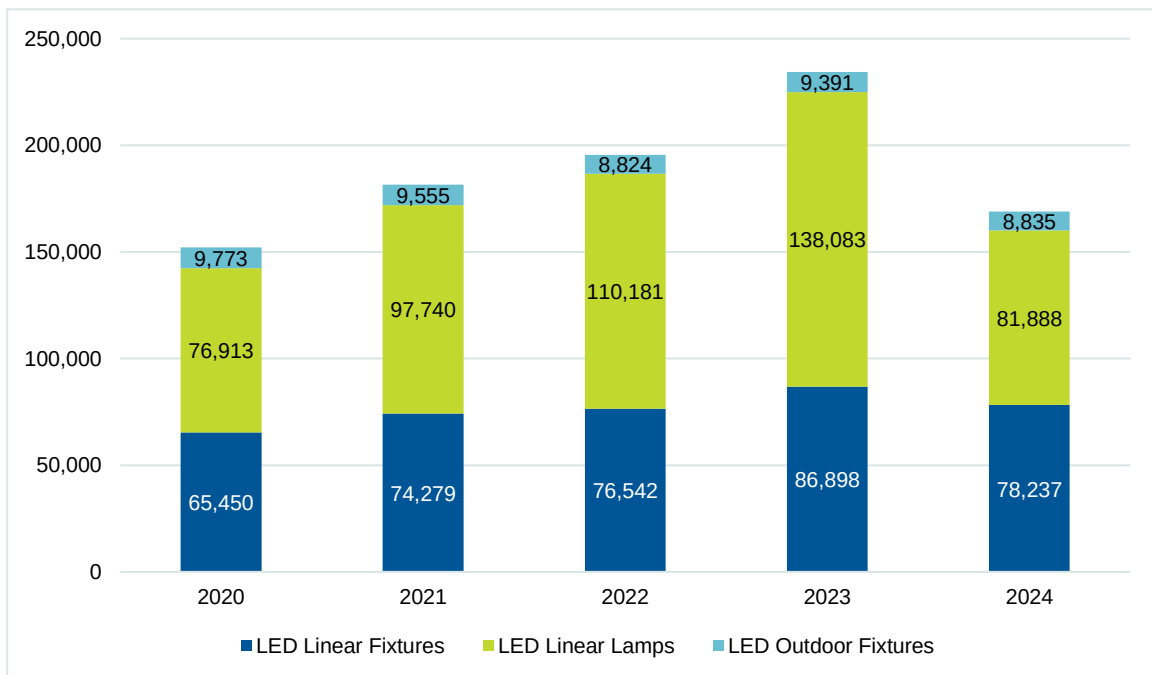
### 7.1 Sales of LED Lighting Technologies

#### 7.1.1 BER-IR Incented LED Products

The total number of LED lamps and fixtures per measure category incented through Instant Rebates since 2020 is presented in Figure 12 below. The Evaluator considers that sales through BER represent an acceptable reflection of overall LED market trends given that not only are there no application requirements, meaning any business in the province of Nova Scotia can participate in the program component by simply purchasing eligible products, but also distributor partners have locations throughout the province, thus ensuring strong geographical coverage.

While the total number of rebated LED linear fixtures and LED linear lamps rebated through Instant Rebates increased between 2022 and 2023, participation in both categories decreased by 10% and 41% respectively in 2024. LED linear fixtures constituted 46% and LED linear lamps comprised 48% of all BER rebated LED lighting products in 2024, the remaining 6% being LED outdoor fixtures. While the proportion of LED outdoor fixtures has remained stable since 2020, the proportion of LED linear fixtures has been increasing over LED linear lamps compared to 2023 when they respectively represented 37% and 59% of all BER rebated LED lighting products.

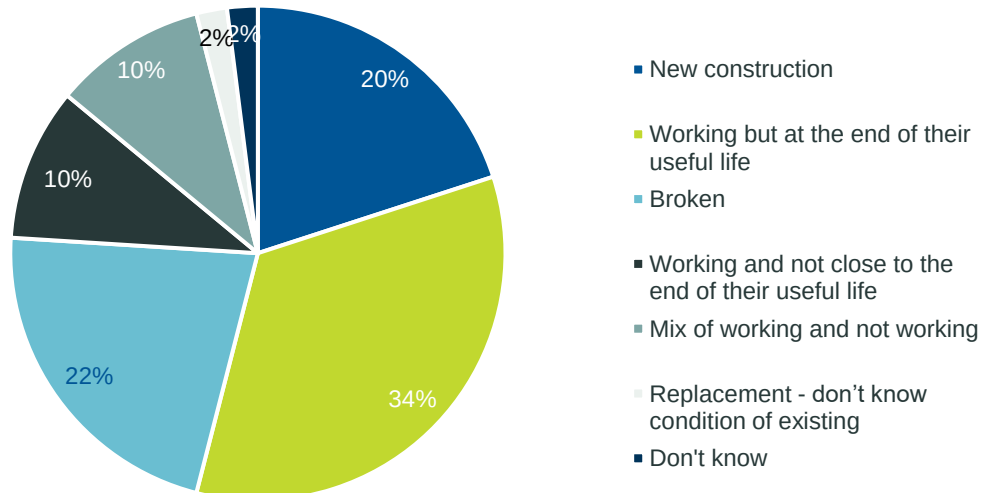
**Figure 12: BER Instant Rebates Incented LED Units, 2020-2024**



## 7.1.2 BER-IR LED Purchasing Decisions

The Evaluator conducted a participant survey, including both contractors and end users, to understand the LED purchasing decisions of participants. Most participants (78%) reported that they had purchased efficient lighting products to replace existing fixtures or lamps, while two in 10 (20%) said they had purchased the efficient products for new constructions. Of those who purchased efficient products to replace their existing fixtures or lamps, close to one-third (34% of all participants surveyed) said their existing fixtures or lamps were working but at the end of their useful life, while one in four (22% of all participants surveyed) said their existing fixtures or lamps were broken. Only 10% said their existing products were working and not close to the end of their useful life, and the same proportion (10%) said that some were working and some were not working. Therefore, in a majority of cases (86%), participants would have had to purchase new lamps or fixtures in the absence of the service. Figure 13 below shows the breakdown between the participants who reported they had decided to purchase LED lighting products for new construction projects, and the different conditions of the existing fixtures or lamps, when LEDs were purchased for replacement.

**Figure 13: Breakdown Between New Construction and Replacement of Existing Lighting**



## 7.2 Evolution of LED Versus Non-LED Lighting Products

To understand the availability of LED versus non-LED products in Nova Scotia, the Evaluator asked BER-IR distributors what proportion of their 2024 lighting stock was LED versus non-LED for each product category. Distributors were then asked how they expected their forecasted lighting sales to evolve in the next two years. The Evaluator considers that interviewed BER-IR distributors represent an acceptable reflection of the overall market in Nova Scotia given that they represented 92% of LED lighting products sold through BER-IR in 2024 and that it was assumed that the majority, if not all, of distributors in the province participate in BER-IR to remain competitive.

Overall, distributors reported carrying a large majority of LED lighting products, reporting on average that 96% of all their lighting stock were LEDs. Distributors reported higher proportions of LED fixtures in their inventories, reporting 100% for linear fixtures and high-bay fixtures and 99% for outdoor fixtures. This is up from the 92% share of fixture shipments estimated using Electro Federation Canada data for the Atlantic region as part of the 2021 evaluation. Distributors reported that the large majority of lamp stock was also LED, and this proportion is expected to grow by 2026. The results are presented in Figure 14 below.

**Figure 14: 2024 LED Versus Non-LED Business Lighting Stock and Expected Evolution**



Distributors reported that finding non-LED linear fixtures is increasingly difficult. Moreover, four distributors said that this is due to suppliers no longer manufacturing or making non-LED or traditional fixtures available. One of these distributors stated that “manufacturers have switched to LED”, with another reporting, “we can’t find anything but LED fixtures at this point from our manufacturers, with few small exceptions”. One distributor also commented that clients no longer ask for non-LED linear fixtures. These findings were largely echoed for high-bay fixtures.

For outdoor fixtures, three distributors reported that they had a very small amount of non-LED stock (1-2%), with two reporting that this is due to old stock being used up over time. One distributor again mentioned that the availability of non-LED outdoor fixtures is limited due to manufacturers.

Very few distributors reported carrying non-LED fixtures at all, and the small quantities of linear, outdoor, and high-bay fixtures they have in stock are either because products have been discontinued or they carry replacement products for a few customers who have not switched to LED technology.



LED linear lamps make up a large majority of stock that is expected to grow in the next two years, but unlike fixtures, the responses of distributors on their proportion of LED linear lamps varied. A total of seven out of the 10 interviewed distributors reported that over 90% of their stock was LED, with the remaining three estimating that LEDs make up between 50- 75% of their stock. Several distributors mentioned that their sales of linear lamps are decreasing overall as more clients shift to integrated LED fixtures, which is also reflected in the LED sales presented in Figure 14 above. Another distributor mentioned increased LED offerings driving them to carry more LED linear lamps. Similar trends were noted for outdoor replacement lamps and high-bay lamps from those distributors that carry these products.

For replacement lamps, many distributors still carry non-LED lamps, whether linear, outdoor, or high-bay, to meet the needs of institutional and government customers and, to a lesser extent, property management companies. One distributor mentioned that there are no LED alternatives for some linear lamps, such as high output lamps used for signage, and that non-LED replacement lamps are sometimes used in difficult-to-access environments in which upgrading the fixtures cannot be easily done.

Nevertheless, distributors expect LED lamps to make up 94-98% of their stock by 2026 depending on the lamp type. The proportion of lamps that are LED is anticipated to increase in the next two years as discontinued non-LED products currently in stock are sold or removed from inventories.

Distributors reported that the LED market is relatively stable at this stage. All 10 interviewed distributors do not expect big changes in the overall proportion of LED stock in the absence of BER-IR. One distributor noted the different quality and efficiency of LED technologies available and that the service should look to incent the best LED technology within a given category. The service has impacted the evolution of the market in Nova Scotia, and two distributors reported unaided that BER-IR, notably the rebates offered, has helped move the market to where it is today.

In terms of LED availability, most distributors mentioned the supply chain has been stable. Also, one distributor mentioned that North American lighting manufacturers have had to strengthen their capacity to effectively compete with increased offerings from low-cost resellers, and one distributor believed that the popularity of just-in-time inventory management (due to high warehousing costs) has had a negative impact on product availability in recent years.

### **7.2.1 DesignLights Consortium (DLC) Certified Fixtures**

Distributors were asked about the breakdown of the LED fixtures between DLC Standard Certified, DLC Premium, and non-certified products. Of the six distributors that were asked those questions, four were able to provide an estimate of the breakdown of their stock. The six respondents represented 73% of LED lighting products sold through BER-IR in 2024. Three of these distributors reported that the majority of their fixture stock (80% or higher) was DLC Premium. The other distributor reported that the majority of their stock is DLC Standard Certified (80%), followed by Premium (15%). Three distributors carry a small stock of non-certified products (ranging from 5-20%), with the other not carrying any.

The other two distributors were unable to provide a breakdown of their stock, although they provided details about their stock. One reported not carrying inventory, instead making orders based on individual project needs, but mentioned that the choice of product is always DLC certified, and project needs dictate whether Standard or Premium is chosen. The other was unable to provide a breakdown yet mentioned that, if they bring in stock, it is always DLC certified, in part to ensure products qualify for a BER rebate.

In addition, three distributors out of the four who provided a breakdown of their stock believe the share of DLC certified fixtures is relatively stable and would remain so even in the absence of E1 rebates. One distributor noted that this is because the price of DLC Premium is continually decreasing while availability is increasing. Another stated that they choose products based on performance. Hence, while the



rebates are important, it is less important than product performance. Another stated that manufacturers all certify products to meet DLC Premium standards “...it is now the standard practice in the industry, so most reputable companies are certifying.” On the other hand, one distributor would expect a large shift from DLC certified to uncertified products without the rebates due to cost differences between the products.

In terms of pricing, for distributors that carry uncertified LED fixtures (n=4), they reported that, once the rebate is applied to DLC certified fixtures, prices are lower than (n=3) or comparable (n=1) to those of uncertified products. Similarly, for the five that carry DLC Premium, they reported that once the rebate is applied to DLC Premium products, prices are lower than (n=3) or comparable (n=2) to those of uncertified LED fixtures.

## 7.3 Average Pricing for LED Lamps and Fixtures in BER-IR

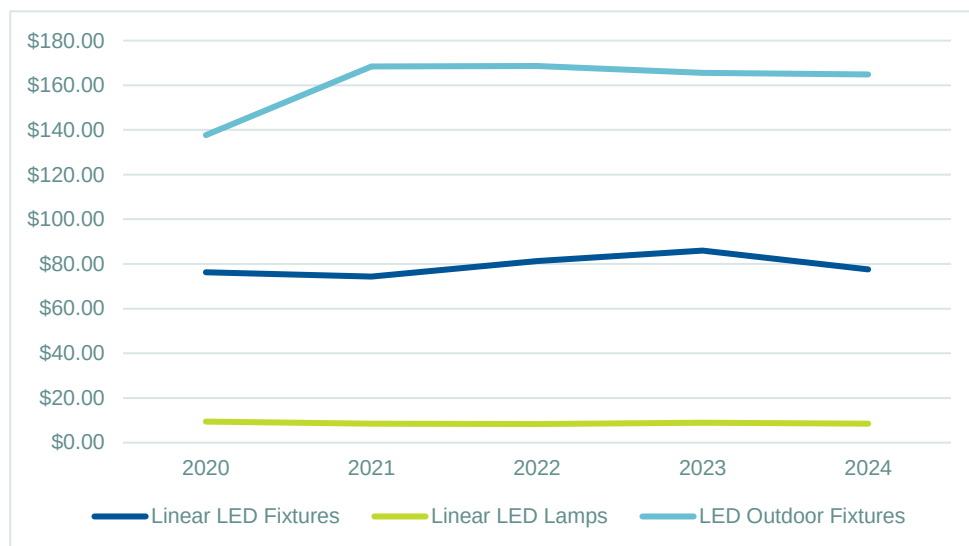
### 7.3.1 LED Lighting Costs

#### Retail Prices

Figure 15 below illustrates the evolution of the average cost per unit (before rebates) from 2020 to 2024 for LED linear lamps and fixtures as well as LED outdoor fixtures rebated through BER-IR. The data were drawn from the BER-IR tracking sheets.

Since 2020, the average retail prices of LED linear fixtures and linear lamps have remained relatively stable, reaching \$77.55 and \$8.54 respectively in 2024. For LED outdoor fixtures, the average retail price dropped in 2021 and has remained steady since at \$164.80 in 2024. Averages are provided to show an overall trend in prices only. Precise values should be interpreted with caution as there is a high range of prices observed across each category.

**Figure 15: Average Retail Prices of IR Rebated LED Lamps and Fixtures, 2020-2024**



## Rebate Values

As outlined in Table 27, the average rebate values under Instant Rebates have remained relatively steady for all measure categories since 2022. This is in part due to E1 capping incentives either at a set maximum amount per unit based on price or at 75% of the unit price, whichever is lowest.

**Table 27: Average Rebate Values Under Instant Rebates for LED Linear Fixtures and Lamps and LED Outdoor Fixtures, 2020-2024**

| Measure Category     | 2020    | 2021    | 2022    | 2023    | 2024    |
|----------------------|---------|---------|---------|---------|---------|
| LED Linear Fixtures  | \$23.35 | \$26.37 | \$38.00 | \$40.11 | \$40.67 |
| LED Linear Lamps     | \$3.71  | \$3.69  | \$4.43  | \$4.94  | \$4.52  |
| LED Outdoor Fixtures | \$49.10 | \$57.89 | \$66.51 | \$66.62 | \$68.11 |

## 7.4 New Technologies and Product Offerings

When asked about new technologies and LED product offerings, distributors have seen increases in available multi-wattage and multi-voltage fixture products, which means that they are able to carry a smaller assortment of lamps and fixtures while continuing to meet customer demand. Econoler noted that multi-wattage products are not easily identifiable in the BER-IR tracking sheet and that tracked wattages may not necessarily be the wattages used in all instances. Lamp technology has also improved, albeit more slowly. Controls have continued to improve over the past three years, notably for colour changing technology for which there is a wider range of choices, especially in colour temperature and lumen outputs, along with better Bluetooth technology in fixtures and better dimming capabilities. One distributor also noticed a better assortment of decorative fixtures for different applications (e.g. ultra flexible rope lighting that can be tied into a bow or fixtures and lamps with an integrated emergency power source).

## 7.5 Codes and Standards

A major indicator of market transformation is the adoption of more stringent codes and standards. Currently, the following products are regulated:

- › Fluorescent lamp ballasts
- › General service fluorescent lamps
- › Metal halide lamp ballasts
- › General service lamps and modified spectrum incandescent lamps
- › General service incandescent reflector lamps

The first two products above relate to linear fixtures and lamps rebated through BER. Regulations for these products were last updated in 2016 when new requirements for higher fluorescent lamp and ballast efficiency were aimed at effectively banning T12 fluorescent tubes. The metal halide lamp ballast regulation applies to non-linear fixtures (primarily outdoor or high-bay fixtures) and, as is the case for the fluorescent lamp regulation, allows inefficient fixtures below the baseline currently used by BER-IR. The latest regulation update in Canada, Amendment 18, primarily impacts non-linear lamps (general service lamps and general service incandescent lamps), which is not relevant to the baseline used for the products sold in BER-IR.

This analysis of lighting standards indicates that, while there is some movement in Canadian regulations with respect to advancing lighting energy efficiency, the market is driving the shift to LED technologies more than regulations.

## 7.6 Market Evolution Summary

In their recommendations on market transformation and market effects, Rosenberg and Hoefgen (2009) identify a number of factors, listed in Table 28 below, to be analyzed to identify whether program support should be withdrawn or reduced in light of changes observed in the market.<sup>14</sup>

**Table 28: 2024 Analysis of Key Factors in Market Evolution**

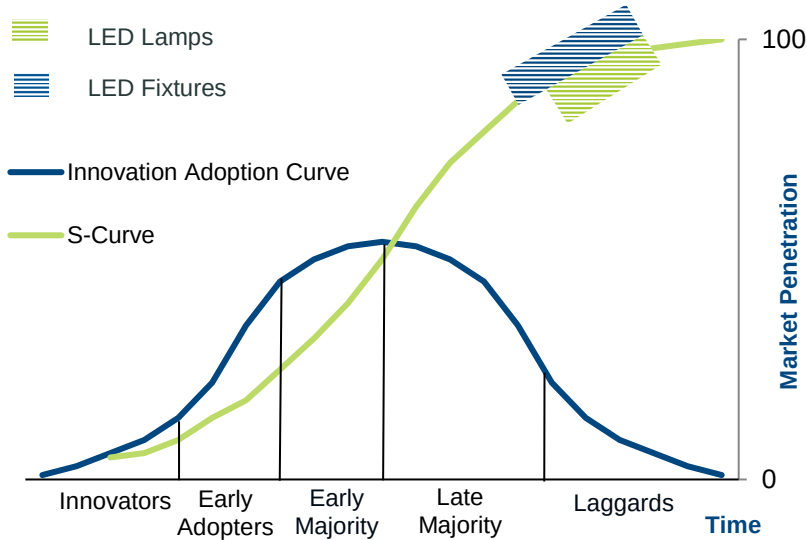
| Factor                                                   | Results                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Market share of LED fixtures for BNI sector              | The fixtures market is fully transformed to LED; distributors report that all or nearly all of their fixture stock is LED and finding non-LED fixtures is very difficult. This is the case for linear, outdoor, and high-bay fixtures.                                                                                                                                                                                             |
| Market share of LED lamps for BNI sector                 | The lamp market lags the fixture market somewhat, although LED products still represent upward of 87-95% of the stock depending on the lamp type, and distributors predict that LED lamps will represent 94-96% of the stock by 2026. A moderate inventory of non-LED lamps is carried by distributors to meet the need of institutional, government, and property management customers who have not yet upgraded to LED fixtures. |
| Trends in prices and availability                        | According to program data, pricing for LED products has been relatively stable over the last three years. While distributors report that the LED market is relatively stable, there are still differences among LED products in terms of quality and efficiency. Distributors report carrying the majority of DLC certified products as opposed to uncertified products.                                                           |
| Likelihood of inclusion in a near-term code or standard  | The efficiency levels of LED linear fixtures and lamps rebated through BER remain superior to the efficiency levels required by current Canadian regulations.                                                                                                                                                                                                                                                                      |
| Market readiness of more efficient substitute technology | No more efficient substitute to LEDs has come to market. Efficiency improvements in LED lamps and fixtures are likely with organizations like the DesignLights Consortium increasing their criteria for certification.                                                                                                                                                                                                             |

Figure 16 below provides a qualitative indication of the stage of LED lighting adoption in the Nova Scotia BNI sector. The technology diffusion curve in the table illustrates how successive groups of customers, from “innovators” to “laggards”, adopt a new technology (as illustrated by the innovation adoption curve in blue)<sup>15</sup> and how market penetration (illustrated by the S-curve in green) eventually reaches 100% saturation levels. The figure does not specifically correlate with distributor stocking, more details on that topic is discussed in Section 7.1 above. The market penetration of the LED commercial lighting market in Nova Scotia is illustrated by the green box. The Evaluator finds that the BNI LED fixture market has reached maturity with some potential to target laggards to move to LED fixtures. The LED lamp market is mature and levelling off as more and more fixtures are integrated. Both product markets are evolving toward more multi-mode models.

<sup>14</sup> Rosenberg and Hoefgen, Market Effects and Market Transformation: Their Role in Energy Efficiency Program Design and Evaluation, prepared for the California Institute of Energy and the Environment, 2009.

<sup>15</sup> Everett M. Rogers, Diffusion of Innovations – Fifth Edition, August 16, 2003.

Figure 16: 2024 Market Evolution for Commercial LED Lighting



To supplement the above market evaluation results, the Evaluator also conducted a jurisdictional scan to investigate similar programs to BER-IR. The Evaluator found very few examples of instant discount programs targeted at the BNI sector. For details, please see Appendix VII.



## 8 BER Key Findings and Recommendations

The main objectives of the 2024 BER evaluation were as follows:

- › Collect information on participant and distributor perspectives
- › Calculate gross and net BER results (for both AR and IR), namely first-year and lifetime electrical energy savings, peak demand savings, as well as avoided GHG emissions
- › Analyze the evolution of the BNI lighting market

This section provides the Evaluator's key findings and recommendations in relation to these objectives.

**2024 BER-Finding: BER almost achieved its net electrical energy savings target, falling short by less than 1%, while exceeding its net peak demand savings target by 13%.**

BER achieved 39.529 GWh in net electrical energy savings and 5.746 MW in net peak demand savings at the generator in 2024, thus almost reaching the planned net electrical energy savings of 39.747 GWh, falling short by less than 1%, and exceeding the planned net peak demand savings of 5.107 MW by 13%.

**2024 BER-Finding: In 2024, Instant Rebates participation decreased by 26% compared to 2023 levels. Application Rebates participation increased by 18% in 2024, with gross energy savings per participant increasing by 16% compared to 2023 levels.**

In 2024, Instant Rebates participation decreased by 26% due to fewer measures rebated. Conversely, Application Rebates participation increased with 18% more participating businesses and with net savings per participant also increasing 16% compared to 2023. Overall, BER gross energy savings and peak demand savings decreased by 2% and 9% respectively between 2023 and 2024. This was mainly due to the decrease in Instant Rebates savings generated by LED linear lamps and LED linear fixtures.

**2024 BER Finding: Overall satisfaction with BER Instant Rebates is high among both participants and distributors.**

For Instant Rebates, average satisfaction ratings of 9.1 and 8.3 out of 10 were reported by participants and distributors respectively. Participants reported being very satisfied with the interaction and communication with distributors and with the rebate amounts (average ratings of 9.0). Distributors were highly satisfied with the service support and communications provided by E1 (average rating of 9.3) and were generally satisfied with rebate processing, tracking, and reporting (average rating of 8.4).

**2024 BER Finding: The Instant Rebates free-ridership algorithm was updated in 2024 and the overall free-ridership levels established in the evaluation ranged between 8% and 15%.**

The Evaluator reviewed and updated the Instant Rebates free-ridership algorithm to give equal weight to the intention score (which averages cost, efficiency planning, quantity, and timing scores) and the influence score. The 2024 evaluation results represent a decrease from the 2022 evaluation; moreover, caution must be taken when comparing free-ridership results between these evaluations since they were established using different approaches. Additionally, lower free-ridership levels can also be attributed to the increased incentives offered in 2023 and 2024.



**2024 BER-Finding:** Both evaluated net electrical energy savings and peak demand savings were identical to the values tracked by E1 for Application Rebates. Evaluated net electrical energy and peak demand savings were both higher by 4% and 6% respectively than tracked results for Instant Rebates.

Overall, evaluated BER net electrical energy and peak demand savings established through this evaluation were both respectively 3% and 5% higher than those calculated in the 2024 tracking sheet. The differences are attributed to Instant Rebates because of updates to unitary savings values and NTGRs.

**2024 BER-Finding:** According to participating BER-IR distributors, the fixture market has been transformed to LED. Distributors indicate that non-LED options for fixtures are now rare, reporting that their entire stock of fixtures is LED.

Distributors reported that 100% of their stock was LED for linear and high-bay fixtures and 99% for outdoor fixtures. They reported that manufacturers no longer supply non-LED alternatives and that this market share would be stable even in the absence of E1 incentives.

**2024 BER-Finding:** Most purchases rebated through BER-IR are for new construction or products at the end of their useful life, which validates the use of a replace-on-burnout baseline for this program component.

**2024 BER-Finding:** The market evaluation results indicate that the market practice for BNI fixtures is LED technology, indicating that an update to the baseline for fixtures sold through BER-IR is imminent.

**Recommendation #1:** Undertake additional research to further validate the market evaluation results to establish, no later than Q3, when the LED baseline for BER-IR LED fixtures should take effect. Research should focus on the potential risk of the fixture market rebounding from reducing or removing the Instant incentives in the Nova Scotia market.

**2024 BER-Finding:** The LED market practice baseline for BNI fixtures also applies to new construction projects incented through BER-AR.

**Recommendation #2:** Review the eligibility criteria for LED lighting in new construction projects in BER-AR given evidence that LEDs are the baseline for this market.

**2024 BER-Finding:** Distributors reported that the majority of their fixture stock is either DLC Premium or DLC standard.

Some distributors carry a small portion of non-certified product, although the majority is DLC certified. Most distributors expect that the market would remain certified products even in the absence of E1 incentives. This should be monitored going forward.

**Recommendation #3:** In line with Recommendation #1, research should also investigate the efficiency level of an LED baseline for LED fixtures.

**2024 BER-Finding:** Distributors still carry a small percentage of non-LED lamps for a subset of customers. They forecast this share to diminish even more over the next two years as more fixtures are replaced with LEDs.



**Recommendation #4:** The current non-LED baseline for lamps should be maintained for BER-IR and reassessed in 2026. Given trends, E1 should plan for a baseline change starting in 2027.

**2024 BER-Finding:** Lighting retrofit opportunities remain for early replacements and particularly in some subsectors where capital funding is limited, like institutional and government buildings and to a lesser extent property management companies.

**Recommendation #5:** Plan for a shift in the product offer for LED fixtures from BER-IR to BER-AR to capture remaining retrofit opportunities once LED baseline is adopted for BER-IR.

**Recommendation #6:** Focus efforts on BER-AR to target market laggards for early replacement retrofits of their lighting.

**Recommendation #7:** A LED baseline should also be applied to the EUL of LED fixtures rebated through BER-AR and SBES to reflect the fact that existing fixtures would have been replaced with LED fixtures at the end of their life. The baseline should consider the proportion of projects targeted for early replacement versus replace on burn-out as well as an estimated remaining EUL.

**2024 BER-Finding:** Distributors report that control products continue to evolve.

**Recommendation #8:** Analyze opportunities for increasing interest around controlled lighting products.

**2024 BER-Finding:** There is an increase in multi-wattage and multi-voltage fixture products available on the market.

For these products, the tracked wattage may not necessarily be the wattage used for all applications.

**Recommendation #9:** Ensure that multi-wattage products are identified in the tracking sheet. Update applications for BER-AR and SBES to identify multi-wattage products and confirm the wattage being used. Select the middle wattage (i.e. not the lowest or highest) as the tracked wattage when information is not available from the participant.

## CONCLUSION

Table 29 presents the participation levels, net-to-gross ratios (NTGRs), evaluated gross and net savings at the generator, annual GHG emission reductions, as well effective useful life (EUL) values for each service and Efficient Product Rebates as a whole.

**Table 29: Overall 2024 Efficient Product Rebates Participation and Evaluated Savings**

|                                                                                                                                                             | Participation Level |               | Gross Savings |                  | NTGR   | Net Savings |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------|---------------|------------------|--------|-------------|------------------|
|                                                                                                                                                             | Value               | Unit          | Value         | Unit             | Value* | Value       | Unit             |
| Application Rebates                                                                                                                                         |                     |               |               |                  |        |             |                  |
| Energy Savings                                                                                                                                              | 262                 | Projects      | 15.526        | GWh              | 0.74   | 11.489      | GWh              |
| Lifetime Energy Savings                                                                                                                                     |                     |               | 293.685       | GWh              | 0.74   | 217.327     | GWh              |
| Peak Demand Savings                                                                                                                                         |                     |               | 1.721         | MW               | 0.74   | 1.274       | MW               |
| Annual GHG Emission Reductions                                                                                                                              |                     |               | 7,331         | Tonnes of CO2 eq | 0.74   | 5,425       | Tonnes of CO2 eq |
| EUL                                                                                                                                                         |                     |               | 18.9          | Years            |        | 18.9        | Years            |
| Instant Rebates                                                                                                                                             |                     |               |               |                  |        |             |                  |
| Energy Savings                                                                                                                                              | 177,358             | Products sold | 31.327        | GWh              | 0.90   | 28.040      | GWh              |
| Lifetime Energy Savings                                                                                                                                     |                     |               | 442.043       | GWh              | 0.89   | 392.559     | GWh              |
| Peak Demand Savings                                                                                                                                         |                     |               | 5.035         | MW               | 0.89   | 4.472       | MW               |
| Annual GHG Emission Reductions                                                                                                                              |                     |               | 14,792        | Tonnes of CO2 eq | 0.90   | 13,241      | Tonnes of CO2 eq |
| EUL                                                                                                                                                         |                     |               | 14.1          | Years            |        | 14.0        | Years            |
| Total                                                                                                                                                       |                     |               |               |                  |        |             |                  |
| Energy Savings                                                                                                                                              |                     |               | 46.852        | GWh              | 0.84   | 39.529      | GWh              |
| Lifetime Energy Savings                                                                                                                                     |                     |               | 735.728       | GWh              | 0.83   | 609.885     | GWh              |
| Peak Demand Savings                                                                                                                                         |                     |               | 6.756         | MW               | 0.85   | 5.746       | MW               |
| Annual GHG Emission Reductions                                                                                                                              |                     |               | 22,124        | Tonnes of CO2 eq | 0.84   | 18,666      | Tonnes of CO2 eq |
| EUL                                                                                                                                                         |                     |               | 15.7          | Years            |        | 15.4        | Years            |
| * The average NTGR values presented in the total correspond to the ratios of net savings to gross savings for both Application Rebates and Instant Rebates. |                     |               |               |                  |        |             |                  |

Figure 17 and Figure 18 below illustrate the net electrical energy and peak demand savings targets for the overall Efficient Product Rebates program and indicate whether targets were achieved in 2024. Efficient Product Rebates was aimed at achieving 39.747 GWh in net electrical energy savings and 5.107 MW in net peak demand savings at the generator for 2024. The program nearly reached the planned net electrical energy savings, falling short by less by 1%, and exceeded the peak demand savings target by 13%. Instant Rebates was the largest contributor to total program net electrical energy and peak demand savings.



**Figure 17: 2024 Efficient Product Rebates Targeted and Evaluated Net Electrical Energy Savings**

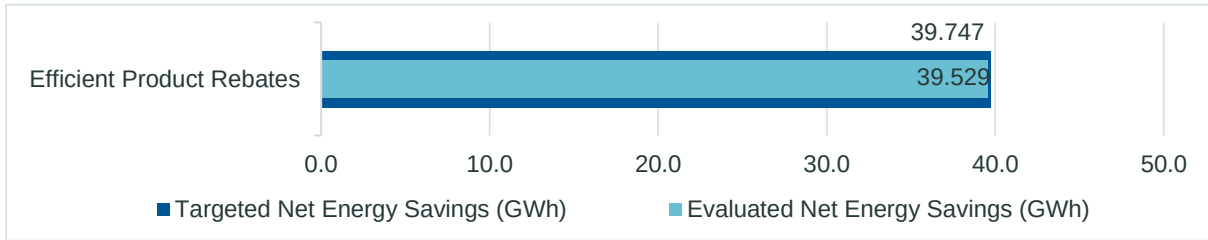
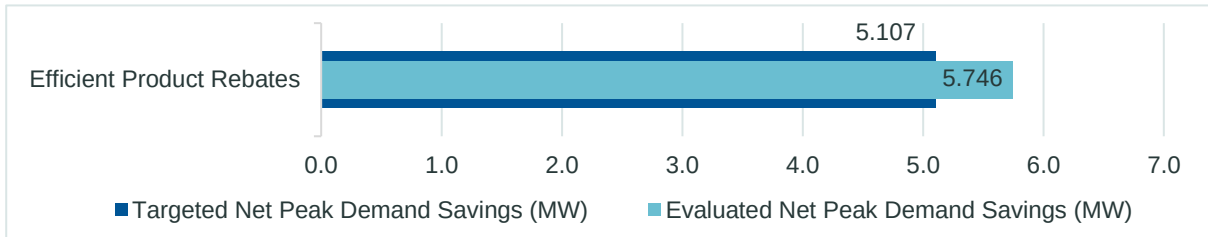


**Figure 18: 2024 Efficient Product Rebates Targeted and Evaluated Net Peak Demand Savings**





## LIST OF APPENDICES

The following are presented in the Efficient Product Rebates Program – Appendices document.

### **Business Energy Rebates**

Appendix I BER: Instant Rebates Participant Survey Questionnaire

Appendix II BER: Instant Rebates Participant Survey Results

Appendix III BER: Instant Rebates Interview Guide with Distributors

Appendix IV BER: Application Rebates Tracking Sheet Audit

Appendix V BER: Instant Rebates Tracking Sheet Audit

Appendix VI BER: Instant Rebates Algorithm for Free-ridership Calculations

Appendix VII BER: Instant Rebates Jurisdictional Scan Results

Appendix VIII BER: 2024 Recommendations



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EfficiencyOne

# EFFICIENT PRODUCT REBATES PROGRAM

Final Appendix Report

2024 DSM EVALUATION

March 26, 2025



NARRATIVE  
RESEARCH



ECONOLUX

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# APPENDIX I

## BER Instant Rebates Participant Survey Questionnaire

### BUSINESS ENERGY REBATES

#### INSTANT REBATES PARTICIPANT SURVEY

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                                                           |
|---------------------------------|---------------------------------------------------------------------------|
| Instrument Type                 | Participant Survey                                                        |
| Estimated Time to Complete      | 15 minutes                                                                |
| Target Audience                 | Business                                                                  |
| Expected Number of Completions  | 50 (17 LED linear lamps, 17 LED linear fixtures, 16 LED outdoor fixtures) |
| Contact List Source             | E1                                                                        |
| Fielding Firm                   | Narrative Research                                                        |
| Estimated Timeline for Fielding | End October – Mid November                                                |

Table 2: Research Objectives and Associated Sections

| Research Objectives                                   | Section        |
|-------------------------------------------------------|----------------|
| Participation and decision to purchase                | C1-C9          |
| Market - Types of projects in Instant Rebates         | C10-C11, F1-F4 |
| Free-ridership                                        | D              |
| Cross-influence                                       | E              |
| Market – Opportunities for LEDs in existing buildings | F5-F6          |
| Satisfaction                                          | G              |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**



## Introduction

### A. INTRODUCTION A – Business with a contact name

Could I speak with <INSERT NAME>?

1. Yes [CONTINUE]
2. No [SAY “PERHAPS YOU CAN HELP ME ANYWAY.” GO TO INTRODUCTION B]

Hello, I am with Narrative Research, and we are conducting an evaluation of energy efficiency services provided by Efficiency Nova Scotia. We have a few questions about your recent experience with Efficiency Nova Scotia’s Business Energy Rebates Program through which you or your organization recently purchased rebated <EFFICIENT PRODUCT> at a participating distributor. More precisely, we are referring to the purchase of <QUANTITY SOLD> <PRODUCT BRAND> <EFFICIENT PRODUCT> made in <MONTH OF PURCHASE> through <DISTRIBUTOR>, for which you received a rebate of <REBATE AMOUNT>.

- A1. Are you the person in your organization who is most knowledgeable about the decision to purchase these <EFFICIENT PRODUCT> from <DISTRIBUTOR> in 2024?
1. Yes [GO TO A3]
  2. No [GO TO A2]
- A2. Is there someone else in your organization who would know about the decision to purchase these <EFFICIENT PRODUCT>? [PROBE IF UNSURE: This person may be an engineer, equipment contractor, or utility account manager].
1. Yes [ASK for name: \_\_\_\_\_ and telephone #: \_\_\_\_\_] [ASK TO SPEAK TO THAT PERSON AND RESTART AT INTRODUCTION. IF OTHER PERSON IS UNAVAILABLE, THANK, TERMINATE, RECORD DATA AND SCHEDULE INTERVIEW WITH BEST CONTACT]
  2. No [THANK & TERMINATE AND RECORD DATA]
- A3. Did you purchase these products for your own organization, or are you a company purchasing products for a customer or project outside of your organization? [SINGLE RESPONSE]
1. I purchased the products for my organization
  2. I purchased the products for a customer or project outside of my organization/I am a contractor
  3. Other, please specify [IF BOTH, SELECT OPTION 1]
  98. Don’t know
  99. Refused

- A4. To help Efficiency Nova Scotia improve the Business Energy Rebates program, would you have a few minutes to answer questions about your organization's participation in the program?

**(IF NEEDED:** The survey will take about 10 minutes to complete. )

**(IF NEEDED:** You may have recently been contacted by Narrative Research or by an Efficiency Nova Scotia representative about your experience with the service. This survey is different as it focuses on other aspects of your participation in the service.)

1. Yes **[CONTINUE]**
2. No **[ASK "CAN WE SCHEDULE A MORE CONVENIENT TIME FOR YOU TO CONDUCT THIS SURVEY?"] [IF NO, THANK, TERMINATE AND RECORD DATA] [IF YES, SCHEDULE CALLBACK]**

## **B. INTRODUCTION B – Business with no contact name**

Hello, I am with Narrative Research, and we are conducting an evaluation of energy efficiency services provided by Efficiency Nova Scotia. We have a few questions about your recent experience with Efficiency Nova Scotia's Business Energy Rebates Program through which you or your organization recently purchased rebated **<EFFICIENT PRODUCT>** at a participating distributor. More precisely, we are referring to the purchase of **<QUANTITY SOLD> <PRODUCT BRAND> <EFFICIENT PRODUCT>** made in **<MONTH OF PURCHASE>** through **<DISTRIBUTOR>**, for which you received a rebate of **<REBATE AMOUNT>**.

- B1. Could you help us identify the person who is most knowledgeable about the decision to purchase these products? **[PROBE IF UNSURE:** This person may be an engineer, equipment contractor, or utility account manager].
1. Yes, the person is **[RECORD NAME AND TELEPHONE NUMBER AND ASK TO SPEAK TO THIS PERSON – GO BACK TO INTRO A]**
  2. Yes, but the person is unavailable **[RECORD NAME AND TELEPHONE NUMBER. THANK AND TERMINATE; SCHEDULE CALL BACK TO SPEAK TO THAT PERSON]**
  3. No **[THANK, TERMINATE AND RECORD DATA]**

## **C. Participation and Decision to Purchase**

- C1. **[ASK IF CONTRACTOR A3=2]** Who usually makes the decision to buy **<EFFICIENT PRODUCT>** rather than standard **<STANDARD PRODUCT>**? Is it... **[READ CODE 1-2 AND 96. SINGLE RESPONSE]**.
1. You or someone else in your organization
  2. Your customer
  96. Someone else (SPECIFY: \_\_\_\_\_)
  98. (Don't know)



C2. **[ASK IF END-USER A3=1 OR C1=1]** Can you describe the main activity of your organization? **[DO NOT READ BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]**

1. (Agriculture)
2. (Banking)
3. (Education)
4. (Health Care)
5. (Hospitality)
6. (Manufacturing/Industrial)
7. (Office/Commercial)
8. (Public Service)
9. (Residential)
10. (Restaurant/Bar)
11. (Retail)
12. (Technology/Science)
13. (Warehouse / storage)
96. (Other (SPECIFY: \_\_\_\_\_))
98. (Don't know)
99. (Refused)

C3. **[ASK IF C1=2]** Before making the decision to purchase <EFFICIENT PRODUCT>, do customers usually ask for your advice? **[SINGLE RESPONSE]**

1. Yes **[GO TO C7]**
2. No **[GO TO C9]**
98. Don't Know **[GO TO C9]**
99. Refused **[GO TO C9]**

C4. **[ASK IF A3=1, C1=1 OR C3=1]** Now, I would like to understand your decision-making process for selecting LED lighting. Did you consider any alternatives to <EFFICIENT PRODUCT> before making your purchase decision? **[SINGLE RESPONSE]**

1. Yes
2. No
98. (Don't know)
99. (Refused)

- C5. **[ASK IF A3=1, C1=1 OR C3=1 AND <LINEAR LAMP>]** What lighting alternatives did you consider? **[DO NOT READ, ACCEPT MULTIPLE RESPONSES]**
1. Standard LED
  2. Incandescent lighting
  3. Fluorescent lighting
  4. Halogen lighting
  5. Other lighting (specify)
  98. (Don't know)
  99. (Refused)
- C6. **[ASK IF A3=1, C1=1 OR C3=1 AND <LINEAR OR OUTDOOR FIXTURE>]** What alternatives to LED fixtures did you consider? **[DO NOT READ, SINGLE RESPONSE]**
1. Keep existing fluorescent fixture
  2. Change for another fluorescent fixture
  3. Other (specify)
  98. (Don't know)
  99. (Refused)
- C7. **[ASK IF A3=1, C1=1 OR C3=1]** What was the SINGLE most important reason you purchased **<EFFICIENT PRODUCT>** rather than standard **<STANDARD PRODUCT>**? **[DO NOT READ. SINGLE RESPONSE.]**
1. Availability of other alternatives
  2. Energy efficiency
  3. Cost savings
  4. Lifespan
  5. Efficiency Nova Scotia program incentives
  6. Environmental cause
  7. Contractor influence
  8. Distributor influence
  96. (Other (SPECIFY: \_\_\_\_\_))
  98. (Don't know)
  99. (Refused)

- C8. **[ASK IF A3=1, C1=1 OR C3=1; DO NOT ASK IF 98 OR 99 IN C4]** What was the SECOND most important reason you purchased <EFFICIENT PRODUCT> rather than standard <STANDARD PRODUCT>? **[DO NOT READ. SINGLE RESPONSE.]**
1. Availability of other alternatives
  2. Energy efficiency
  3. Cost savings
  4. Lifespan
  5. Efficiency Nova Scotia program incentives
  6. Environmental cause
  7. Contractor influence
  8. Distributor influence
  96. (Other (SPECIFY: \_\_\_\_\_))
  97. No other reason
  98. (Don't know)
- C9. **[ASK ALL]** Did your distributor recommend <EFFICIENT PRODUCT> to you? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know)
  99. (Refused)
- C10. For what type of project did you purchase the <EFFICIENT PRODUCT>? Was it for a... **[READ. SINGLE RESPONSE]**
1. New construction
  2. Replacement of existing fixtures or lamps
  98. (Don't know)
  99. (Refused)
- C11. **[ASK IF C10=2]** In what state were the existing fixtures or lamps when you decided to purchase the <EFFICIENT PRODUCT>? Were they... **[READ. SINGLE RESPONSE]**
1. Working but at the end of their useful life
  2. Working and not close to the end of their useful life
  3. Broken
  4. **[DO NOT READ]** (Some were working, some were not working)
  96. **[DO NOT READ]** (Other (SPECIFY: \_\_\_\_\_))
  98. (Don't know)
  99. (Refused)

## D. Free-Ridership

- D1. **[ASK ALL]** Were you aware that you received a rebate when purchasing these **<EFFICIENT PRODUCT>?** **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know)
- D2. **[ASK IF D1=2 OR 98]** Have I understood correctly that you were not aware that a rebate would be given on the product's total cost when you purchased these items? **[DO NOT READ. SINGLE RESPONSE]**
1. Yes, correct (unaware of the rebate)
  2. No, incorrect (aware of the rebate)
  98. Don't know
  99. Refused
- D3. **[ASK IF D1=1 OR D2=2]** Were you aware that the rebate was offered by Efficiency Nova Scotia? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. Don't know
- D4. **[ASK IF END-USER A3=1 AND D3=1]** How did you first become aware of the rebates available from Efficiency Nova Scotia's Business Energy Rebates Program? **[DO NOT READ. SINGLE RESPONSE]**
1. Through my contractor
  2. Through my distributor
  3. Efficiency Nova Scotia staff contacted me about the program
  4. Efficiency Nova Scotia website
  5. Efficiency Nova Scotia promotion
  6. Past experience with another Efficiency Nova Scotia program
  7. Word of mouth from other organizations/businesses/Friends/Family
  8. Online - general
  96. Other, please specify
  98. Don't know
  99. Refused

D5. **[ASK ALL]** Had you *already* decided to purchase these <EFFICIENT PRODUCT> *before* talking to a distributor? **[SINGLE RESPONSE]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

D6. **[ASK IF AWARE (D1=1 or D2=2)]** Had you *already* decided to purchase these <EFFICIENT PRODUCT> *before* knowing that these efficient products were rebated? **[SINGLE RESPONSE]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

D7. **[ASK ALL]** Efficiency Nova Scotia offered a rebate for the purchase of efficient lighting products. If your organization had not received the rebate and the cost of <EFFICIENT PRODUCT> had been about <REBATE AVERAGE VALUE BY CATEGORY> higher per unit, what is the likelihood you would have paid the full cost of the <EFFICIENT PRODUCT>? **[SINGLE RESPONSE]**

- 1. Definitely would have
- 2. Probably would have
- 3. Probably would not have
- 4. Definitely would not have
- 98. (Don't know)
- 99. (Refused)

**[ASK D8 TO D11 IF AWARE OF REBATE (D1=1 or D2=2), RANDOMIZE D8 TO D11]**

D8. Without the BER rebate, what is the likelihood that you would have purchased the exact same model of premium lighting products? **[SINGLE RESPONSE]**

- 1. Definitely would have
- 2. Probably would have
- 3. Probably would not have
- 4. Definitely would not have
- 98. (Don't know)
- 99. (Refused)

D9. **[ASK IF C11=2]** If the rebate had not been offered, what is the likelihood that you would have kept your existing fixtures or lamps? **[SINGLE RESPONSE]**

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have
98. (Don't know)
99. (Refused)

D10. **[ASK IF TOTAL MEASURE CATEGORY QTY>1]** Without the rebate, which of the following scenarios would have most likely occurred? **[SINGLE RESPONSE]**

You would have purchased...

1. ... exactly the same number of efficient lighting products
2. ...some, but not all of the efficient lighting products
3. You would not have purchased any efficient lighting products
98. (Don't know)
99. (Refused)

D11. **[ASK END USERS ONLY AND IF D7= 1 OR 2]** Without the program rebate, what is the likelihood that you would have postponed the purchase of the efficient lighting products by at least one year? **[SINGLE RESPONSE]**

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have
98. (Don't know)
99. (Refused)

D12. How influential were the following four factors in your decision to purchase **<EFFICIENT PRODUCT>? [RANDOMIZE]**

| Factor (READ AND RANDOMIZE)                                                                                                             | Responses                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| a. <b>[ASK IF D1=1 OR D2=2]</b> The program rebate                                                                                      | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |
| b. <b>[ASK IF D3=1]</b> Information received from an Efficiency Nova Scotia program representative on high-efficiency lighting products | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |
| c. <b>[ASK ALL]</b> Information received from a distributor on high-efficiency lighting products                                        | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |
| d. <b>[ASK ALL]</b> Prevalence of LED products among products that met your lighting requirements                                       | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |

## E. Cross-Influence

### ASK ALL - READ AND ROTATE (E1 + E2-E4) AND (E5 + E6-E8) SEQUENCES

E1. Before participating in the Business Energy Rebates program in **<APPLICATION DATE>**, had your company/organization at any time in the past already participated in the Business Energy Rebates program or any other Efficiency Nova Scotia programs? **[SINGLE RESPONSE]**

1. Yes, in Business Energy Rebates
2. Yes, in another program(s)
3. Yes, in both Business Energy Rebates and another program(s)
4. No **[GO TO E5]**
98. (Don't know) **[GO TO E5]**
99. (Refused) **[GO TO E5]**

For the following three statements, please indicate whether you agree or disagree.

- E2. **[IF E1=1, 2 OR 3]** Do you agree or disagree that your company/ organization's previous participation in an Efficiency Nova Scotia program was a major factor in the decision to purchase **<EFFICIENT PRODUCT>?** **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E3. **[ASK IF END USER A3=1 AND E1=1, 2 OR 3]** Do you agree or disagree that because of your company/ organization's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative asked a contractor or a technical staff member to examine the energy efficiency options for your facility? **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E4. **[IF E1=1, 2 OR 3]** Do you agree or disagree that because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative took into account the cost-effectiveness of energy-efficient **<EFFICIENT CATEGORY>** measures when evaluating different options for your facility? **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E5. **[ASK ALL]** Before participating in the Business Energy Rebates program, had you at any time in the past already seen Efficiency Nova Scotia promotional materials or communications advertising the benefits of energy efficiency? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know) **[GO TO F1]**
  99. (Refused) **[GO TO F1]**

**[READ IF E5=1]** For the following statements, please indicate whether you agree or disagree.



- 
- E6. **[IF E5=1]** Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications were a major factor in the company/organization's decision to purchase **<EFFICIENT PRODUCT>?****[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E7. **[IF END USER A3=1 AND IF D5=1]** Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to ask a contractor or a distributor about efficient lighting options for your organization?
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E8. **[IF E5=1]** Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to take into account the cost-effectiveness of **<EFFICIENT PRODUCT>** when evaluating different options for the facility? **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)

## F. Market – LED Lighting

The next series of questions are about how the market for LED lighting is evolving in Nova Scotia

- F1. **[ASK IF A3 = 2]** Over the last year, have you made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor?
1. Yes
  2. No
  98. (Don't know)
  99. (Refused)
- F2. **[ASK IF A3=2 and F1=1 ]** Thinking about all the lighting projects this year where you purchased lighting for customers that received rebates, what proportion of the projects were for :
- New construction\_\_\_\_%      Replacement of existing fixtures or lamps\_\_\_\_% **[TOTAL MUST EQUAL 100%]**

F3. **[ASK IF Response to F2 Replacement of existing fixtures or lamps  $\neq$  0]** And, of those lighting projects that were for replacement of existing lamps or fixtures, what proportion of the existing lamps or fixtures were:

Working but at the end of their useful life \_\_\_\_%

Working and not close to the end of their useful life \_\_\_\_%

Broken \_\_\_\_%

**[TOTAL MUST EQUAL 100%]**

98. (Don't know)

99. (Refused)

F4. **[ASK IF CONTRACTOR (A3=2)]** Do you have customers who have been less likely or slower to adopt LED lighting than others?

1. Yes

2. No

98. (Don't know)

99. (Refused)

F5. **[ASK IF CONTRACTOR A3=2 AND F4=1]** Why do you think these customers are less likely or slower to adopt LED lighting? **[DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY(IES) YOU MATCH TO THEIR RESPONSES ARE CORRECT- ACCEPT MULTIPLE RESPONSES]**

1. (Cost – less willing or able to pay for LED products)

2. (Lack of awareness of facility staff of LED products)

3. (Lack of knowledge of facility staff of LED products)

4. (Less technical applicability of LED products to their building or facility types)

96. (Other (SPECIFY: \_\_\_\_\_))

98. (Don't know)

99. (Refused)

F6. **[ASK IF CONTRACTOR A3=2]** In your experience, which facility or building types still have the most potential to adopt LED lighting? **[DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY(IES) YOU MATCH TO THEIR RESPONSES ARE CORRECT- ACCEPT MULTIPLE RESPONSES]**

1. (Education)
2. (Food Sales (grocery))
3. (Food Service (restaurant))
4. (Health Care – Inpatient)
5. (Health Care – Outpatient)
6. (Lodging)
7. (Mercantile– Retail (Enclosed and Strip Malls))
8. (Mercantile – Retail (Other than Mall))
9. (Office)
10. (Public Assembly)
11. (Public Order and Safety)
12. (Religious Worship)
13. (Service)
14. (Warehouse / storage)
15. (Manufacturing)
16. (Building is vacant)
17. (Agriculture)
96. (Other (SPECIFY: \_\_\_\_\_))
98. (Don't know)
99. (Refused)

## G. Satisfaction

G1. **[ASK ALL]** On a scale of 1 to 10, where 1 is 'not at all satisfied' and 10 is 'completely satisfied,' how was your organization's experience with each of the following aspects of the Business Energy Rebates Program? If your organization did not have experience with one of these aspects please tell me. **[DO NOT RANDOMIZE] [97 = NOT APPLICABLE, 98 = DON'T KNOW/DON'T RECALL, 99 = REFUSED]**

- a) Interaction and communication with distributors
- b) Rebate amounts
- c) Eligible products

- G2. Why were you not more satisfied with the **[READ STATEMENTS IN ORDER AS APPLICABLE]**  
**[DO NOT READ PRE-CODES. PROBE FOR SPECIFIC REASON. ACCEPT MULTIPLE RESPONSES. repeat entire question text for G2A AND G2B]**
- a. **[ASK G1A<8]** Interaction and communication with distributors
1. (Lack of communication/availability with distributors)
  2. (Less knowledgeable about the program)
  3. (Took too long/Communication was slow)
  96. (Other: \_\_\_\_\_)
  98. (Don't know)
  99. (Refused)
- b. **[ASK IF G1B<8]** Rebate amounts
1. (Rebate is too small/Expected higher rebate)
  2. (Cost of measures was expensive)
  96. (Other: \_\_\_\_\_)
  98. (Don't know)
  99. (Refused)
- c. **[ASK IF G1C<8]** Were there other types of efficient equipment or services you would have liked to see Efficiency Nova Scotia provide rebates for? **[OPEN-END RESPONSE]**
98. (Don't know)
- G3. **[ASK ALL]** Using a scale from 1 to 10 where 1 is “not at all satisfied” and 10 is “completely satisfied” how would you rate your satisfaction with the Business Energy Rebates – Instant Rebates program overall? **[RECORD NUMBER, 98=DON'T KNOW, 99 REFUSED]** **[DO NOT ACCEPT A RANGE]**
- G4. **[IF G3<8]** What was the most important reason you were not more satisfied with the Instant Rebates program overall? **[DO NOT READ. PROBE FOR SPECIFIC REASON. ACCEPT MULTIPLE RESPONSES]** Probe: Any other reasons? **[RECORD FIRST AND SUBSEQUENT MENTIONS SEPARATELY]**
1. (Too expensive)
  2. (I don't like the products rebated)
  3. (Rebate/incentive is too small)
  96. (Other (SPECIFY: \_\_\_\_\_)
  98. (Don't know)
  99. (Refused)



G5. Do you have any suggestions on how to improve the Business Energy Rebates - Instant Rebates program?

Probe: Anything else? **[DO NOT READ. ACCEPT MULTIPLE KEEPING CODE 98 AND 99 EXCLUSIVE]**

1. Improve communication
2. Simplify the program/Less paperwork
3. Better marketing/awareness
4. Increase rebates
5. Offer more measures eligible for rebates
6. No recommendations
96. (Other (SPECIFY: \_\_\_\_\_))
98. (Don't know)
99. (Refused)

**END.** Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

## APPENDIX II

### BER Instant Rebates Participant Survey Results

A3. Did you purchase these products for your own organization, or are you a company purchasing products for a customer or project outside of your organization?

| Purchase for Contractor or End User                                                   | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|---------------------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                           | 50   | 60   | 51   | 50   | 50   | 50   |
| I purchased them for my organization                                                  | 60%  | 62%  | 41%  | 50%  | 30%  | 60%  |
| I purchased them for a client or project outside of my organization/I am a contractor | 40%  | 28%  | 59%  | 44%  | 68%  | 38%  |
| I purchased them for my personal use                                                  | -    | 5%   | -    | -    | -    | -    |
| The contractor made the purchase for me                                               | -    | 3%   | -    | -    | -    | -    |
| Others                                                                                | -    | -    | -    | 6%   | -    | -    |
| Don't know                                                                            | -    | 2%   | -    | -    | 2%   | 2%   |

C1. Who usually makes the decision to buy <EFFICIENT PRODUCT> rather than standard <STANDARD PRODUCT>? Is it...?

| Purchase Decision-maker                          | 2018 | 2019   | 2020 | 2021 | 2022 | 2024   |
|--------------------------------------------------|------|--------|------|------|------|--------|
| Sample Size                                      | 20   | 17 (#) | 30   | 22   | 34   | 19 (#) |
| Contractor (or their organization)               | 65%  | 12     | 63%  | 77%  | 71%  | 17     |
| Client                                           | 35%  | 5      | 23%  | 9%   | 6%   | -      |
| Both - Contractor (or their organization)/Client | -    | -      | 13%  | 14%  | 21%  | 1      |
| Someone else                                     | -    | -      | -    | -    | 3%   | 1      |
| Base: Contractors                                |      |        |      |      |      |        |

C2. Can you describe the main activity of your organization?

| Main Activity of Organization                     | 2019          | 2020      | 2021      | 2022      | 2024      |
|---------------------------------------------------|---------------|-----------|-----------|-----------|-----------|
| <b>Sample Size</b>                                | <b>12 (#)</b> | <b>40</b> | <b>42</b> | <b>39</b> | <b>47</b> |
| Electrical contracting/installation               | 11            | 55%       | 43%       | 59%       | 32%       |
| Residential                                       | -             | -         | -         | -         | 13%       |
| Manufacturing/Industrial                          | -             | 20%       | 10%       | 3%        | 11%       |
| Education                                         | -             | -         | -         | 3%        | 9%        |
| Construction                                      | -             | -         | 2%        | 13%       | 6%        |
| Office/Commercial                                 | -             | -         | -         | -         | 6%        |
| Agriculture                                       | -             | 3%        | 5%        | -         | 4%        |
| Mercantile/Retail (Other than Mall)               | -             | 3%        | 2%        | -         | 4%        |
| Food Service (Restaurant)                         | -             | 3%        | 2%        | -         | 2%        |
| Technology/Science                                | -             | -         | -         | -         | 2%        |
| Hospitality                                       | -             | -         | -         | -         | 2%        |
| Warehouse/Storage                                 | -             | -         | -         | 3%        | -         |
| Health Care – Inpatient                           | -             | -         | -         | 3%        | -         |
| Service                                           | -             | -         | 7%        | -         | -         |
| Public Assembly                                   | -             | 3%        | -         | -         | -         |
| Lodging                                           | -             | 3%        | -         | -         | -         |
| Religious Worship                                 | 1             | -         | -         | -         | -         |
| Others                                            | -             | 13%       | 29%       | 18%       | 9%        |
| Base: Contractors that make the purchase decision |               |           |           |           |           |

C3. Before making the decision to purchase <EFFICIENT PRODUCT>, do clients usually ask for your advice?

| Clients Seeking Purchase Decision Advice from Contractors  | 2018         | 2019         | 2020         | 2021         | 2022         | 2024         |
|------------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>Sample Size</b>                                         | <b>7 (#)</b> | <b>5 (#)</b> | <b>7 (#)</b> | <b>2 (#)</b> | <b>2 (#)</b> | <b>0 (#)</b> |
| Yes                                                        | 6            | 4            | 6            | 2            | 2            | -            |
| No                                                         | 1            | 1            | 1            | -            | -            | -            |
| Base: Contractors whose client makes the purchase decision |              |              |              |              |              |              |

- C4. Now, I would like to understand your decision-making process for selecting LED lighting. Did you consider any alternatives to <EFFICIENT PRODUCT> before making your purchase decision?

| Considered Alternatives to LED Lighting Prior to Making Purchase Decision |  | 2024 |
|---------------------------------------------------------------------------|--|------|
| Sample Size                                                               |  | 47   |
| Yes                                                                       |  | 15%  |
| No                                                                        |  | 81%  |
| Don't know                                                                |  | 4%   |
| Base: Contractors that make the purchase decision                         |  |      |

- C5. What lighting alternatives did you consider?

| Alternatives to LED Lighting considered                                                                     |  | 2024  |
|-------------------------------------------------------------------------------------------------------------|--|-------|
| Sample Size                                                                                                 |  | 3 (#) |
| Standard LED                                                                                                |  | 2     |
| Fluorescent lighting                                                                                        |  | 1     |
| Base: Contractors that make the purchase decision and consider alternatives before making purchase decision |  |       |

- C6. What alternatives to LED fixtures did you consider?

| Alternatives to LED Lighting considered                                                                     |  | 2024  |
|-------------------------------------------------------------------------------------------------------------|--|-------|
| Sample Size                                                                                                 |  | 6 (#) |
| Others                                                                                                      |  | 5     |
| Don't know                                                                                                  |  | 1     |
| Base: Contractors that make the purchase decision and consider alternatives before making purchase decision |  |       |

- C7. What was the SINGLE most important reason you purchased <EFFICIENT PRODUCT> rather than standard <STANDARD PRODUCT>?



C8. What was the SECOND most important reason you purchased <EFFICIENT PRODUCT> rather than standard <STANDARD PRODUCT>?

| Motivations for Buying Efficient Products     | 2018                  |                | 2019                  |                | 2020                  |                | 2021                  |                | 2022                  |                | 2024                  |                |
|-----------------------------------------------|-----------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|----------------|
|                                               | Most Important Reason | Other Reasons* | Most Important Reason | Other Reasons* | Most Important Reason | Other Reasons* | Most Important Reason | Other Reasons* | Most Important Reason | Other Reasons* | Most Important Reason | Other Reasons* |
| <b>Sample Size</b>                            | <b>49</b>             | <b>49</b>      | <b>53</b>             | <b>53</b>      | <b>46</b>             | <b>46</b>      | <b>44</b>             | <b>44</b>      | <b>41</b>             | <b>41</b>      | <b>47</b>             | <b>47</b>      |
| To improve energy efficiency                  | 27%                   | 10%            | 26%                   | 4%             | 22%                   | 9%             | 32%                   | 11%            | 37%                   | 10%            | 43%                   | 26%            |
| Save on energy costs/bills                    | 18%                   | 14%            | 45%                   | 13%            | 46%                   | 4%             | 23%                   | 20%            | 12%                   | 2%             | 13%                   | 19%            |
| Availability of other alternatives            | -                     | -              | -                     | -              | -                     | -              | -                     | -              | -                     | -              | 11%                   | -              |
| Longer lifespan                               | -                     | -              | 6%                    | 9%             | 4%                    | 17%            | 5%                    | 9%             | 5%                    | 12%            | 9%                    | 13%            |
| Efficiency Nova Scotia program incentives     | -                     | -              | -                     | -              | -                     | -              | -                     | -              | -                     | -              | 9%                    | 4%             |
| Better lighting                               | -                     | -              | -                     | -              | -                     | -              | 16%                   | 11%            | -                     | 2%             | 2%                    | 13%            |
| Update equipment                              | 2%                    | -              | 2%                    | -              | -                     | 4%             | -                     | 2%             | 2%                    | -              | 2%                    | 9%             |
| Reduce maintenance and associated costs       | 8%                    | 6%             | 2%                    | 11%            | 2%                    | 4%             | -                     | 2%             | -                     | 7%             | 2%                    | 6%             |
| Quality of efficiency products/Better quality | 29%                   | 41%            | 6%                    | 25%            | 9%                    | 26%            | 5%                    | 2%             | 5%                    | 7%             | 2%                    | 4%             |
| Protect the environment/ Environmental cause  | 2%                    | -              | -                     | 6%             | 2%                    | 2%             | -                     | -              | 5%                    | 5%             | 2%                    | -              |
| What the customer/owner wanted                | -                     | 2%             | 2%                    | -              | 4%                    | 2%             | -                     | -              | 10%                   | 2%             | -                     | -              |
| Price of product                              | 4%                    | 6%             | 4%                    | 8%             | 2%                    | 2%             | 7%                    | 7%             | 7%                    | 17%            | -                     | -              |
| Availability of product/Easier to get         | 2%                    | 4%             | -                     | 4%             | 2%                    | 7%             | -                     | 5%             | 7%                    | 10%            | -                     | -              |
| Take advantage of program rebates             | 2%                    | 2%             | -                     | 4%             | 7%                    | 9%             | 2%                    | 7%             | 2%                    | 5%             | -                     | -              |
| Better brightness                             | -                     | -              | -                     | -              | -                     | -              | -                     | -              | 2%                    | 2%             | -                     | -              |
| Safer/More secure                             | -                     | -              | -                     | -              | -                     | -              | -                     | 5%             | -                     | -              | -                     | -              |
| More recyclable                               | -                     | -              | -                     | -              | -                     | -              | -                     | 5%             | -                     | 2%             | -                     | -              |
| To replace non-working equipment              | -                     | -              | 2%                    | -              | -                     | -              | -                     | -              | -                     | -              | -                     | -              |
| Recommended by contractor                     | -                     | 2%             | -                     | -              | -                     | -              | -                     | -              | -                     | -              | -                     | -              |
| Others                                        | 6%                    | 2%             | 6%                    | 8%             | -                     | 2%             | 11%                   | 11%            | 5%                    | 7%             | 6%                    | 4%             |
| None/No other reason                          | -                     | 10%            | -                     | 9%             | -                     | 11%            | -                     | -              | -                     | 7%             | -                     | 2%             |
| Don't know                                    | -                     | -              | -                     | -              | -                     | -              | -                     | 2%             | -                     | -              | -                     | -              |

Base: Respondents who purchased products for their organization or who make the decision to buy efficient products, or before making the decision to purchase clients usually ask respondent for advice and who consider alternatives before making purchase decision

\*Multiple Responses

C9. Did your distributor recommend <EFFICIENT PRODUCT> to you?

| Distributor Recommended Product | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|---------------------------------|------|------|------|------|------|------|
| Sample Size                     | 49   | 60   | 51   | 50   | 50   | 50   |
| Yes                             | 51%  | 62%  | 71%  | 60%  | 62%  | 52%  |
| No                              | 43%  | 33%  | 29%  | 40%  | 38%  | 40%  |
| Don't know                      | 6%   | 5%   | -    | -    | -    | 8%   |

C10. For what type of project did you purchase the <EFFICIENT PRODUCT>? Was it for a...

| Type of Project – Contractors             | 2018 | 2019   | 2020 | 2021 | 2022 | 2024 |
|-------------------------------------------|------|--------|------|------|------|------|
| Sample Size                               | 20   | 17 (#) | 30   | 22   | 34   | 50   |
| Replacement of existing fixtures or lamps | 35%  | 8      | 57%  | 59%  | 53%  | 78%  |
| New construction                          | 60%  | 9      | 43%  | 36%  | 29%  | 20%  |
| Don't know                                | 5%   | -      | -    | 5%   | 18%  | 2%   |
| Base: Contractors                         |      |        |      |      |      |      |

C11. In what state were your existing fixtures or lamps when you decided to purchase the <EFFICIENT PRODUCT>? Were they...

| Condition of Existing Fixtures or Lamps               | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|-------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                           | 31   | 36   | 35   | 33   | 33   | 39   |
| Working but at the end of their useful life           | 29%  | 53%  | 49%  | 39%  | 42%  | 46%  |
| Broken                                                | 16%  | 22%  | 20%  | 18%  | 24%  | 28%  |
| Working and not close to the end of their useful life | 32%  | 19%  | 11%  | 9%   | 18%  | 13%  |
| Some were working, some were not working              | 13%  | 3%   | 17%  | 21%  | 15%  | 10%  |
| Others                                                | 3%   | 3%   | 3%   | 6%   | -    | -    |
| Don't know                                            | 6%   | -    | -    | 6%   | -    | 3%   |
| Base: Respondents who are replacing existing fixtures |      |      |      |      |      |      |

D1. Were you aware that you had received a rebate when purchasing these <EFFICIENT PRODUCT>?

D2. Have I understood correctly that you were not aware that a rebate would be given on the product's total cost when you purchased these items? \*

| Aware of Product Rebate Prior to Purchase | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|-------------------------------------------|------|------|------|------|------|------|
| Sample Size                               | 50   | 60   | 51   | 50   | 50   | 50   |
| Yes                                       | 92%  | 98%  | 98%  | 98%  | 100% | 94%  |
| No                                        | 8%   | -    | 2%   | 2%   | -    | 6%   |
| Don't know                                | -    | 2%   | -    | -    | -    | -    |
| *Slight wording change 2022 and 2024      |      |      |      |      |      |      |

D3. Were you aware that the rebate was offered by Efficiency Nova Scotia as part of its Business Energy Rebates Program?

| Aware Rebate Was Offered by ENS                                                  | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|----------------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                      | 46   | 59   | 50   | 49   | 50   | 47   |
| Yes                                                                              | 93%  | 85%  | 94%  | 86%  | 92%  | 91%  |
| No                                                                               | 7%   | 14%  | 6%   | 14%  | 8%   | 9%   |
| Don't know                                                                       | -    | 2%   | -    | -    | -    | -    |
| Base: Respondents who were aware they received a rebate when purchasing products |      |      |      |      |      |      |

D4. How did you first become aware of the rebates available under Efficiency Nova Scotia's Business Energy Rebates Program?

| Source of Awareness of Rebates                                          | 2018 | 2019 | 2020 | 2021 | 2022     | 2024 |
|-------------------------------------------------------------------------|------|------|------|------|----------|------|
| Sample Size                                                             | 30*  | 31** | 20** | 20** | 13** (#) | 23** |
| Through my distributor                                                  | 57%  | 39%  | 65%  | 55%  | 9        | 74%  |
| Online - general                                                        | -    | -    | -    | -    | -        | 9%   |
| Word of mouth from other organizations/<br>businesses/Friends/Family*** | 7%   | 6%   | 10%  | -    | 1        | 4%   |
| Past experience with another ENS program                                | 3%   | 10%  | -    | 5%   | -        | 4%   |
| Through my contractor                                                   | 3%   | 3%   | 5%   | 20%  | -        | 4%   |
| ENS promotion                                                           | 7%   | 6%   | 5%   | -    | 1        | -    |
| ENS staff contacted me about the program                                | 10%  | 6%   | 5%   | -    | 1        | -    |
| Through my business                                                     | -    | -    | -    | 10%  | -        | -    |
| ENS website                                                             | 7%   | 6%   | 10%  | -    | -        | -    |
| I contacted ENS                                                         | -    | 6%   | -    | -    | -        | -    |
| Others                                                                  | -    | 10%  | -    | 10%  | 1        | 4%   |
| Don't know                                                              | 7%   | 6%   | -    | -    | -        | -    |
| *Base: End users                                                        |      |      |      |      |          |      |
| **Base: End users aware of the rebate                                   |      |      |      |      |          |      |
| ***Slight wording change in 2024                                        |      |      |      |      |          |      |

D5. Had you already decided to purchase these <EFFICIENT PRODUCT> before talking to a distributor?

| Already Made Decision to Purchase Product Before Talking to a Distributor | 2022 | 2024 |
|---------------------------------------------------------------------------|------|------|
| Sample Size                                                               | 50   | 50   |
| Yes                                                                       | 86%  | 72%  |
| No                                                                        | 14%  | 26%  |
| Don't know                                                                | -    | 2%   |

D6. Had you **already** decided to purchase <EFFICIENT PRODUCT> **before** knowing that these products were rebated?

| Already Made Decision to Purchase Product Before Knowing About Rebate | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|-----------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                           | 46   | 59   | 50   | 49   | 50   | 47   |
| Yes                                                                   | 59%  | 66%  | 56%  | 73%  | 74%  | 53%  |
| No                                                                    | 39%  | 32%  | 44%  | 22%  | 22%  | 47%  |
| Did not get any quotes                                                | -    | -    | -    | -    | 2%   | -    |
| Refused                                                               | -    | -    | -    | -    | 2%   | -    |
| Don't know                                                            | 2%   | 2%   | -    | 4%   | -    | -    |
| Base: Respondents who were aware of rebate                            |      |      |      |      |      |      |

D7. Efficiency Nova Scotia offered a rebate for the purchase of efficient lighting products. If your organization had not received the rebate, and the cost for each <EFFICIENT PRODUCT> had been about \$[REBATE AVERAGE VALUE PER UNIT] higher, would you have paid the full cost of the <EFFICIENT PRODUCT>? \*

| Would Have Paid Cost of Product                                                 | 2024 |
|---------------------------------------------------------------------------------|------|
| Sample Size                                                                     | 49   |
| Definitely/Probably would have                                                  | 67%  |
| Probably/Definitely would not have                                              | 33%  |
| *Wording and scale change in 2024 Don't know/Refused excluded from calculations |      |

D8. Without the BER rebate, what is the likelihood that you would have purchased the exact same model of premium lighting products? \*

| Likelihood of Purchasing the Exact Same Model of Premium Lighting Products |  | 2024 |
|----------------------------------------------------------------------------|--|------|
| Sample Size                                                                |  | 46   |
| Definitely/Probably would have                                             |  | 57%  |
| Probably/Definitely would not have                                         |  | 43%  |
| Base: Respondents who were aware of rebate                                 |  |      |
| *Wording and scale change in 2024                                          |  |      |
| Don't know/Refused excluded from calculations                              |  |      |

D9. If the rebate had not been offered, what is the likelihood that you would have kept your existing fixtures or lamps? \*

| Likelihood to Keep Existing Fixtures or Lamps if Rebate Was Not Offered                                                                                                       |  | 2024  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------|
| Sample Size                                                                                                                                                                   |  | 5 (#) |
| Definitely/Probably would have                                                                                                                                                |  | 3     |
| Probably/Definitely would not have                                                                                                                                            |  | 2     |
| Base: Respondents who were aware of rebate and whose state of existing fixtures or lamps were working and not close to the end of their useful life when deciding to purchase |  |       |
| *Wording and scale change in 2024                                                                                                                                             |  |       |
| Don't know/Refused excluded from calculations                                                                                                                                 |  |       |

D10. Without the rebate, which of the following scenarios would have most likely occurred? \*

| Likelihood of Purchasing Same or Less Quantity of Efficient Lighting Products if Rebate Was Not Offered |  | 2024 |
|---------------------------------------------------------------------------------------------------------|--|------|
| Sample Size                                                                                             |  | 33   |
| Purchase exactly the same number of efficient lighting products                                         |  | 30%  |
| Purchase some, but not all of the efficient lighting products                                           |  | 55%  |
| Not purchase any efficient lighting products                                                            |  | 15%  |
| Base: Respondents who were aware of rebate and whose total measure category quantity >1                 |  |      |
| *Wording and scale change in 2024                                                                       |  |      |

D11. Without the program rebate, what is the likelihood that you would have postponed the purchase of the efficient lighting products by at least one year? \*

| Likelihood of Postponing Purchase of Efficient Lighting Products by at Least One Year if Rebate Was Not Offered                                                                                                                 |  | 2024   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------|
| Sample Size                                                                                                                                                                                                                     |  | 16 (#) |
| Definitely/Probably would have                                                                                                                                                                                                  |  | 5      |
| Probably/Definitely would not have                                                                                                                                                                                              |  | 11     |
| Base: Respondents who were aware of rebate and who definitely/probably would have paid the full cost of efficient product if rebate was not offered and cost of efficient product was higher per unit than rebate average value |  |        |
| *Wording and scale change in 2024                                                                                                                                                                                               |  |        |
| Don't know/Refused excluded from calculations                                                                                                                                                                                   |  |        |

D12. How influential were the following four factors in your decision to purchase <EFFICIENT PRODUCT>? \*

| Influence of Factors in Decision to Purchase Efficient Product                                                      | 2024        |                          |                                 |
|---------------------------------------------------------------------------------------------------------------------|-------------|--------------------------|---------------------------------|
|                                                                                                                     | Sample Size | Vey/Somewhat influential | Not very/Not at all influential |
| The program rebate**                                                                                                | 47          | 89%                      | 11%                             |
| Prevalence of LED products among products that met your lighting requirements                                       | 50          | 86%                      | 4%                              |
| Information received from a distributor on high-efficiency lighting products                                        | 49          | 80%                      | 20%                             |
| Information received from an Efficiency Nova Scotia program representative on high efficiency lighting products *** | 41          | 61%                      | 39%                             |
| *Wording and scale change in 2024                                                                                   |             |                          |                                 |
| **Respondents aware of rebate                                                                                       |             |                          |                                 |
| ***Respondents aware that rebate was offered by Efficiency Nova Scotia                                              |             |                          |                                 |
| Don't know/Refused excluded from calculations                                                                       |             |                          |                                 |

E1. Before participating in the Business Energy Rebates program in <MONTH OF PURCHASE>, had your company/organization at any time in the past already participated in the Business Energy Rebates program or any other Efficiency Nova Scotia programs?

| Previous Participation in Another ENS Program Component |                                                              | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|---------------------------------------------------------|--------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                             |                                                              | 50   | 60   | 51   | 50   | 50   | 50   |
| Yes (Total)                                             | Yes, in Business Energy Rebates*                             | 58%  | 62%  | 69%  | 22%  | 26%  | 26%  |
|                                                         | Yes, in another program(s)*                                  |      |      |      | 2%   | -    | 1%   |
|                                                         | Yes, in both Business Energy Rebates and another program(s)* |      |      |      | 34%  | 42%  | 28%  |
| No                                                      |                                                              | 34%  | 35%  | 31%  | 30%  | 24%  | 24%  |
| Don't know                                              |                                                              | 8%   | 3%   | -    | 12%  | 8%   | 20%  |
| *Wording change in 2021                                 |                                                              |      |      |      |      |      |      |

- E2. Do you agree or disagree that your company/organization's previous participation in an Efficiency Nova Scotia program was a major factor in the decision to purchase <EFFICIENT PRODUCT>? \*

| Previous Participation in BER and/or Another ENS Program Was a Major Factor in Purchase | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|-----------------------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                             | 29   | 37   | 35   | 29   | 34   | 28   |
| Agree                                                                                   | 76%  | 73%  | 69%  | 62%  | 79%  | 86%  |
| Disagree                                                                                | 24%  | 27%  | 31%  | 38%  | 18%  | 14%  |
| Don't know                                                                              | -    | -    | -    | -    | 3%   | -    |
| Base: Respondents who previously participated in BER and/or another ENS program         |      |      |      |      |      |      |
| *Wording change in 2024                                                                 |      |      |      |      |      |      |

- E3. Do you agree or disagree that because of your company/organization's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative asked a contractor or a technical staff member to examine the energy efficiency options for your facility? \*

| Previous BER and/or ENS Program Participation Led to Ask About Energy Efficiency Options | 2018 | 2019 | 2020 | 2021 | 2022 | 2024   |
|------------------------------------------------------------------------------------------|------|------|------|------|------|--------|
| Sample Size                                                                              | 29   | 37   | 35   | 29   | 34   | 15 (#) |
| Agree                                                                                    | 69%  | 78%  | 74%  | 72%  | 85%  | 9      |
| Disagree                                                                                 | 24%  | 22%  | 20%  | 17%  | 15%  | 6      |
| Don't know/Refused                                                                       | 6%   | -    | 6%   | 10%  | -    | -      |
| Base: Respondents who previously participated in BER or another ENS program or both.     |      |      |      |      |      |        |
| *Wording change in 2024                                                                  |      |      |      |      |      |        |

- E4. Do you agree or disagree that because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative took into account the cost-effectiveness of energy-efficient <EFFICIENT PRODUCT> measures when evaluating different options for your facility? \*

| Previous BER and/or ENS Program Participation Led to Assess Cost-Effectiveness of Different Energy-Efficient Options | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|----------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                                                          | 29   | 37   | 35   | 29   | 34   | 28   |
| Agree                                                                                                                | 86%  | 89%  | 94%  | 86%  | 88%  | 93%  |
| Disagree                                                                                                             | 7%   | 11%  | 6%   | 14%  | 12%  | 7%   |
| Don't know                                                                                                           | 6%   | -    | -    | -    | -    | -    |
| Base: Respondents who previously participated in BER or another ENS program or both.                                 |      |      |      |      |      |      |
| *Wording change in 2024                                                                                              |      |      |      |      |      |      |

- E5. Before participating in the Business Energy Rebates program, had you at any time in the past already seen Efficiency Nova Scotia promotional materials or communications advertising the benefits of energy efficiency?

| Previously Seen Energy Efficiency Promotional Materials Distributed by ENS | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|----------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                | 50   | 60   | 51   | 50   | 50   | 50   |
| Yes                                                                        | 96%  | 87%  | 88%  | 88%  | 86%  | 84%  |
| No                                                                         | 2%   | 13%  | 12%  | 10%  | 14%  | 12%  |
| Don't know                                                                 | 2%   | -    | -    | 2%   | -    | 4%   |

- E6. Efficiency Nova Scotia promotional materials or communications were a major factor in the company's decision to purchase <EFFICIENT PRODUCT>\*.

| ENS Energy Efficiency Promotional Materials Was a Major Factor in Purchase Decision | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|-------------------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                         | 48   | 52   | 45   | 44   | 43   | 42   |
| Agree                                                                               | 67%  | 62%  | 69%  | 61%  | 58%  | 57%  |
| Disagree                                                                            | 33%  | 38%  | 31%  | 39%  | 42%  | 40%  |
| Don't know                                                                          | -    | -    | -    | -    | -    | 2%   |
| Base: Respondents who previously saw ENS energy-efficiency promotional materials    |      |      |      |      |      |      |
| *Slight wording change in 2022                                                      |      |      |      |      |      |      |

- E7. Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to ask a contractor or a distributor about efficient lighting options for your organization? \*

| ENS Energy Efficiency Promotional Materials Led to Ask About Products            | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|----------------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                      | 48   | 52   | 45   | 44   | 43   | 23   |
| Agree                                                                            | 63%  | 62%  | 69%  | 61%  | 65%  | 39%  |
| Disagree                                                                         | 35%  | 37%  | 31%  | 36%  | 30%  | 43%  |
| Don't know                                                                       | 2%   | 2%   | -    | 2%   | 5%   | 17%  |
| Base: Respondents who previously saw ENS energy-efficiency promotional materials |      |      |      |      |      |      |
| *Slight wording change in 2022 and 2024                                          |      |      |      |      |      |      |



- E8. Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to take into account the cost-effectiveness of <EFFICIENT PRODUCT> when evaluating different options for the facility? \*

| ENS Energy Efficiency Promotional Materials Led to Assess Product Cost-Effectiveness | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 |
|--------------------------------------------------------------------------------------|------|------|------|------|------|------|
| Sample Size                                                                          | 48   | 52   | 45   | 44   | 43   | 42   |
| Agree                                                                                | 81%  | 77%  | 71%  | 66%  | 63%  | 76%  |
| Disagree                                                                             | 19%  | 23%  | 29%  | 32%  | 37%  | 21%  |
| Don't know                                                                           | -    | -    | -    | 2%   | -    | 2%   |
| Base: Respondents who previously saw ENS energy-efficiency promotional materials     |      |      |      |      |      |      |
| *Slight wording change in 2022 and 2024                                              |      |      |      |      |      |      |

- F1. Over the last year, have you made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor?

| 2024              |        |
|-------------------|--------|
| Sample Size       | 19 (#) |
| Yes               | 17     |
| No                | 2      |
| Base: Contractors |        |

- F2. Thinking about all the lighting projects this year where you purchased lighting for customers that received rebates, what proportion of the projects were for:

New construction: 38.5%

Replacement of existing fixtures or lamps: 61.5%

| Proportion of Projects That Involved Purchasing Lighting for Customers That Received Rebates: New Construction                                       | 2024   |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Sample Size                                                                                                                                          | 17 (#) |
| 0                                                                                                                                                    | 2      |
| 10                                                                                                                                                   | 1      |
| 20                                                                                                                                                   | 1      |
| 25                                                                                                                                                   | 3      |
| 30                                                                                                                                                   | 1      |
| 50                                                                                                                                                   | 7      |
| 70                                                                                                                                                   | 1      |
| 100                                                                                                                                                  | 1      |
| Base: Contractors who made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor over the last year |        |

| Proportion of Projects That Involved Purchasing Lighting for Customers That Received Rebates: Replacement of Existing Fixtures or Lamps              |  | 2024   |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------|
| Sample Size                                                                                                                                          |  | 17 (#) |
| 0                                                                                                                                                    |  | 1      |
| 30                                                                                                                                                   |  | 1      |
| 50                                                                                                                                                   |  | 7      |
| 70                                                                                                                                                   |  | 1      |
| 75                                                                                                                                                   |  | 3      |
| 80                                                                                                                                                   |  | 1      |
| 90                                                                                                                                                   |  | 1      |
| 100                                                                                                                                                  |  | 2      |
| Base: Contractors who made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor over the last year |  |        |

F3. And, of those lighting projects that were for replacement of existing lamps or fixtures, what proportion of the existing lamps or fixtures were:

Working but at the end of their useful life: 41.4%

Working and not close to the end of their useful life: 28.8%

Broken: 29.8%

| Proportion of Existing Lamps or Fixtures Were: Working but at the End of Their Useful Life                                                           |  | 2024   |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------|
| Sample Size                                                                                                                                          |  | 16 (#) |
| 0                                                                                                                                                    |  | 1      |
| 5                                                                                                                                                    |  | 1      |
| 10                                                                                                                                                   |  | 1      |
| 20                                                                                                                                                   |  | 1      |
| 30                                                                                                                                                   |  | 1      |
| 33                                                                                                                                                   |  | 1      |
| 34                                                                                                                                                   |  | 1      |
| 40                                                                                                                                                   |  | 1      |
| 50                                                                                                                                                   |  | 5      |
| 60                                                                                                                                                   |  | 1      |
| 80                                                                                                                                                   |  | 1      |
| 100                                                                                                                                                  |  | 1      |
| Base: Contractors who made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor over the last year |  |        |

| Proportion of Existing Lamps or Fixtures Were: Working and Not Close to the End of Their Useful Life                                                 |  | 2024   |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------|
| Sample Size                                                                                                                                          |  | 16 (#) |
| 0                                                                                                                                                    |  | 4      |
| 5                                                                                                                                                    |  | 1      |
| 10                                                                                                                                                   |  | 1      |
| 20                                                                                                                                                   |  | 1      |
| 30                                                                                                                                                   |  | 1      |
| 33                                                                                                                                                   |  | 2      |
| 40                                                                                                                                                   |  | 1      |
| 50                                                                                                                                                   |  | 3      |
| 70                                                                                                                                                   |  | 2      |
| Base: Contractors who made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor over the last year |  |        |

| Proportion of Existing Lamps or Fixtures Were: Broken                                                                                                |  | 2024   |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------|
| Sample Size                                                                                                                                          |  | 16 (#) |
| 0                                                                                                                                                    |  | 3      |
| 10                                                                                                                                                   |  | 2      |
| 20                                                                                                                                                   |  | 4      |
| 30                                                                                                                                                   |  | 1      |
| 33                                                                                                                                                   |  | 1      |
| 34                                                                                                                                                   |  | 1      |
| 40                                                                                                                                                   |  | 1      |
| 60                                                                                                                                                   |  | 1      |
| 90                                                                                                                                                   |  | 2      |
| Base: Contractors who made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor over the last year |  |        |

F4. Do you have customers who have been less likely or slower to adopt LED lighting than others?

| Have Customers Who Are Less Likely/Slower to Adopt LED Lighting |  | 2024   |
|-----------------------------------------------------------------|--|--------|
| Sample Size                                                     |  | 19 (#) |
| Yes                                                             |  | 7      |
| No                                                              |  | 10     |
| Don't know                                                      |  | 1      |
| Refused                                                         |  | 1      |
| Base: Contractors                                               |  |        |

F5. Why do you think these customers are less likely or slower to adopt LED lighting?

| Reasons Why Customers Are Less Likely/Slower to Adopt LED Lighting                             |  | 2024  |
|------------------------------------------------------------------------------------------------|--|-------|
| Sample Size                                                                                    |  | 7 (#) |
| Lack of knowledge of facility staff of LED products                                            |  | 3     |
| Cost – less willing or able to pay for LED products                                            |  | 3     |
| Lack of awareness of facility staff of LED products                                            |  | 1     |
| Others                                                                                         |  | 2     |
| Don't know                                                                                     |  | 1     |
| Base: Contractors who have customers who have been less likely or slower to adopt LED lighting |  |       |

F6. In your experience, which facility or building types still have the most potential to adopt LED lighting?

| Facility/Building Types That Have the Most Potential to Adopt LED Lighting |  | 2024   |
|----------------------------------------------------------------------------|--|--------|
| Sample Size                                                                |  | 16 (#) |
| Office                                                                     |  | 10     |
| Manufacturing                                                              |  | 4      |
| Mercantile – Retail (Other than mall)                                      |  | 3      |
| Mercantile – Retail (Enclosed and Strip malls)                             |  | 3      |
| Garages/Residential garages                                                |  | 2      |
| Food sales (grocery)                                                       |  | 2      |
| Warehouse/storage                                                          |  | 1      |
| Don't know                                                                 |  | 1      |
| Base: Contractors                                                          |  |        |
| ° Note: Three contractor respondents did not receive this question         |  |        |

G1. On a scale of 1 to 10, where 1 is 'Not at all Satisfied' and 10 is 'Completely Satisfied,' how was your organization's experience with each of the following aspects of the Business Energy Rebates Program? If your organization did not have experience with one of these aspects please tell me.

| Satisfaction with Aspects of BER                                                                                            | 2019        |      | 2020        |      | 2021        |      | 2022        |      | 2024        |      |
|-----------------------------------------------------------------------------------------------------------------------------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|
|                                                                                                                             | Sample Size | Mean | Sample Size | Mean | Sample Size | Mean | Sample Size | Mean | Sample Size | Mean |
| Rebate amounts                                                                                                              | 58          | 8.3  | 51          | 7.9  | 49          | 8.9  | 50          | 8.8  | 47          | 9.0  |
| Interaction and communication with distributors                                                                             | 56          | 9.0  | 48          | 8.4  | 48          | 9.2  | 48          | 8.8  | 46          | 9.0  |
| Eligible products                                                                                                           | 58°         | 7.9° | 48          | 7.3  | 47          | 8.6  | 49          | 8.3  | 46          | 8.3  |
| ° Note: correction in 2019 mean calculation and sample size<br>Don't know/Refused/Not applicable excluded from calculations |             |      |             |      |             |      |             |      |             |      |

G2. G2A. Why were you not more satisfied with the interaction and communication with contractors or distributors?

| Most Important Reason for Not Being More Satisfied with Interaction and Communication with Contractors or Distributors             | 2019  | 2020   | 2021  | 2022  | 2024  |
|------------------------------------------------------------------------------------------------------------------------------------|-------|--------|-------|-------|-------|
| Sample Size                                                                                                                        | 4 (#) | 13 (#) | 5 (#) | 7 (#) | 5 (#) |
| Lack of communication/availability of distributor                                                                                  | 2     | 4      | -     | 2     | 2     |
| Took too long/Communication was slow                                                                                               | -     | 1      | 1     | 1     | 1     |
| Lack of knowledge / less knowledgeable about the program                                                                           | 1     | 3      | -     | -     | 1     |
| Limited to the product that's available                                                                                            | -     | -      | 1     | 2     | -     |
| Rebate can be more than the cost                                                                                                   | -     | -      | 1     | -     | -     |
| Always room for improvement                                                                                                        | -     | -      | 1     | -     | -     |
| Have to give specific address for products                                                                                         | -     | 1      | -     | -     | -     |
| Others                                                                                                                             | 1     | 1      | -     | 1     | 1     |
| Don't know                                                                                                                         | -     | 3      | 1     | 2     | 1     |
| Base: Respondents dissatisfied with the interaction and communication with contractors or distributors, G3A<8<br>Multiple Response |       |        |       |       |       |

G2B. Why were you not more satisfied with the rebate amounts?

| Most Important Reason for Not Being More Satisfied with Rebate Amounts            | 2019   | 2020   | 2021   | 2022  | 2024  |
|-----------------------------------------------------------------------------------|--------|--------|--------|-------|-------|
| Sample Size                                                                       | 12 (#) | 17 (#) | 10 (#) | 8 (#) | 6 (#) |
| Rebate is too small/Expected higher rebate                                        | 9      | 6      | 6      | 3     | 5     |
| Rebate sometimes higher than the cost of the lights                               | -      | -      | 1      | -     | -     |
| Some measures don't have a rebate                                                 | -      | 4      | -      | 2     | 1     |
| Rebate amounts not consistent/kept changing                                       | 1      | -      | 1      | 3     | -     |
| Cost of measures was expensive                                                    | -      | 1      | -      | 1     | -     |
| Rebate should be based on quality/output of product                               | -      | -      | 1      | -     | -     |
| Lack of information on the amount/structure of the rebate                         | -      | 2      | -      | -     | -     |
| Not informed about all of the rebates available                                   | 1      | -      | -      | -     | -     |
| Cost of measures was expensive                                                    | 1      | -      | -      | -     | -     |
| Others                                                                            | 1      | 1      | 1      | 2     | -     |
| Don't know                                                                        | -      | 4      | -      | -     | -     |
| Base: Respondents dissatisfied with the rebate amount, G3B<8<br>Multiple Response |        |        |        |       |       |

G2C. Were there other types of efficient equipment or services you would like to see Efficiency Nova Scotia provide rebates for?

| Other Equipment or Services Wished Rebated by ENS                                 | 2019 | 2020 | 2021   | 2022   | 2024   |
|-----------------------------------------------------------------------------------|------|------|--------|--------|--------|
| Sample Size                                                                       | 20   | 22   | 13 (#) | 13 (#) | 12 (#) |
| More lighting                                                                     | 15%  | 18%  | 4      | 1      | 5      |
| Heating equipment                                                                 | 5%   | 5%   | -      | 1      | 2      |
| Heat pumps/Geothermal heat pumps                                                  | 5%   | 5%   | -      | -      | 1      |
| Solar equipment                                                                   | 10%  | -    | -      | -      | -      |
| More residential equipment/services                                               | 5%   | -    | -      | -      | -      |
| Energy storage                                                                    | 5%   | -    | -      | -      | -      |
| Appliances                                                                        | 5%   | -    | -      | -      | -      |
| Insulation                                                                        | 5%   | -    | -      | -      | -      |
| Others                                                                            | -    | -    | 2      | 1      | -      |
| No other equipment or services                                                    | 40%  | 73%  | 7      | 8      | 1      |
| Don't know                                                                        | 20%  | -    | -      | 2      | 3      |
| Base: Respondents dissatisfied with eligible products, G3B<8<br>Multiple Response |      |      |        |        |        |

G3. Using a scale from 1 to 10 where 1 is 'Not at all Satisfied' and 10 is 'Completely Satisfied', how would you rate your satisfaction with the Business Energy Rebates – Instant Rebates program overall? \*

| Satisfaction with BER Overall                                                                 | 2019        |      | 2020        |      | 2021        |      | 2022        |      | 2024        |      |
|-----------------------------------------------------------------------------------------------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|
|                                                                                               | Sample Size | Mean | Sample Size | Mean | Sample Size | Mean | Sample Size | Mean | Sample Size | Mean |
| Overall Satisfaction                                                                          | 60          | 8.8  | 51          | 8.6  | 49          | 8.9  | 50          | 8.8  | 49          | 9.1  |
| Base: Don't know/Refused/Not applicable excluded from calculations<br>*Wording change in 2024 |             |      |             |      |             |      |             |      |             |      |

G4. What was the most important reason you were not more satisfied with the program overall? Any other reasons?

| Most Important Reason Not More Satisfied with BER Overall       | 2019         | 2020          | 2021         | 2022         | 2024         |
|-----------------------------------------------------------------|--------------|---------------|--------------|--------------|--------------|
| <b>Sample Size</b>                                              | <b>7 (#)</b> | <b>12 (#)</b> | <b>5 (#)</b> | <b>7 (#)</b> | <b>2 (#)</b> |
| Don't like the products rebated                                 | -            | -             | -            | 1            | 1            |
| Too many changes/Rebates not consistent                         | -            | 2             | -            | -            | 1            |
| Lack of knowledge on the program/how things work                | -            | 4             | -            | 2            | -            |
| Too much paperwork                                              | 2            | -             | -            | 1            | -            |
| Don't like the mail-in rebates/Prefer the instant rebates       | -            | 2             | 1            | -            | -            |
| Rebate/incentive is too small                                   | 3            | 1             | 1            | -            | -            |
| Delays with suppliers/distributors                              | -            | 1             | -            | -            | -            |
| Have to give a specific address where the products will be used | -            | 1             | -            | -            | -            |
| Others                                                          | 2            | 1             | 2            | 3            | -            |
| Don't know                                                      | -            | -             | 2            | -            | 1            |
| Base: Respondents dissatisfied with BER program overall (F1<8)  |              |               |              |              |              |
| Multiple response                                               |              |               |              |              |              |

G5. Do you have any suggestions on how to improve the Business Energy Rebates – Instant Rebates program? Anything else? \*

| Suggestions to Improve BER                                          | 2019      | 2020      | 2021      | 2022      | 2024       |
|---------------------------------------------------------------------|-----------|-----------|-----------|-----------|------------|
| <b>Sample Size</b>                                                  | <b>60</b> | <b>51</b> | <b>50</b> | <b>50</b> | <b>50</b>  |
| Increase the rebate/Rebate is too small                             | -         | 8%        | -         | 6%        | <b>10%</b> |
| Simplify the program/Less paperwork                                 | 2%        | -         | -         | 2%        | 8%         |
| More instant rebates/Prefer instant rebates over mail-in            | -         | 2%        | -         | -         | 8%         |
| Better marketing/awareness                                          | 3%        | -         | 8%        | 10%       | 6%         |
| Offer more measures rebated/eligible for rebates                    | 7%        | 4%        | 4%        | 4%        | 6%         |
| ENS staff should be easier to contact/Improve communication         | 2%        | -         | 2%        | -         | 2%         |
| More information on measures available for rebates                  | 5%        | 6%        | 2%        | 4%        | -          |
| Keep it going/Extend the program                                    | -         | -         | -         | 4%        | -          |
| More consistency in measures available for rebates/Too many changes | -         | 6%        | 2%        | 2%        | -          |
| Rebates should be paid back quicker                                 | -         | -         | 2%        | -         | -          |
| Others                                                              | 5%        | 8%        | 8%        | 8%        | 8%         |
| No recommendation                                                   | 78%       | 71%       | 72%       | 74%       | 66%        |
| *Wording change in 2024                                             |           |           |           |           |            |

## APPENDIX III

### BER Instant Rebates Interview Guide with Distributors

## BUSINESS ENERGY REBATES

### INSTANT REBATES PARTICIPANT SURVEY

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                                                           |
|---------------------------------|---------------------------------------------------------------------------|
| Instrument Type                 | Participant Survey                                                        |
| Estimated Time to Complete      | 15 minutes                                                                |
| Target Audience                 | Business                                                                  |
| Expected Number of Completions  | 50 (17 LED linear lamps, 17 LED linear fixtures, 16 LED outdoor fixtures) |
| Contact List Source             | E1                                                                        |
| Fielding Firm                   | Narrative Research                                                        |
| Estimated Timeline for Fielding | End October – Mid November                                                |

Table 2: Research Objectives and Associated Sections

| Research Objectives                                   | Section        |
|-------------------------------------------------------|----------------|
| Participation and decision to purchase                | C1-C9          |
| Market - Types of projects in Instant Rebates         | C10-C11, F1-F4 |
| Free-ridership                                        | D              |
| Cross-influence                                       | E              |
| Market – Opportunities for LEDs in existing buildings | F5-F6          |
| Satisfaction                                          | G              |

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Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**





## Introduction

### A. INTRODUCTION A – Business with a contact name

Could I speak with <INSERT NAME>?

1. Yes [CONTINUE]
2. No [SAY “PERHAPS YOU CAN HELP ME ANYWAY.” GO TO INTRODUCTION B]

Hello, I am with Narrative Research, and we are conducting an evaluation of energy efficiency services provided by Efficiency Nova Scotia. We have a few questions about your recent experience with Efficiency Nova Scotia’s Business Energy Rebates Program through which you or your organization recently purchased rebated <EFFICIENT PRODUCT> at a participating distributor. More precisely, we are referring to the purchase of <QUANTITY SOLD> <PRODUCT BRAND> <EFFICIENT PRODUCT> made in <MONTH OF PURCHASE> through <DISTRIBUTOR>, for which you received a rebate of <REBATE AMOUNT>.

- A1. Are you the person in your organization who is most knowledgeable about the decision to purchase these <EFFICIENT PRODUCT> from <DISTRIBUTOR> in 2024?
1. Yes [GO TO A3]
  2. No [GO TO A2]
- A2. Is there someone else in your organization who would know about the decision to purchase these <EFFICIENT PRODUCT>? [PROBE IF UNSURE: This person may be an engineer, equipment contractor, or utility account manager].
1. Yes [ASK for name: \_\_\_\_\_ and telephone #: \_\_\_\_\_] [ASK TO SPEAK TO THAT PERSON AND RESTART AT INTRODUCTION. IF OTHER PERSON IS UNAVAILABLE, THANK, TERMINATE, RECORD DATA AND SCHEDULE INTERVIEW WITH BEST CONTACT]
  2. No [THANK & TERMINATE AND RECORD DATA]
- A3. Did you purchase these products for your own organization, or are you a company purchasing products for a customer or project outside of your organization? [SINGLE RESPONSE]
1. I purchased the products for my organization
  2. I purchased the products for a customer or project outside of my organization/I am a contractor
  3. Other, please specify [IF BOTH, SELECT OPTION 1]
  98. Don’t know
  99. Refused

- A4. To help Efficiency Nova Scotia improve the Business Energy Rebates program, would you have a few minutes to answer questions about your organization's participation in the program?

**(IF NEEDED:** The survey will take about 10 minutes to complete. )

**(IF NEEDED:** You may have recently been contacted by Narrative Research or by an Efficiency Nova Scotia representative about your experience with the service. This survey is different as it focuses on other aspects of your participation in the service.)

1. Yes **[CONTINUE]**
2. No **[ASK "CAN WE SCHEDULE A MORE CONVENIENT TIME FOR YOU TO CONDUCT THIS SURVEY?"] [IF NO, THANK, TERMINATE AND RECORD DATA] [IF YES, SCHEDULE CALLBACK]**

## **B. INTRODUCTION B – Business with no contact name**

Hello, I am with Narrative Research, and we are conducting an evaluation of energy efficiency services provided by Efficiency Nova Scotia. We have a few questions about your recent experience with Efficiency Nova Scotia's Business Energy Rebates Program through which you or your organization recently purchased rebated **<EFFICIENT PRODUCT>** at a participating distributor. More precisely, we are referring to the purchase of **<QUANTITY SOLD> <PRODUCT BRAND> <EFFICIENT PRODUCT>** made in **<MONTH OF PURCHASE>** through **<DISTRIBUTOR>**, for which you received a rebate of **<REBATE AMOUNT>**.

- B1. Could you help us identify the person who is most knowledgeable about the decision to purchase these products? **[PROBE IF UNSURE:** This person may be an engineer, equipment contractor, or utility account manager].
1. Yes, the person is **[RECORD NAME AND TELEPHONE NUMBER AND ASK TO SPEAK TO THIS PERSON – GO BACK TO INTRO A]**
  2. Yes, but the person is unavailable **[RECORD NAME AND TELEPHONE NUMBER. THANK AND TERMINATE; SCHEDULE CALL BACK TO SPEAK TO THAT PERSON]**
  3. No **[THANK, TERMINATE AND RECORD DATA]**

## **C. Participation and Decision to Purchase**

- C1. **[ASK IF CONTRACTOR A3=2]** Who usually makes the decision to buy **<EFFICIENT PRODUCT>** rather than standard **<STANDARD PRODUCT>**? Is it... **[READ CODE 1-2 AND 96. SINGLE RESPONSE]**.
1. You or someone else in your organization
  2. Your customer
  96. Someone else (SPECIFY: \_\_\_\_\_)
  98. (Don't know)

C2. **[ASK IF END-USER A3=1 OR C1=1]** Can you describe the main activity of your organization? **[DO NOT READ BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]**

1. (Agriculture)
2. (Banking)
3. (Education)
4. (Health Care)
5. (Hospitality)
6. (Manufacturing/Industrial)
7. (Office/Commercial)
8. (Public Service)
9. (Residential)
10. (Restaurant/Bar)
11. (Retail)
12. (Technology/Science)
13. (Warehouse / storage)
96. (Other (SPECIFY: \_\_\_\_\_))
98. (Don't know)
99. (Refused)

C3. **[ASK IF C1=2]** Before making the decision to purchase <EFFICIENT PRODUCT>, do customers usually ask for your advice? **[SINGLE RESPONSE]**

1. Yes **[GO TO C7]**
2. No **[GO TO C9]**
98. Don't Know **[GO TO C9]**
99. Refused **[GO TO C9]**

C4. **[ASK IF A3=1, C1=1 OR C3=1]** Now, I would like to understand your decision-making process for selecting LED lighting. Did you consider any alternatives to <EFFICIENT PRODUCT> before making your purchase decision? **[SINGLE RESPONSE]**

1. Yes
2. No
98. (Don't know)
99. (Refused)

- C5. **[ASK IF A3=1, C1=1 OR C3=1 AND <LINEAR LAMP>]** What lighting alternatives did you consider? **[DO NOT READ, ACCEPT MULTIPLE RESPONSES]**
1. Standard LED
  2. Incandescent lighting
  3. Fluorescent lighting
  4. Halogen lighting
  5. Other lighting (specify)
  98. (Don't know)
  99. (Refused)
- C6. **[ASK IF A3=1, C1=1 OR C3=1 AND <LINEAR OR OUTDOOR FIXTURE>]** What alternatives to LED fixtures did you consider? **[DO NOT READ, SINGLE RESPONSE]**
1. Keep existing fluorescent fixture
  2. Change for another fluorescent fixture
  3. Other (specify)
  98. (Don't know)
  99. (Refused)
- C7. **[ASK IF A3=1, C1=1 OR C3=1]** What was the SINGLE most important reason you purchased **<EFFICIENT PRODUCT>** rather than standard **<STANDARD PRODUCT>**? **[DO NOT READ. SINGLE RESPONSE.]**
1. Availability of other alternatives
  2. Energy efficiency
  3. Cost savings
  4. Lifespan
  5. Efficiency Nova Scotia program incentives
  6. Environmental cause
  7. Contractor influence
  8. Distributor influence
  96. (Other (SPECIFY: \_\_\_\_\_))
  98. (Don't know)
  99. (Refused)

- C8. **[ASK IF A3=1, C1=1 OR C3=1; DO NOT ASK IF 98 OR 99 IN C4]** What was the SECOND most important reason you purchased <EFFICIENT PRODUCT> rather than standard <STANDARD PRODUCT>? **[DO NOT READ. SINGLE RESPONSE.]**
1. Availability of other alternatives
  2. Energy efficiency
  3. Cost savings
  4. Lifespan
  5. Efficiency Nova Scotia program incentives
  6. Environmental cause
  7. Contractor influence
  8. Distributor influence
  96. (Other (SPECIFY: \_\_\_\_\_))
  97. No other reason
  98. (Don't know)
- C9. **[ASK ALL]** Did your distributor recommend <EFFICIENT PRODUCT> to you? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know)
  99. (Refused)
- C10. For what type of project did you purchase the <EFFICIENT PRODUCT>? Was it for a... **[READ. SINGLE RESPONSE]**
1. New construction
  2. Replacement of existing fixtures or lamps
  98. (Don't know)
  99. (Refused)
- C11. **[ASK IF C10=2]** In what state were the existing fixtures or lamps when you decided to purchase the <EFFICIENT PRODUCT>? Were they... **[READ. SINGLE RESPONSE]**
1. Working but at the end of their useful life
  2. Working and not close to the end of their useful life
  3. Broken
  4. **[DO NOT READ]** (Some were working, some were not working)
  96. **[DO NOT READ]** (Other (SPECIFY: \_\_\_\_\_))
  98. (Don't know)
  99. (Refused)

## D. Free-Ridership

- D1. **[ASK ALL]** Were you aware that you received a rebate when purchasing these <EFFICIENT PRODUCT>? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know)
- D2. **[ASK IF D1=2 OR 98]** Have I understood correctly that you were not aware that a rebate would be given on the product's total cost when you purchased these items? **[DO NOT READ. SINGLE RESPONSE]**
1. Yes, correct (unaware of the rebate)
  2. No, incorrect (aware of the rebate)
  98. Don't know
  99. Refused
- D3. **[ASK IF D1=1 OR D2=2]** Were you aware that the rebate was offered by Efficiency Nova Scotia? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. Don't know
- D4. **[ASK IF END-USER A3=1 AND D3=1]** How did you first become aware of the rebates available from Efficiency Nova Scotia's Business Energy Rebates Program? **[DO NOT READ. SINGLE RESPONSE]**
1. Through my contractor
  2. Through my distributor
  3. Efficiency Nova Scotia staff contacted me about the program
  4. Efficiency Nova Scotia website
  5. Efficiency Nova Scotia promotion
  6. Past experience with another Efficiency Nova Scotia program
  7. Word of mouth from other organizations/businesses/Friends/Family
  8. Online - general
  96. Other, please specify
  98. Don't know
  99. Refused

- D5. **[ASK ALL]** Had you *already* decided to purchase these **<EFFICIENT PRODUCT>** *before* talking to a distributor? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know)
  99. (Refused)
- D6. **[ASK IF AWARE (D1=1 or D2=2)]** Had you *already* decided to purchase these **<EFFICIENT PRODUCT>** *before* knowing that these efficient products were rebated? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know)
  99. (Refused)
- D7. **[ASK ALL]** Efficiency Nova Scotia offered a rebate for the purchase of efficient lighting products. If your organization had not received the rebate and the cost of **<EFFICIENT PRODUCT>** had been about **<REBATE AVERAGE VALUE BY CATEGORY>** higher per unit, what is the likelihood you would have paid the full cost of the **<EFFICIENT PRODUCT>?** **[SINGLE RESPONSE]**
1. Definitely would have
  2. Probably would have
  3. Probably would not have
  4. Definitely would not have
  98. (Don't know)
  99. (Refused)

**[ASK D8 TO D11 IF AWARE OF REBATE (D1=1 or D2=2), RANDOMIZE D8 TO D11]**

- D8. Without the BER rebate, what is the likelihood that you would have purchased the exact same model of premium lighting products? **[SINGLE RESPONSE]**
1. Definitely would have
  2. Probably would have
  3. Probably would not have
  4. Definitely would not have
  98. (Don't know)
  99. (Refused)

D9. **[ASK IF C11=2]** If the rebate had not been offered, what is the likelihood that you would have kept your existing fixtures or lamps? **[SINGLE RESPONSE]**

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have
98. (Don't know)
99. (Refused)

D10. **[ASK IF TOTAL MEASURE CATEGORY QTY>1]** Without the rebate, which of the following scenarios would have most likely occurred? **[SINGLE RESPONSE]**

You would have purchased...

1. ... exactly the same number of efficient lighting products
2. ...some, but not all of the efficient lighting products
3. You would not have purchased any efficient lighting products
98. (Don't know)
99. (Refused)

D11. **[ASK END USERS ONLY AND IF D7= 1 OR 2]** Without the program rebate, what is the likelihood that you would have postponed the purchase of the efficient lighting products by at least one year? **[SINGLE RESPONSE]**

1. Definitely would have
2. Probably would have
3. Probably would not have
4. Definitely would not have
98. (Don't know)
99. (Refused)



D12. How influential were the following four factors in your decision to purchase **<EFFICIENT PRODUCT>? [RANDOMIZE]**

| Factor (READ AND RANDOMIZE)                                                                                                             | Responses                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| a. <b>[ASK IF D1=1 OR D2=2]</b> The program rebate                                                                                      | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |
| b. <b>[ASK IF D3=1]</b> Information received from an Efficiency Nova Scotia program representative on high-efficiency lighting products | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |
| c. <b>[ASK ALL]</b> Information received from a distributor on high-efficiency lighting products                                        | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |
| d. <b>[ASK ALL]</b> Prevalence of LED products among products that met your lighting requirements                                       | 1. Very influential<br>2. Somewhat influential<br>3. Not very influential<br>4. Not at all influential<br>98. (Don't know)<br>99. (Refused) |

## E. Cross-Influence

### ASK ALL - READ AND ROTATE (E1 + E2-E4) AND (E5 + E6-E8) SEQUENCES

E1. Before participating in the Business Energy Rebates program in **<APPLICATION DATE>**, had your company/organization at any time in the past already participated in the Business Energy Rebates program or any other Efficiency Nova Scotia programs? **[SINGLE RESPONSE]**

1. Yes, in Business Energy Rebates
2. Yes, in another program(s)
3. Yes, in both Business Energy Rebates and another program(s)
4. No **[GO TO E5]**
98. (Don't know) **[GO TO E5]**
99. (Refused) **[GO TO E5]**

For the following three statements, please indicate whether you agree or disagree.

- E2. **[IF E1=1, 2 OR 3]** Do you agree or disagree that your company/ organization's previous participation in an Efficiency Nova Scotia program was a major factor in the decision to purchase **<EFFICIENT PRODUCT>?** **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E3. **[ASK IF END USER A3=1 AND E1=1, 2 OR 3]** Do you agree or disagree that because of your company/ organization's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative asked a contractor or a technical staff member to examine the energy efficiency options for your facility? **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E4. **[IF E1=1, 2 OR 3]** Do you agree or disagree that because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative took into account the cost-effectiveness of energy-efficient **<EFFICIENT CATEGORY>** measures when evaluating different options for your facility? **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E5. **[ASK ALL]** Before participating in the Business Energy Rebates program, had you at any time in the past already seen Efficiency Nova Scotia promotional materials or communications advertising the benefits of energy efficiency? **[SINGLE RESPONSE]**
1. Yes
  2. No
  98. (Don't know) **[GO TO F1]**
  99. (Refused) **[GO TO F1]**

**[READ IF E5=1]** For the following statements, please indicate whether you agree or disagree.

- 
- E6. **[IF E5=1]** Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications were a major factor in the company/organization's decision to purchase <EFFICIENT PRODUCT>? **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E7. **[IF END USER A3=1 AND IF D5=1]** Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to ask a contractor or a distributor about efficient lighting options for your organization?
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)
- E8. **[IF E5=1]** Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to take into account the cost-effectiveness of <EFFICIENT PRODUCT> when evaluating different options for the facility? **[SINGLE RESPONSE]**
1. Agree
  2. Disagree
  98. (Don't know)
  99. (Refused)

## F. Market – LED Lighting

The next series of questions are about how the market for LED lighting is evolving in Nova Scotia

- F1. **[ASK IF A3 = 2]** Over the last year, have you made other lighting purchases for customers that received Efficiency Nova Scotia rebates at the distributor?
1. Yes
  2. No
  98. (Don't know)
  99. (Refused)
- F2. **[ASK IF A3=2 and F1=1 ]** Thinking about all the lighting projects this year where you purchased lighting for customers that received rebates, what proportion of the projects were for :
- New construction \_\_\_\_\_%      Replacement of existing fixtures or lamps \_\_\_\_\_% **[TOTAL MUST EQUAL 100%]**

F3. **[ASK IF Response to F2 Replacement of existing fixtures or lamps  $\neq$  0]** And, of those lighting projects that were for replacement of existing lamps or fixtures, what proportion of the existing lamps or fixtures were:

Working but at the end of their useful life \_\_\_\_%

Working and not close to the end of their useful life \_\_\_\_%

Broken \_\_\_\_%

**[TOTAL MUST EQUAL 100%]**

98. (Don't know)

99. (Refused)

F4. **[ASK IF CONTRACTOR (A3=2)]** Do you have customers who have been less likely or slower to adopt LED lighting than others?

1. Yes

2. No

98. (Don't know)

99. (Refused)

F5. **[ASK IF CONTRACTOR A3=2 AND F4=1]** Why do you think these customers are less likely or slower to adopt LED lighting? **[DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY(IES) YOU MATCH TO THEIR RESPONSES ARE CORRECT- ACCEPT MULTIPLE RESPONSES]**

1. (Cost – less willing or able to pay for LED products)

2. (Lack of awareness of facility staff of LED products)

3. (Lack of knowledge of facility staff of LED products)

4. (Less technical applicability of LED products to their building or facility types)

96. (Other (SPECIFY: \_\_\_\_\_))

98. (Don't know)

99. (Refused)

F6. **[ASK IF CONTRACTOR A3=2]** In your experience, which facility or building types still have the most potential to adopt LED lighting? **[DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY(IES) YOU MATCH TO THEIR RESPONSES ARE CORRECT- ACCEPT MULTIPLE RESPONSES]**

1. (Education)
2. (Food Sales (grocery))
3. (Food Service (restaurant))
4. (Health Care – Inpatient)
5. (Health Care – Outpatient)
6. (Lodging)
7. (Mercantile– Retail (Enclosed and Strip Malls))
8. (Mercantile – Retail (Other than Mall))
9. (Office)
10. (Public Assembly)
11. (Public Order and Safety)
12. (Religious Worship)
13. (Service)
14. (Warehouse / storage)
15. (Manufacturing)
16. (Building is vacant)
17. (Agriculture)
96. (Other (SPECIFY: \_\_\_\_\_))
98. (Don't know)
99. (Refused)

## G. Satisfaction

G1. **[ASK ALL]** On a scale of 1 to 10, where 1 is 'not at all satisfied' and 10 is 'completely satisfied,' how was your organization's experience with each of the following aspects of the Business Energy Rebates Program? If your organization did not have experience with one of these aspects please tell me. **[DO NOT RANDOMIZE] [97 = NOT APPLICABLE, 98 = DON'T KNOW/DON'T RECALL, 99 = REFUSED]**

- a) Interaction and communication with distributors
- b) Rebate amounts
- c) Eligible products

- G2. Why were you not more satisfied with the **[READ STATEMENTS IN ORDER AS APPLICABLE]**  
**[DO NOT READ PRE-CODES. PROBE FOR SPECIFIC REASON. ACCEPT MULTIPLE RESPONSES. repeat entire question text for G2A AND G2B]**
- a. **[ASK G1A<8]** Interaction and communication with distributors
1. (Lack of communication/availability with distributors)
  2. (Less knowledgeable about the program)
  3. (Took too long/Communication was slow)
  96. (Other: \_\_\_\_\_)
  98. (Don't know)
  99. (Refused)
- b. **[ASK IF G1B<8]** Rebate amounts
1. (Rebate is too small/Expected higher rebate)
  2. (Cost of measures was expensive)
  96. (Other: \_\_\_\_\_)
  98. (Don't know)
  99. (Refused)
- c. **[ASK IF G1C<8]** Were there other types of efficient equipment or services you would have liked to see Efficiency Nova Scotia provide rebates for? **[OPEN-END RESPONSE]**
98. (Don't know)
- G3. **[ASK ALL]** Using a scale from 1 to 10 where 1 is “not at all satisfied” and 10 is “completely satisfied” how would you rate your satisfaction with the Business Energy Rebates – Instant Rebates program overall? **[RECORD NUMBER, 98=DON'T KNOW, 99 REFUSED]** **[DO NOT ACCEPT A RANGE]**
- G4. **[IF G3<8]** What was the most important reason you were not more satisfied with the Instant Rebates program overall? **[DO NOT READ. PROBE FOR SPECIFIC REASON. ACCEPT MULTIPLE RESPONSES]** Probe: Any other reasons? **[RECORD FIRST AND SUBSEQUENT MENTIONS SEPARATELY]**
1. (Too expensive)
  2. (I don't like the products rebated)
  3. (Rebate/incentive is too small)
  96. (Other (SPECIFY: \_\_\_\_\_)
  98. (Don't know)
  99. (Refused)

G5. Do you have any suggestions on how to improve the Business Energy Rebates - Instant Rebates program?

Probe: Anything else? **[DO NOT READ. ACCEPT MULTIPLE KEEPING CODE 98 AND 99 EXCLUSIVE]**

- 4. Improve communication
- 5. Simplify the program/Less paperwork
- 6. Better marketing/awareness
- 7. Increase rebates
- 8. Offer more measures eligible for rebates
- 9. No recommendations
- 96. (Other (SPECIFY: \_\_\_\_\_))
- 98. (Don't know)
- 99. (Refused)

**END.** Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

## APPENDIX IV

### BER Application Rebates Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that the parameters used to calculate service results (gross and net electrical energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 Application Rebates Corrected Tracked Savings**

| Service Result                             | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>BER Application Rebates</b>             |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 15.582              | GWh  | 15.582                  | GWh  | 0.00%               |
| Gross Peak Demand Savings at the Generator | 1.902               | MW   | 1.902                   | MW   | 0.00%               |
| Net Energy Savings at the Generator        | 11.530              | GWh  | 11.530                  | GWh  | 0.00%               |
| Net Peak Demand Savings at the Generator   | 1.407               | MW   | 1.407                   | MW   | 0.00%               |



## APPENDIX V

### BER Instant Rebates Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that the parameters used to calculate service results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 and Table 2 below present the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 Instant Rebates Corrected Tracked Savings - Lighting**

| Service Results                            | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>Instant Rebates - Lighting</b>          |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 31.777              | GWh  | 31.796                  | GWh  | 0.06%               |
| Gross Peak Demand Savings at the Generator | 4.665               | MW   | 4.960                   | MW   | 6.34%               |
| Net Energy Savings at the Generator        | 26.581              | GWh  | 26.613                  | GWh  | 0.12%               |
| Net Peak Demand Savings at the Generator   | 3.850               | MW   | 4.134                   | MW   | 7.38%               |

Tracked gross and net electrical energy savings at the generator were almost identical with less than 1% difference with the corrected values. This was due to occupancy sensor entries having inconsistent unitary energy savings and, to a lesser extent, a few entries having inconsistent interactive effects factors for energy savings and wattage baselines.

The differences between tracked and corrected peak demand savings at the generator were larger for both the gross and net values with differences of 6% and 7% respectively. These were due to many entries having either inconsistent interactive effects factors for peak demand savings, peak coincidence factors, unitary demand savings values, or net-to-gross ratios.

**Table 2: 2024 Instant Rebates Corrected Tracked Savings - Pumping**

| Program Component Results                  | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                            | Value               | Unit | Value                   | Unit | Value               |
| <b>Instant Rebates - Pumping</b>           |                     |      |                         |      |                     |
| Gross Energy Savings at the Generator      | 0.455               | GWh  | 0.455                   | GWh  | -0.09%              |
| Gross Peak Demand Savings at the Generator | 0.071               | MW   | 0.071                   | MW   | -0.09%              |
| Net Energy Savings at the Generator        | 0.455               | GWh  | 0.455                   | GWh  | -0.09%              |
| Net Peak Demand Savings at the Generator   | 0.071               | MW   | 0.071                   | MW   | -0.09%              |

Tracked and corrected electrical energy and peak demand savings at the generator were slightly different for both gross and net results.

The differences between tracked and corrected values at the generator are due to inconsistent line loss factors for both electrical energy and demand savings.



## APPENDIX VI

### BER Instant Rebates Algorithm for Free-Ridership Calculations

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Table 1 and Table 2 below present the algorithms<sup>1</sup> used to calculate the free-ridership levels for Instant Rebates measures. The algorithms are based on participant survey questions designed to assess program influence on variables such as planning, quantity, efficiency, timing, cost, and distributor influence on participant decision-making. The algorithms also incorporate distributor interview questions designed to assess the influence of the program on distributors' sales strategies. Distributor influence levels were obtained for each distributor and then applied to the free-ridership results of participants who purchased products at the given distributor.

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<sup>1</sup> As part of the 2024 evaluation, the Evaluator conducted a Net-to-gross Review and all algorithms, including BER-IR, were updated.

## BER Instant Rebates – Distributor Interview

**Table 1: Instant Rebates Distributor Influence Level Algorithm**

| 2022 Algorithm |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                 |                  | 2024 Algorithm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                |                       |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Question       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Answer                          | Score            | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Answer                                                                                                                         | Score                 |
| Influence 1    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                 |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                |                       |
| B3             | [ASK IF B1=1-6 OR 96 OR B2=2] I'd like to learn more about what influenced your organization's decisions to use these strategies to sell <EFFICIENT PRODUCT> this year. For each of the six following items, answer using a 0-10 scale, where 0 means that the item did not influence at all your organization's decisions to use these sales strategies, and 10 means that the item had a great deal of influence on your use of the sales strategies. To what extent did you use these sales strategies because of?<br>a. The incentives offered by ENS<br>b. The educational, promotional and marketing efforts and support provided or driven by ENS<br>c. The quality or great value of <EFFICIENT PRODUCT><br>d. Your organization's policies and desire to support sustainability<br>e. Your organization's interest in increasing your sales and profits | 1) Answer: ____<br>(scale 0-10) | MAX(B3a;<br>B3b) | [ASK IF B1=1-6 OR 96 OR B2=2]<br>Please indicate the influence of the following six factors on your company's decision to use the strategies we just talked about to increase your sales of <EFFICIENT PRODUCT> this year. Was [INSERT FACTOR] very, somewhat, not very, or not at all influential on your company's choice of these sales strategies?<br>a. The incentives offered by ENS<br>b. The educational, promotional and marketing efforts and support provided or driven by ENS<br>c. The quality or value of <EFFICIENT PRODUCT><br>d. Your company/organization's policies and desire to support sustainability<br>e. Your company/organization's interest in increasing your sales and profits | 1) Very influential (100%)<br>2) Somewhat influential (75%)<br>3) Not very influential (25%)<br>4) Not at all influential (0%) | MAX (B3a;<br>B3b) (%) |
|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 98/99) Don't know/Refused       | EMPTY            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 98/99) Don't know/Refused                                                                                                      |                       |
|                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Influence Score (IS1)           |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | B3 x 10%                                                                                                                       |                       |

| 2022 Algorithm        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                  |                  | 2024 Algorithm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                  |                  |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------|
| Influence 2           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                  |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                  |                  |
| B4                    | <p>[ASK IF B1=1-6 OR 96 OR B2=2] The factors we just discussed can be divided into two categories: those that relate to the BER program (the incentive, the educational, promotional and marketing efforts and support provided or driven by ENS), and those that are external to the program (the product quality, your organization's sustainability policies or your organization's desire for increased sales).</p> <p>I'd like to know the influence of each of those categories on your organization's decision to use the sales strategies we discussed earlier. In percentage points, out of 100% in total, what would be the influence of the program-related factors versus the influence of the non-program-related factors on your organization's decision to use these sales strategies? In other words, what is more or less likely to explain why you use these strategies? [MAKE SURE THAT B4a+B4b=100%]</p> | a) Points awarded to program factors: _____%     | B4a = Answer (%) | <p>[ASK IF B1=1-6 OR 96 OR B2=2] The factors we just discussed can be divided into two categories: those that relate to the BER program (the incentive, the educational, promotional and marketing efforts and support provided or driven by ENS), and those that are external to the program (the product quality, your organization's sustainability policies or your organization's desire for increased sales).</p> <p>I'd like to know the influence of each of those categories on your organization's decision to use the sales strategies we discussed earlier. In percentage points, out of 100% in total, what would be the influence of the program-related factors versus the influence of the non-program-related factors on your organization's decision to use these sales strategies? In other words, what is more or less likely to explain why you used these strategies? [MAKE SURE THAT B4a+B4b=100%]</p> | a) Points awarded to program factors: _____%     | B4a = Answer (%) |
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | b) Points awarded to non-program factors: _____% | EMPTY            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | b) Points awarded to non-program factors: _____% | EMPTY            |
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 98/99) Don't know/Refused                        | EMPTY            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 98/99) Don't know/Refused                        | EMPTY            |
| Influence Score (IS2) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                  | B4a              | Influence Score (IS2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                  | B4a              |

| 2022 Algorithm                                                                                                                                             |                                                                                                                                                                                                                                                                                                 |                                                  |                                        | 2024 Algorithm                                                                                                                                           |                                                                                                                                                                                                                               |                                                                                                                                                                                                                                              |                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Influence 3                                                                                                                                                |                                                                                                                                                                                                                                                                                                 |                                                  |                                        |                                                                                                                                                          |                                                                                                                                                                                                                               |                                                                                                                                                                                                                                              |                         |
| B5                                                                                                                                                         | [ASK IF B1=1-6 OR 96. DO NOT ASK IF B4=0%] Using a scale from 0 to 10, where 0 is “Not at all likely” and 10 is “Extremely likely”, if the BER program had not been available this year, what is the likelihood that you would have used the same sales strategies to sell <EFFICIENT PRODUCT>? |                                                  | 1) Answer: ____<br>(scale 0-10)        | B5 = Answer                                                                                                                                              | [ASK IF B1=1-6 OR 96. DO NOT ASK IF B4a=0%] If the BER program had not been available this year, what is the likelihood that you would have used the same sales strategies as you used this year to sell <EFFICIENT PRODUCT>? | 1) Definitely would have used the same strategies (0%)<br>2) Probably would have used the same strategies (25%)<br>3) Probably would not have used the same strategies (75%)<br>4) Definitely would not have used the same strategies (100%) | Answer (%)              |
|                                                                                                                                                            |                                                                                                                                                                                                                                                                                                 |                                                  | 98/99) Don't know/Refused              | EMPTY                                                                                                                                                    |                                                                                                                                                                                                                               | 98/99) Don't know/Refused                                                                                                                                                                                                                    | EMPTY                   |
|                                                                                                                                                            |                                                                                                                                                                                                                                                                                                 |                                                  | Influence Score 3 (IS3)                |                                                                                                                                                          |                                                                                                                                                                                                                               | (10–B5) x 10%                                                                                                                                                                                                                                | Influence Score 3 (IS3) |
| Inconsistency Test                                                                                                                                         |                                                                                                                                                                                                                                                                                                 | IF IS3>70% & IS1<30% OR<br>IF IS3<30% & IS1>70%: | IS3 = MEAN (IS1; IS3) &<br>IS1 = EMPTY | IF IS3≥75% & IS1≤25% OR<br>IF IS3≤25% & IS1≥75%                                                                                                          |                                                                                                                                                                                                                               | IS3 = MEAN (IS1; IS3) &<br>IS1 = EMPTY                                                                                                                                                                                                       |                         |
| Inconsistency Test                                                                                                                                         |                                                                                                                                                                                                                                                                                                 | IF IS2>70% & IS1<30% OR<br>IF IS2<30% & IS1>70%: | IS2 = MEAN (IS1; IS2) &<br>IS1 = EMPTY | IF IS2≥75% & IS1≤25% OR<br>IF IS2≤25% & IS1≥75%:                                                                                                         |                                                                                                                                                                                                                               | IS2 = MEAN (IS1; IS2) &<br>IS1 = EMPTY                                                                                                                                                                                                       |                         |
| Distributor Influence Level: IF B2 = 1 OR IF MEAN (IS1; IS2; IS3) = 100%:<br>Dist Influence = EMPTY<br>OTHERWISE:<br>Dist Influence = MEAN (IS1; IS2; IS3) |                                                                                                                                                                                                                                                                                                 |                                                  |                                        | Distributor Influence Level: IF B2 = 1 OR IF MEAN (IS1; IS2; IS3) = 0%:<br>Dist Influence = EMPTY<br>OTHERWISE:<br>Dist Influence = MEAN (IS1; IS2; IS3) |                                                                                                                                                                                                                               |                                                                                                                                                                                                                                              |                         |

## BER Instant Rebates – Participant Survey

**Table 2: Instant Rebates Participant and Overall Free-ridership Algorithm**

| 2022 Algorithm                                                 |                                                                                                                                                                                                                                                                                                          |                               |              | 2024 Algorithm                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                          |                       |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Question                                                       |                                                                                                                                                                                                                                                                                                          | Answer                        | Score        | Question                                                                                                                                                                                                                                                                                                                                        | Answer                                                                                                                                   | Score                 |
| INTENTION                                                      |                                                                                                                                                                                                                                                                                                          |                               |              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |                       |
| Cost                                                           |                                                                                                                                                                                                                                                                                                          |                               |              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |                       |
| D7                                                             | Efficiency Nova Scotia offered a rebate for the purchase of efficient lighting products. If your organization had not received the rebate and the cost for <EFFICIENT PRODUCT> had been about \$[REBATE AVERAGE VALUE BY CATEGORY] higher, would you have paid the full cost of the <EFFICIENT PRODUCT>? | 1) Answer: ____ (scale 0-10)  | Answer x 10% | Efficiency Nova Scotia offered a rebate for the purchase of efficient lighting products. If your company/organization had not received the rebate and the cost of <EFFICIENT PRODUCT> had been about \$<REBATE AVERAGE VALUE BY CATEGORY> higher per unit, what is the likelihood you would have paid the full cost of the <EFFICIENT PRODUCT>? | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%)            |
|                                                                |                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused     | EMPTY        |                                                                                                                                                                                                                                                                                                                                                 | 98/99) Don't know/Refused                                                                                                                |                       |
|                                                                |                                                                                                                                                                                                                                                                                                          |                               |              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |                       |
| Efficiency                                                     |                                                                                                                                                                                                                                                                                                          |                               |              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |                       |
| D8                                                             | If BER rebate had not been offered, what is the likelihood that you would have purchased the exact same model of premium lighting products?                                                                                                                                                              | 1) Answer: ____ (scale 0-10)  | Answer x 10% | Without the BER rebate, what is the likelihood that you would have purchased the exact same model of premium lighting products?                                                                                                                                                                                                                 | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%)            |
|                                                                |                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused     | EMPTY        |                                                                                                                                                                                                                                                                                                                                                 | 98/99) Don't know/Refused                                                                                                                |                       |
|                                                                |                                                                                                                                                                                                                                                                                                          | Cost + Efficiency Score (PA1) |              |                                                                                                                                                                                                                                                                                                                                                 | MEAN (D7; D8)                                                                                                                            | Efficiency Score (ηS) |
| Inconsistency Test<br>IF ABS (D7 – D8) ≥ 50%: CS= MIN (D7; D8) |                                                                                                                                                                                                                                                                                                          |                               |              | Inconsistency Test<br>IF ABS (D7 – D8) ≥ 75%: CS= MIN (D7; D8)                                                                                                                                                                                                                                                                                  |                                                                                                                                          |                       |

| 2022 Algorithm       |                                                                                                                                                                                                |                               |              | 2024 Algorithm                                                                                                                                                          |                                                                                                                                                                                                                                                |            |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Question             |                                                                                                                                                                                                | Answer                        | Score        | Question                                                                                                                                                                | Answer                                                                                                                                                                                                                                         | Score      |
| Planning             |                                                                                                                                                                                                |                               |              |                                                                                                                                                                         |                                                                                                                                                                                                                                                |            |
| D1                   | Were you aware that you received a rebate when purchasing these <EFFICIENT PRODUCT>?                                                                                                           | 1) Yes                        |              | Were you aware that you received a rebate when purchasing these <EFFICIENT PRODUCT>?                                                                                    | 1) Yes                                                                                                                                                                                                                                         |            |
|                      |                                                                                                                                                                                                | 2) No                         |              |                                                                                                                                                                         | 2) No                                                                                                                                                                                                                                          |            |
|                      |                                                                                                                                                                                                | 98/99) Don't know/Refused     |              |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      |            |
| D2                   | [ASK IF D1=2 OR 98] I want to make sure I understand. When you purchased these <EFFICIENT PRODUCT>, you were not aware that a rebate would be given to reduce the product's total cost?        | 1) Yes, unaware of the rebate |              | [ASK IF D1=2 OR 98] Have I understood correctly that you were <u>not</u> aware that a rebate would be given on the product's total cost when you purchased these items? | 1) Yes, correct (unaware of the rebate)                                                                                                                                                                                                        | 100%       |
|                      |                                                                                                                                                                                                | 2) No, aware of the rebate    |              |                                                                                                                                                                         | 2) No, incorrect (aware of the rebate)                                                                                                                                                                                                         | EMPTY      |
|                      |                                                                                                                                                                                                | 98/99) Don't know/Refused     |              |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      | EMPTY      |
| D6                   | [ASK IF AWARE (D1=1 or D2=2)] Had you already decided to purchase these <EFFICIENT PRODUCT> before knowing that these products were rebated?                                                   | 1) Yes                        | 100%         | [ASK IF AWARE (D1=1 or D2=2)] Had you already decided to purchase these <EFFICIENT PRODUCT> before knowing that these efficient products were rebated?                  | 1) Yes                                                                                                                                                                                                                                         | 100%       |
|                      |                                                                                                                                                                                                | 2) No                         | 0%           |                                                                                                                                                                         | 2) No                                                                                                                                                                                                                                          | 0%         |
|                      |                                                                                                                                                                                                | 98/99) Don't know/Refused     |              |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      |            |
| Planning Score (PA2) |                                                                                                                                                                                                |                               | D6           | Planning Score (PS)                                                                                                                                                     |                                                                                                                                                                                                                                                | D6         |
| Quantity             |                                                                                                                                                                                                |                               |              |                                                                                                                                                                         |                                                                                                                                                                                                                                                |            |
| D10                  | [ASK IF TOTAL MEASURE CATEGORY QTY>1] If the rebate had not been offered, what is the likelihood that you would have purchased exactly the same quantity of lighting products that you bought? | 1) Answer: ____ (scale 0-10)  | Answer x 10% | [ASK IF TOTAL MEASURE CATEGORY QTY>1] Without the rebate, which of the following scenarios would have most likely occurred?                                             | You would have purchased...<br>1) ...exactly the same number of efficient lighting products (100%)<br>2) ...some, but not all of the efficient lighting products (50%)<br>3) You would not have purchased any efficient lighting products (0%) | Answer (%) |
|                      |                                                                                                                                                                                                | 98/99) Don't know/Refused     | EMPTY        |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      | EMPTY      |



| 2022 Algorithm |                                                                                                                                                                            |                                 |                     | 2024 Algorithm                                                                                                                                                                                |                                                                                                                                          |            |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Question       |                                                                                                                                                                            | Answer                          | Score               | Question                                                                                                                                                                                      | Answer                                                                                                                                   | Score      |
|                | Quantity Score (QS)                                                                                                                                                        |                                 | D10                 |                                                                                                                                                                                               | Quantity Score (QS)                                                                                                                      | D10        |
| Timing         |                                                                                                                                                                            |                                 |                     |                                                                                                                                                                                               |                                                                                                                                          |            |
| D11            | [ASK IF D7≥5] If the program rebate had not been offered, what is the likelihood that you would have postponed the purchase of the lighting products by at least one year? | 1) Answer: ____<br>(scale 0-10) | (10 – Answer) x 10% | [ASK END USERS ONLY AND IF D7=1 OR 2] Without the program rebate, what is the likelihood that you would have postponed the purchase of the efficient lighting products by at least one year?  | 1) Definitely would have (0%)<br>2) Probably would have (25%)<br>3) Probably would not have (75%)<br>4) Definitely would not have (100%) | Answer (%) |
|                |                                                                                                                                                                            | 98/99) Don't know/Refused       | EMPTY               |                                                                                                                                                                                               | 98/99) Don't know/Refused<br>[CONTRACTORS]                                                                                               | EMPTY      |
|                | Timing Score (TS)                                                                                                                                                          |                                 | D11                 |                                                                                                                                                                                               | Timing Score (TS)                                                                                                                        | D11        |
|                | Inconsistency Test<br>IF D6 = 100% AND D7 < 70%: PS = EMPTY                                                                                                                |                                 |                     | Inconsistency Test:<br>IF D6 = 100% AND D7 < 60%: PS = EMPTY                                                                                                                                  |                                                                                                                                          |            |
|                |                                                                                                                                                                            |                                 |                     | INTENTION SCORE: MIN [MEAN (PS; CS); MEAN (PS; CS; ηS); MEAN (PS; CS; TS); MEAN (PS; CS; QS); MEAN (PS; CS; ηS; TS); MEAN (PS; CS; ηS; QS); MEAN (PS; CS; TS; QS); MEAN (PS; CS; ηS; TS; QS)] |                                                                                                                                          |            |

| 2022 Algorithm                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              |                                                                                                                                         | 2024 Algorithm                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                |                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Question                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Answer                                       | Score                                                                                                                                   | Question                                                                                                                                                                                                                                                                                                                                                                                                                               | Answer                                                                                                                         | Score                                                                                                                                        |
| INFLUENCE                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                |                                                                                                                                              |
| D5                                                                                                                                | Had you already decided to purchase these <EFFICIENT PRODUCT> before talking to a distributor?                                                                                                                                                                                                                                                                                                                                                                          | 1) Yes                                       |                                                                                                                                         | Had you already decided to purchase these <EFFICIENT PRODUCT> before talking to a distributor?                                                                                                                                                                                                                                                                                                                                         | 1) Yes                                                                                                                         | Question used for scoring in D12                                                                                                             |
|                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2) No                                        |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2) No                                                                                                                          |                                                                                                                                              |
|                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                    |                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                        | 98/99) Don't know/Refused                                                                                                      |                                                                                                                                              |
| D12                                                                                                                               | Using a scale from 0 to 10, please rate the influence of each of the following in your organization's decision to purchase <EFFICIENT PRODUCT><br>a) [ASK IF D1=1 OR D2=2] The program rebate<br>b) Information received from an ENS program representative on high efficiency lighting products<br>c) Information received from a distributor on high-efficiency lighting products<br>d) Prevalence of LED products among products that met your lighting requirements | 1) Answer: ____ (scale 0-10)                 | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c<7 & D12d<7:<br>D12 = MAX(D12a; D12b)<br>OTHERWISE<br>D12 = MAX(D12a; D12b; D12c; D12d) | How influential were the following four factors in your decision to purchase <EFFICIENT PRODUCT>? [RANDOMIZE]<br>a) [ASK IF D1=1 OR D2=2] The program rebate<br>b) Information received from an ENS program representative on high efficiency lighting products<br>c) Information received from a distributor on high-efficiency lighting products<br>d) Prevalence of LED products among products that met your lighting requirements | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%) | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c≥75% & D12d≥75%:<br>D12 = MIN(D12a; D12b)<br>OTHERWISE:<br>D12 = MIN(D12a; D12b; D12c; D12d) |
|                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 97/98/99) Not applicable/ Don't know/Refused |                                                                                                                                         | 97/98/99) Not applicable/ Don't know/Refused                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                |                                                                                                                                              |
| Influence Score (IS)                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              | (10–D12) x 10%                                                                                                                          | INFLUENCE Score (IS)                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                | D12                                                                                                                                          |
| Participant Free-Ridership (FR): MIN (MEAN (CS; PS; IS); MEAN (CS; PS; IS; QS); MEAN (CS; PS; IS; QS; TS); MEAN (CS; PS; IS; TS)) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              |                                                                                                                                         | Participant Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                |                                                                                                                                              |

| 2022 Algorithm         |                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                     |       | 2024 Algorithm                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                     |       |  |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--|
| Question               |                                                                                                                                                                                                                                                                                                   | Answer                                                                                                                                                                              | Score | Question                                                                                                                                                                                                                                                                                                                                                   | Answer                                                                                                                                                                              | Score |  |
| <b>Cross-Influence</b> |                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                     |       |                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                     |       |  |
| E1                     | Before participating in the Business Energy Rebates program in <APPLICATION DATE>, had your organization at any time in the past already participated in the Business Energy Rebates program or any other Efficiency Nova Scotia programs?                                                        | 1. Yes, in Business Energy Rebates<br>2. Yes, in another program(s)<br>3. Yes, in both Business Energy Rebates and another program(s)<br>4. No<br>98. (Don't know)<br>99. (Refused) |       | Before participating in the Business Energy Rebates program in <MONTH OF PURCHASE>, had your company/organization at any time in the past already participated in the Business Energy Rebates program or any other Efficiency Nova Scotia programs?                                                                                                        | 1. Yes, in Business Energy Rebates<br>2. Yes, in another program(s)<br>3. Yes, in both Business Energy Rebates and another program(s)<br>4. No<br>98. (Don't know)<br>99. (Refused) |       |  |
| E5                     | Before participating in the Business Energy Rebates program, had you at any time in the past seen Efficiency Nova Scotia promotional materials advertising the benefits of energy efficiency?                                                                                                     | 1. Yes<br>2. No<br>98. (Don't know)<br>99. (Refused)                                                                                                                                |       | Before participating in the Business Energy Rebates program, had you at any time in the past seen Efficiency Nova Scotia promotional materials advertising the benefits of energy efficiency?                                                                                                                                                              | 1. Yes<br>2. No<br>98. (Don't know)<br>99. (Refused)                                                                                                                                |       |  |
| E2                     | [IF E1=1, 2 OR 3] Your organization's previous participation in an Efficiency Nova Scotia program was a major factor in the decision to purchase <EFFICIENT PRODUCT>.                                                                                                                             | 1) Agree                                                                                                                                                                            | 1     | [IF E1=1, 2 OR 3] Do you agree or disagree that your company/organization's previous participation in an Efficiency Nova Scotia program was a major factor in the decision to purchase <EFFICIENT PRODUCT>?                                                                                                                                                | 1) Agree                                                                                                                                                                            | 1     |  |
|                        |                                                                                                                                                                                                                                                                                                   | 2) Disagree                                                                                                                                                                         | EMPTY |                                                                                                                                                                                                                                                                                                                                                            | 2) Disagree                                                                                                                                                                         | EMPTY |  |
|                        |                                                                                                                                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                           | EMPTY |                                                                                                                                                                                                                                                                                                                                                            | 98/99) Don't know/Refused                                                                                                                                                           | EMPTY |  |
| E3                     | [IF E1=1, 2 OR 3] Because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative asked a contractor or a technical staff member to examine the energy efficiency options for your facility | 1) Agree                                                                                                                                                                            | 1     | [IF END USER AND E1=1, 2 OR 3] Do you agree or disagree that because of your company/organization's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative asked a contractor or a technical staff member to examine the energy efficiency options for your facility? | 1) Agree                                                                                                                                                                            | 1     |  |
|                        |                                                                                                                                                                                                                                                                                                   | 2) Disagree                                                                                                                                                                         | EMPTY |                                                                                                                                                                                                                                                                                                                                                            | 2) Disagree                                                                                                                                                                         | EMPTY |  |
|                        |                                                                                                                                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                           | EMPTY |                                                                                                                                                                                                                                                                                                                                                            | 98/99) Don't know/Refused                                                                                                                                                           | EMPTY |  |

| 2022 Algorithm |                                                                                                                                                                                                                                                                                                                                       |                           | 2024 Algorithm                                                                                                                                                                                                                                                                                                                                                       |                                         |       |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------|
| Question       | Answer                                                                                                                                                                                                                                                                                                                                | Score                     | Question                                                                                                                                                                                                                                                                                                                                                             | Answer                                  | Score |
| E4             | [IF E1=1, 2 OR 3] Because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative took into account the cost-effectiveness of energy-efficient <MEASURE CATEGORY> measures when evaluating different options for your facility. | 1) Agree                  | [IF E1=1, 2 OR 3] Do you agree or disagree that because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative took into account the cost-effectiveness of energy-efficient <EFFICIENT PRODUCT> measures when evaluating different options for your facility? | 1) Agree                                | 1     |
|                |                                                                                                                                                                                                                                                                                                                                       | 2) Disagree               |                                                                                                                                                                                                                                                                                                                                                                      | 2) Disagree                             | EMPTY |
|                |                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused |                                                                                                                                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused               | EMPTY |
| E6             | [IF E5=1] Efficiency Nova Scotia promotional materials or communications were a major factor in the company's decision to purchase <EFFICIENT PRODUCT>.                                                                                                                                                                               | 1) Agree                  | [IF E5=1] Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications were a major factor in your company/organization's decision to purchase <EFFICIENT PRODUCT>?                                                                                                                                                                  | 1) Agree                                | 1     |
|                |                                                                                                                                                                                                                                                                                                                                       | 2) Disagree               |                                                                                                                                                                                                                                                                                                                                                                      | 2) Disagree                             | EMPTY |
|                |                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused |                                                                                                                                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused               | EMPTY |
| E7             | [IF E5=1] Efficiency Nova Scotia promotional materials or communications prompted a company representative to ask a contractor or a distributor about efficient lighting options for your organization.                                                                                                                               | 1) Agree                  | [IF END USER AND IF E5=1] Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to ask a contractor or a distributor about efficient lighting options for your organization?                                                                                                                | 1) Agree                                | 1     |
|                |                                                                                                                                                                                                                                                                                                                                       | 2) Disagree               |                                                                                                                                                                                                                                                                                                                                                                      | 2) Disagree                             | EMPTY |
|                |                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused |                                                                                                                                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused [CONTRACTORS] | EMPTY |
| E8             | [IF E5=1] Efficiency Nova Scotia promotional materials or communications prompted a company representative to take into account the cost-effectiveness of <EFFICIENT PRODUCT> when evaluating different options for the facility.                                                                                                     | 1) Agree                  | [IF E5=1] Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to take into account the cost-effectiveness of <EFFICIENT PRODUCT> when evaluating different options for the facility?                                                                                                      | 1) Agree                                | 1     |
|                |                                                                                                                                                                                                                                                                                                                                       | 2) Disagree               |                                                                                                                                                                                                                                                                                                                                                                      | 2) Disagree                             | EMPTY |
|                |                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused |                                                                                                                                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused               | EMPTY |

| 2022 Algorithm                                                                                 |                                                                                                                                                                   |       | 2024 Algorithm                                                                                          |                                                                                                                                                                                                      |       |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Question                                                                                       | Answer                                                                                                                                                            | Score | Question                                                                                                | Answer                                                                                                                                                                                               | Score |
| Cross-Influence (CI):<br>IF(E2 OR E6=Agree; 1) + IF(E3 OR E7=Agree; 1) + IF(E4 OR E8=Agree; 1) |                                                                                                                                                                   |       | Cross-Influence (CI):<br>IF(E2 OR E6=Agree; 1) + IF(E3 OR E7=Agree; 1) + IF(E4 OR E8=Agree; 1)          |                                                                                                                                                                                                      |       |
| Revised Participant Free-Ridership:                                                            | IF CI = 0 OR 1: Revised FR = Part FR<br>IF CI = 2: Revised FR = Part FR*0.75<br>IF CI = 3: Revised FR = Part FR*0.50                                              |       | Revised Participant Free-Ridership (End Users):<br><br>Revised Participant Free-Ridership (Contractors) | IF CI = 0 OR 1: Revised FR = Part FR<br>IF CI = 2: Revised FR = Part FR*0.75<br>IF CI = 3: Revised FR = Part FR*0.50<br>IF CI = 0 OR 1: Revised FR = Part FR<br>IF CI = 2: Revised FR = Part FR*0.75 |       |
| Overall Free Ridership:                                                                        | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c < 7 & D12d < 7 :<br>Overall FR = Rev Part FR<br>OTHERWISE:<br>Overall FR = Rev Part FR * (100% - Dist Influence) |       | Overall Free Ridership:                                                                                 | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c ≥ 70% & D12d ≥ 70%:<br>Overall FR = Rev Part FR<br>OTHERWISE:<br>Overall FR = Rev Part FR * (100% - Dist Influence)                                 |       |

## APPENDIX VII

### BER Instant Rebates Jurisdictional Scan

To further supplement the market evaluation findings, the Evaluator conducted a jurisdictional scan to investigate similar programs to BER-IR. **The Evaluator found very few instant discount programs targeted at the BNI sector.** BC Hydro, Efficiency Manitoba, NB Power, Efficiency Vermont, Efficiency Maine, and PG&E do not have an instant discount program. Con Edison's program at first glance looks like an instant program, although it is more like BER-AR, requiring a contractor to replace inefficient lighting. As presented in table below, the Evaluator found only one instant discount program (the IESO program) that incents lighting. The IESO program requires that incented measures replace less efficient lighting, similarly to BER-AR.

| Jurisdiction - Program                               | Measures                                                                                                         | Baseline Information                                                                                               | Notes                                                                                                                                                                                                                                                                                                                                                       |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Massachusetts – MassSave Instant Lighting Incentives | Lamps are not incented.<br>Controlled lighting products only – fixtures and troffer retrofit kits with controls. | Past studies indicate they expected a LED baseline in 2024.                                                        | Incentives for non-controlled lighting removed as of January 1, 2025.                                                                                                                                                                                                                                                                                       |
| Wisconsin – Instant Discount                         | Does not include lighting.                                                                                       | N/A                                                                                                                |                                                                                                                                                                                                                                                                                                                                                             |
| Ontario – IESO Save on Energy                        | LED lamps<br>LED fixtures<br>LED recessed downlights<br>Controls                                                 | 2025 TRM:<br>- LED lamps – baseline is a mix of T5 fluorescent and T5 LED<br>- Linear fixtures – mix of T8 and T12 | Lighting moved to midstream in 2024.<br>Program rules dictate that “Discounts only available for retrofits to existing buildings where less efficient lighting previously existed. This is determined at point of purchase.”<br>New construction is not eligible.<br>It is not clear how these rules are enforced.<br>Evaluation results not yet published. |

## APPENDIX VIII

### BER 2024 Recommendations

This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 BER evaluation.

| Section           | Recommendations                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | Recommendation #1: Undertake additional research to further validate the market evaluation results to establish, no later than Q3, when the LED baseline for BER-IR LED fixtures should take effect. Research should focus on the potential risk of the fixture market rebounding from reducing or removing the Instant incentives in the Nova Scotia market.                                |
| Executive Summary | Recommendation #2: Review the eligibility criteria for LED lighting in new construction projects in BER-AR given evidence that LEDs are the baseline for this market.                                                                                                                                                                                                                        |
| Executive Summary | Recommendation #3: In line with Recommendation #1, research should also investigate the efficiency level of an LED baseline for LED fixtures.                                                                                                                                                                                                                                                |
| Executive Summary | Recommendation #4: The current non-LED baseline for lamps should be maintained for BER-IR and reassessed in 2026. Given trends, E1 should plan for a baseline change starting in 2027.                                                                                                                                                                                                       |
| Executive Summary | Recommendation #5: Plan for a shift in the product offer for LED fixtures from BER-IR to BER-AR to capture remaining retrofit opportunities once LED baseline is adopted for BER-IR.                                                                                                                                                                                                         |
| Executive Summary | Recommendation #6: Focus efforts on BER-AR to target market laggards for early replacement retrofits of their lighting.                                                                                                                                                                                                                                                                      |
| Executive Summary | Recommendation #7: A LED baseline should also be applied to the EUL of LED fixtures rebated through BER-AR and SBES to reflect the fact that existing fixtures would have been replaced with LED fixtures at the end of their life. The baseline should consider the proportion of projects targeted for early replacement versus replace on burn-out as well as an estimated remaining EUL. |
| Executive Summary | Recommendation #8: Analyze opportunities for increasing interest around controlled lighting products                                                                                                                                                                                                                                                                                         |
| Executive Summary | Recommendation #9: Ensure that multi-wattage products are identified in the tracking sheet. Update applications for BER-AR and SBES to identify multi-wattage products and confirm the wattage being used. Select the middle wattage (i.e. not the lowest or highest) as the tracked wattage when information is not available from the participant.                                         |



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EfficiencyOne

# CUSTOM INCENTIVES PROGRAM

Final Report

2024 DSM EVALUATION

March 25, 2025





## ABBREVIATIONS

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|                 |                                                                 |
|-----------------|-----------------------------------------------------------------|
| <b>BC</b>       | British Columbia                                                |
| <b>BDM</b>      | Business development manager                                    |
| <b>BER</b>      | Business Energy Rebates                                         |
| <b>BNI</b>      | Business, non-profit, and institutional                         |
| <b>BOpt</b>     | Building Optimization                                           |
| <b>BPA</b>      | Bouthillette Parizeau                                           |
| <b>CPA</b>      | Custom Project Agreement                                        |
| <b>DR</b>       | Demand response                                                 |
| <b>DSM</b>      | Demand-side management                                          |
| <b>E1</b>       | EfficiencyOne                                                   |
| <b>EMIS</b>     | Energy Management Information Systems                           |
| <b>ENS</b>      | Efficiency Nova Scotia                                          |
| <b>ERVs</b>     | Energy recovery ventilators                                     |
| <b>EUI</b>      | Energy Use Intensity                                            |
| <b>EUL</b>      | Effective useful life                                           |
| <b>GHG</b>      | Greenhouse gas                                                  |
| <b>HRM</b>      | Halifax Regional Municipality                                   |
| <b>IEM</b>      | Industrial energy manager                                       |
| <b>IPMVP</b>    | International Performance Measurement and Verification Protocol |
| <b>KPIs</b>     | Key performance indicators                                      |
| <b>LED</b>      | Light-emitting diode                                            |
| <b>M&amp;V</b>  | Measurement and verification                                    |
| <b>MA</b>       | Measure Assessment                                              |
| <b>MOU</b>      | Memorandum of Understanding                                     |
| <b>MURB</b>     | Multi-unit residential building                                 |
| <b>NECB</b>     | National Energy Code of Canada for Buildings                    |
| <b>NS Power</b> | Nova Scotia Power                                               |
| <b>NSUARB</b>   | Nova Scotia Utility and Review Board                            |
| <b>NTGR</b>     | Net-to-gross ratio                                              |
| <b>OEM</b>      | On-site energy manager                                          |
| <b>P4P</b>      | Pay-for-Performance                                             |
| <b>PV</b>       | Photovoltaics                                                   |
| <b>ROI</b>      | Return on investment                                            |
| <b>SEM</b>      | Strategic Energy Management                                     |

## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life values.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Available Demand Response Capacity</b> | The capacity that is available to Nova Scotia Power (NS Power) to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure available demand response (DR) capacity. Available DR capacity is evaluated on a per-participant basis based on the average demand reduction observed for each event in which the participant was scheduled to participate. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established, providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                                                      |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or a load reduction in response to events called by the electric utility (NS Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.                                                                                                                                                                                                                                                                                             |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and that of the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                                                                 |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both electrical energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Equipment life</b>                     | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                         |                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global warming potential is estimated over a timescale of 100 years.                                                                           |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual electrical energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net electrical energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                                    |
| <b>First-year savings</b>               | The first full year of electrical energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                                    |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an energy efficiency program regardless of why they participated.                                                                                                                                        |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                                 |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems (such as heating and cooling) in a building due to the installation of an energy efficiency measure.                                                                                                                                                                         |
| <b>In-service rate</b>                  | The proportion of incentivized products installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as light-emitting diode (LED) lamps.                                                |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.                        |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                                         |
| <b>Line loss factor</b>                 | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                                 |
| <b>Margin of error</b>                  | The amount of random sampling error.                                                                                                                                                                                                                                                                                            |
| <b>Market effects</b>                   | The impact of a program on the market (in terms of product availability, practices, and prices) and that extends beyond changing program participant behaviours. Market effects include spillover among non-participants.                                                                                                       |

|                                 |                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Net savings</b>              | Electrical energy or peak demand savings that can be reliably attributed to a program. These include effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                               |
| <b>Net-to-gross ratio</b>       | The ratio of net electrical energy savings to gross electrical energy savings.                                                                                                                                                                                                                                                                              |
| <b>Non-sampling error</b>       | Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                 |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                                |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when NS Power's 10-minute reserve is low.                                        |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                                           |
| <b>Random sampling error</b>    | An error in measurement due to the fact that measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                          |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                                          |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                                  |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                                          |
| <b>Spillover</b>                | Savings attributable to participants who implement additional energy efficiency measure(s) introduced by a program after participating in it once and without participating in the program a second time.                                                                                                                                                   |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, with the exception of the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Electrical energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                          |

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# EXECUTIVE SUMMARY

This report presents the 2024 demand-side management (DSM) results of the Custom Incentives program administered by EfficiencyOne (E1). This program is comprised of two program components: (1) Custom and (2) Strategic Energy Management (SEM).<sup>1</sup> Custom is further comprised of the Retrofit, Pay-for-Performance, New Construction, and Building Optimization services. Combined, the two program components help commercial, industrial, and institutional participants identify, prioritize, and implement energy efficiency projects, processes, or policies in their organizations by providing support, training, and financial incentives.

## Evaluation Approach

The 2024 evaluation was aimed at calculating program component gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided greenhouse gas (GHG) emissions. For Custom New Construction, the 2024 evaluation also included a process evaluation. Table 1 summarizes the types of evaluation conducted for each program component and the corresponding methodology.

**Table 1: Summary of 2024 Custom Incentives Program Evaluation**

| Program Component | Evaluation Type |                  |        | Methodology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------|-----------------|------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | Impact          | Process          | Market |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Custom            | Comprehensive   | New Construction |        | <ul style="list-style-type: none"><li>› Participant builder and non-participant modeller phone interviews (New Construction)</li><li>› Consultant and Business Development Manager (BDM) interviews (Retrofit)</li><li>› Program manager and BDM interviews (New Construction)</li><li>› Participant and Service Provider interviews (Retrofit)</li><li>› Interviews with participants who recently signed Custom Project Agreements (CPAs) (New Construction)</li><li>› Project file reviews and participant follow-up interviews or site visits (regular Retrofit and Building Optimization [BOpt])</li><li>› Project desk reviews (Solar PV)</li><li>› Project reviews and energy model reviews (New Construction)</li><li>› Logic model update (Retrofit, New Construction)</li><li>› Jurisdictional scan (New Construction)</li><li>› Analysis of regional and building type representativeness of program participation (New Construction)</li><li>› Tracking sheet audit and analysis</li><li>› Effective useful life (EUL) update (Retrofit, New Construction)</li><li>› Calculations using evaluation results</li><li>› Avoided GHG emission reduction calculations</li></ul> |
| SEM               | Comprehensive   |                  |        | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Project reviews supported by site visits or phone interviews</li><li>› Effective useful life (EUL) update</li><li>› Calculations using evaluation results</li><li>› Greenhouse gas (GHG) emission reduction calculations</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

<sup>1</sup> In 2023, SEM and Energy Management Information Systems (EMIS) were merged into a single program component. Previously, SEM and EMIS were offered as separate program components.

## Program Performance

Table 2 below presents the participation levels, average net-to-gross ratios (NTGRs), evaluated gross and net savings at the generator, annual GHG emission reductions, as well as average EUL values for each program component and for Custom Incentives as a whole.

**Table 2: Overall 2024 Custom Incentives Participation and Savings**

|                                                                                                               | Participation Level |                                 | Gross Savings |                  | NTGR* | Net Savings |                  |
|---------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------|---------------|------------------|-------|-------------|------------------|
|                                                                                                               | Value               | Unit                            | Value         | Unit             | Value | Unit        | Value            |
| Custom                                                                                                        |                     |                                 |               |                  |       |             |                  |
| Energy Savings                                                                                                | 104                 | Projects completed              | 49.825        | GWh              | 0.80  | 39.951      | GWh              |
| Lifetime Energy Savings                                                                                       |                     |                                 | 628.964       | GWh              | 0.78  | 488.215     | GWh              |
| Peak Demand Savings                                                                                           |                     |                                 | 6.774         | MW               | 0.78  | 5.255       | MW               |
| Annual GHG Emission Reductions                                                                                |                     |                                 | 23,527        | Tonnes of CO2 eq | 0.80  | 18,865      | Tonnes of CO2 eq |
| EUL                                                                                                           |                     |                                 | 12.6          | Years            |       | 12.2        | Years            |
| SEM                                                                                                           |                     |                                 |               |                  |       |             |                  |
| Energy Savings                                                                                                | 7                   | Projects completed <sup>2</sup> | 4.478         | GWh              | 1     | 4.478       | GWh              |
| Lifetime Energy Savings                                                                                       |                     |                                 | 11.581        | GWh              | 1     | 11.581      | GWh              |
| Peak Demand Savings                                                                                           |                     |                                 | 0.538         | MW               | 1     | 0.538       | MW               |
| Annual GHG Emission Reductions                                                                                |                     |                                 | 2,114         | Tonnes of CO2 eq | 1     | 2,114       | Tonnes of CO2 eq |
| EUL                                                                                                           |                     |                                 | 2.6           | Years            |       | 2.6         | Years            |
| Total                                                                                                         |                     |                                 |               |                  |       |             |                  |
| Energy Savings                                                                                                | 111                 | Projects completed              | 54.303        | GWh              | 0.82  | 44.429      | GWh              |
| Lifetime Energy Savings                                                                                       |                     |                                 | 640.545       | GWh              | 0.78  | 499.796     | GWh              |
| Peak Demand Savings                                                                                           |                     |                                 | 7.312         | MW               | 0.79  | 5.793       | MW               |
| Annual GHG Emission Reductions                                                                                |                     |                                 | 25,641        | Tonnes of CO2 eq | 0.82  | 20,979      | Tonnes of CO2 eq |
| EUL                                                                                                           |                     |                                 | 11.8          | Years            |       | 11.2        | Years            |
| *The NTGRs listed in this table match the rounded averages obtained by dividing net savings by gross savings. |                     |                                 |               |                  |       |             |                  |

Custom Incentives was aimed at achieving 31.258 GWh in net electrical energy savings and 4.571 MW in net peak demand savings at the generator for 2024. The program surpassed both the net electrical energy and demand savings targets. Custom was the largest contributor to total program net electrical energy and peak demand savings.

The following subsections present evaluation results at the program component level.

<sup>2</sup> Completed SEM projects reference participants that generated savings in a given year.



## Custom Findings and Recommendations

This section provides the key findings and recommendations from the Custom evaluation. The first key findings and recommendations apply to Custom in general, while the others are specific to certain Custom services. The recommendations are also outlined in Appendix XIV.

### Custom General Key Findings and Recommendations

**2024 Custom-Finding:** Custom achieved 39.951 GWh in net electrical energy savings and 5.225 MW in net peak demand savings at the generator in 2024, thereby surpassing the planned electrical energy savings of 27.036 GWh by 48% and the planned peak demand savings of 4.101 MW by 28%.

**2024 Custom-Finding:** While Retrofit and Building-Optimization participation levels decreased, New Construction experienced a significant increase in 2024. Overall, Custom participation decreased in 2024 compared to 2023.

**2024 Custom-Finding:** Following the project reviews, the Evaluator adjusted the electrical energy and peak demand savings for all three Custom services. For Retrofit, these adjustments resulted in adjustment ratios of 1.012 and 1.002 for electrical energy and peak demand savings respectively. Similarly, resulting adjustment ratios for Building Optimization were 1.068 and 0.899 for electrical energy and peak demand savings respectively, while New Construction saw resulting adjustment ratios of 1.028 and 1.003 for electrical energy and peak demand savings respectively.

**2024 Custom-Finding:** The free-ridership level decreased from 25% to 15% for regular Retrofit projects, while free-ridership levels were not updated for other Retrofit project categories. New Construction free-ridership decreased compared to the 2023 level and was established at 28%. Retrofit spillover was nil for regular Retrofit projects. Free-ridership and spillover were not measured for Building Optimization and were therefore maintained at 9% and 0% respectively (values from 2021).

**2024 Custom-Finding:** Evaluated net energy and peak demand savings determined by the Evaluator were both 7% higher than the savings tracked by E1.

### New Construction Key Findings and Recommendations

**2024 New Construction-Finding:** The demand savings calculation approach used by E1 for projects modelled in eQuest can generate results that are difficult to confirm.

**2024 New Construction Recommendation #1:** Review the demand savings script used for projects modelled in eQuest to ensure accurate results and favour an approach that can be applied consistently across a variety of modelling software.

**2024 New Construction-Finding:** E1 expects a large industrial New Construction project to be closed in 2025. Savings associated with the building portion were claimed in 2024, and E1 staff will conduct M&V for savings related to the industrial equipment to be installed in 2025, given the large savings generated by this measure.

**2024 New Construction Recommendation #2:** Amend section 7.10 of the New Construction program guide to require M&V for large industrial New Construction projects.



**2024 New Construction-Finding:** The share of completed projects supported by the service that are MURBs has increased in recent years, consistent with the growth of the MURB market inside the HRM.

**2024 New Construction-Finding:** The service has a higher portion of projects inside the HRM, which is to be expected. Targeting a higher number of buildings outside the HRM may require a change in building size eligibility criteria.

**2024 New Construction-Finding:** Participants are satisfied with the program overall, particularly in terms of E1's responsiveness, and are moderately satisfied with the value of the program for their business.

**2024 New Construction-Finding:** Non-participant modellers are aware of and somewhat familiar with New Construction service, including those that work on non-MURB projects.

**2024 New Construction-Finding:** Decarbonization is a motivator for participating in New Construction service.

**2024 New Construction-Finding:** Financial factors are the primary barriers for energy efficient new construction projects (higher costs of energy efficient measures, cost of energy modelling), as well as builder awareness and understanding of the benefits of energy efficient construction, and insufficient modeller participation in the service.

**2024 New Construction-Finding:** The share of modelling costs covered by the program's modelling incentive may be insufficient to motivate some builders.

**New Construction Recommendation #3:** Investigate the impact of increasing modelling incentives (the share of modelling costs covered as well as the incentive cap) on the service.

**2024 New Construction-Finding:** The service would benefit from additional energy modellers supporting the program. While historically one energy modeller supported most of the New Construction projects, E1 has worked to bring in more modellers to the program and in 2024, five energy modellers participated in the program.

**New Construction Recommendation #4:** Endeavour to recruit new energy modellers through targeted outreach; modellers put a premium on networking opportunities with builders.

**New Construction Recommendation #5:** Consider collaborating with educational institutions and professional associations for energy modelling to build a stronger pipeline of qualified and engaged energy modellers across Nova Scotia.



**2024 New Construction-Finding:** The service should prepare for the shift to NECB 2020 in Nova Scotia. Builders will need to adjust designs, plan for higher efficiency technologies and higher upfront costs, and work closely with energy modellers under the new code.

**New Construction Recommendation #6:** The program should increase targeted outreach and educational activities for builders and energy modellers related to the code shift and its impacts, particularly those involving technologies (including electrification), costs, and energy efficiency improvements. By providing practical guidance on meeting new requirements and exceeding them with the program's support, the program can position itself as a valuable resource while increasing program awareness and encouraging more participation.

**New Construction Recommendation #7:** Review the program guidelines and update to align with NECB 2020, which will be adopted in April 2025.

**New Construction Recommendation #8:** Investigate aligning implementation incentives with NECB 2020 Tiers. Such alignment would need to consider the phased-in adoption of NECB 2020 Tiers 1–3 over 2025–29.

**2024 New Construction-Finding:** The logic model is out of date and does not sufficiently document the program barriers or the activities currently being undertaken by the program to address these barriers.

**New Construction Recommendation #9:** E1 should update the Custom New Construction logic model to document and address current barriers and update the theory of change to include all activities being carried out to address these barriers.

## SEM Findings and Recommendations

This subsection provides the key findings and recommendations from the SEM evaluation. The recommendations are also outlined in Appendix XVIII.

**2024 SEM-Finding: SEM exceeded its net electrical energy and peak demand savings targets.**

In 2024, SEM achieved 4.478 GWh and 0.538 MW in net electrical energy and peak demand savings respectively. Electrical energy savings were 6% above the planned electrical energy savings of 4.222 GWh and 14% above the planned peak demand savings of 0.470 MW.

**2024 SEM-Finding: The SEM participation level has remained stable over the past five years. Electrical energy savings per participant were similar to those in 2023.**

There were 12 participants in SEM in 2024, nine continuing participants and three new participants. Moreover, seven of the 12 participants completed projects with savings in 2024, which corresponds to the average for the previous five years.

**2024 SEM-Finding: The measurement and verification (M&V) methodologies applied to quantify savings were generally appropriate and accurate. The quality of peak demand savings estimates was greatly improved compared to previous years.**

While there continued to be adjustments to electrical energy savings and peak demand savings, these adjustments were less than 1%. While not perfect, the Service Provider appears to be more consistently applying the guideline written by E1 for calculating peak demand savings.

## Program Tracked and Evaluated Savings

Table 3 below compares E1 tracked energy and peak demand savings to evaluated savings at the generator. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings. Furthermore, the NTGRs are also presented and correspond to the rounded averages obtained by dividing net savings by gross savings, which explains why the NTGR values are different from those presented in the other sections.

**Table 3: Comparison of 2024 Tracked and Evaluated Savings at the Generator**

|                                                                                                               |                       | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|---------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                               |                       | Value         | Unit |       | Value       | Unit |                  |
| Custom                                                                                                        | Energy Savings        |               |      |       |             |      |                  |
|                                                                                                               | Tracked Savings by E1 | 48.969        | GWh  | 0.77  | 36.918      | GWh  | 108%             |
|                                                                                                               | Evaluation Results    | 49.825        | GWh  | 0.8   | 39.951      | GWh  |                  |
|                                                                                                               | Peak Demand Savings   |               |      |       |             |      |                  |
|                                                                                                               | Tracked Savings by E1 | 6.782         | MW   | 0.71  | 5.017       | MW   | 105%             |
|                                                                                                               | Evaluation Results    | 6.774         | MW   | 0.79  | 5.255       | MW   |                  |
| SEM                                                                                                           | Energy Savings        |               |      |       |             |      |                  |
|                                                                                                               | Tracked Savings by E1 | 4.480         | GWh  | 1.00  | 4.480       | GWh  | 100%             |
|                                                                                                               | Evaluation Results    | 4.478         | GWh  | 1.00  | 4.478       | GWh  |                  |
|                                                                                                               | Peak Demand Savings   |               |      |       |             |      |                  |
|                                                                                                               | Tracked Savings by E1 | 0.537         | MW   | 1.00  | 0.537       | MW   | 100%             |
|                                                                                                               | Evaluation Results    | 0.538         | MW   | 1.00  | 0.538       | MW   |                  |
| *The NTGRs listed in this table match the rounded averages obtained by dividing net savings by gross savings. |                       |               |      |       |             |      |                  |



## INTRODUCTION

EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response, and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight of its DSM activities is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electricity demand-side management (DSM) activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs, three business, non-profit, and institutional (BNI) programs, and one demand response (DR) program that are marketed to Nova Scotians through the Efficiency Nova Scotia (ENS) franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2024 DSM program portfolio.

This report presents the evaluation results of the Custom Incentives program comprised of two components: (1) Custom and (2) Strategic Energy Management (SEM).<sup>3</sup> Table 4 below lists the Custom Incentives program components and the types of evaluations conducted for 2024. A comprehensive impact evaluation involves reviewing the following four key elements: (1) The baseline definition; (2) the savings calculation methodology; (3) the values of the parameters used to calculate savings; and (4) net-to-gross ratios (NTGRs).

**Table 4: Types of Evaluations Conducted for Each Program Component, 2024**

| Program           | Program Component | 2024                 |        |               |
|-------------------|-------------------|----------------------|--------|---------------|
|                   |                   | Process              | Market | Impact        |
| Custom Incentives | Custom            | X – New Construction |        | Comprehensive |
|                   | SEM               |                      |        | Comprehensive |

For each program, the Evaluator prepared a DSM evaluation report presenting key findings, electrical first-year and lifetime energy savings, peak demand savings, and avoided greenhouse gas (GHG) emissions.<sup>4</sup>

<sup>3</sup> In 2023, SEM and Energy Management Information Systems (EMIS) were merged into a single program component. Previously, SEM and EMIS were offered as separate program components.

<sup>4</sup> Unless specified otherwise, energy savings refer to first-year energy savings rather than lifetime energy savings throughout this report.

# 1 Custom Overview

This section describes the Custom component of the Custom Incentives program, follows up on past evaluation recommendations, and provides an overview of participation history.

## 1.1 Custom Description

Custom provides large business, non-profit, and institutional (BNI) participants with technical assistance, financial incentives, and project financing to help reduce their electricity consumption and peak demand. Business Development Managers (BDM) also work with participants to assist them in moving their projects forward and identifying consultants. As illustrated in Figure 1, Custom includes four different services.

**Figure 1: Custom Services**

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Retrofit</b>                     | <ul style="list-style-type: none"><li>• Technical and financial support to help organizations conduct scoping and feasibility studies.</li><li>• Technical and financial support for the implementation of energy efficiency projects using a customized and flexible approach.*</li><li>• Organizations with annual consumption of 350,000 kWh or higher are eligible provided projects have not yet started.</li></ul>                                                                                                                                                                                                   |
| <b>New Construction</b>             | <ul style="list-style-type: none"><li>• Technical and financial support to achieve electrical energy savings in new buildings and for major renovations in existing buildings, excluding savings from lighting systems.</li><li>• Participation begins at the preliminary design stage to ensure the effective implementation of energy efficiency measures and achievement of maximum savings.</li><li>• Eligible facilities must be 15,000 sq ft or larger.</li><li>• Projects must achieve reductions in total building energy consumption of at least 25% and must save at least 100,000 kWh in electricity.</li></ul> |
| <b>Building Optimization (BOpt)</b> | <ul style="list-style-type: none"><li>• Technical and financial support to help organizations conduct an investigation study with the objective of improving building operational efficiency.</li><li>• Technical and financial support for the implementation of no-cost or low-cost energy efficiency measures (e.g. operating schedule changes) identified through a recommissioning process.</li><li>• Eligible facilities must not have been commissioned in the previous two years, must have a building automation system, and annually consume 350,000 kWh or more.</li></ul>                                      |
| <b>Pay-for-Performance (P4P)</b>    | <ul style="list-style-type: none"><li>• Financial support for reductions in electricity consumption achieved through a variety of capital and behavioural energy efficiency upgrades.</li><li>• Incentives are based on verified facility energy performance.</li><li>• Organizations with annual consumption of 1,000,000 kWh or higher are eligible if projects generate reductions in electricity consumption of at least 10%.</li></ul>                                                                                                                                                                                |

\* The Retrofit service also includes compressed air leak audits and solar PV projects for which a semi-prescriptive approach is used to establish evaluated savings.

EfficiencyOne (E1) claims savings for certain Custom projects over multiple years since certain phases or measures can be fully operational before an entire project is completed. There are three types of projects for which savings were tracked in 2024:

- › For projects that were not completed in 2024, the portion of savings corresponding to the savings claims submitted in 2024 were claimed as partial savings.
- › For single-year projects completed in 2024 and for which savings were only claimed in that year, all project savings were claimed as final savings.
- › For multiyear projects, which are projects with partial savings claimed in previous years and that were fully completed in 2024, the remaining portion of savings corresponding to the savings claims submitted in 2024 were claimed as final savings. Since they were completed in 2024, the 2024 adjustment ratios and NTGRs were applied to all savings for those projects.

Retrofit, P4P, New Construction, and Building Optimization combined were aimed at generating net electrical energy savings of 27.036 GWh and net peak demand savings of 4.101 MW at the generator in 2024.

## 1.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated Custom in previous years and issued improvement recommendations. Table 5 below provides a summary of the implementation status of each recommendation that is still being implemented, as presented in the Executive Summary section of the 2023 Custom Incentives Evaluation Report as well as recommendations issued in the 2022 Custom Incentives Evaluation Report.

**Table 5: Implementation Status of Past Recommendations for Custom**

| #                        | Recommendations                                                                                                                                                                                                    | Status      | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2022 Retrofit R2         | Require measurement and verification (M&V) efforts based on the International Performance Measurement and Verification Protocol (IPMVP) Option C approach for any Retrofit indoor horticultural lighting projects. | In progress | Program staff are currently exploring different methods to accurately represent the interactive effects associated with indoor horticultural lighting projects, including the International Performance Measurement and Verification Protocol (IPMVP) Option C approach. E1 staff are trialing a project with one customer using interactive effects calculations informed by the Efficiency Maine 2024 TRM. E1 staff estimated savings using this approach in 2024 and will conduct M&V throughout 2025 to assess the calculations used. |
| 2022 New Construction R1 | Revisit the model review process to ensure that as-built documents are used.                                                                                                                                       | Complete    | In 2024, E1 staff revised the model review and site visit templates to ensure better standardization across projects. E1 staff now use the updated documents.                                                                                                                                                                                                                                                                                                                                                                             |
| 2022 New Construction R3 | Monitor free-ridership for this service and undertake a process evaluation in 2023 or 2024 to provide recommendations on the service given the potentially shifting market and regulatory context.                 | Complete    | The Evaluator conducted a comprehensive impact evaluation of Custom New Construction in 2023, which included a review of the free-ridership algorithm to ensure different aspects of the decision-making process were captured. The free-ridership level in 2023 was established at 31%, and participant interview responses indicated changes in the market. The Evaluator conducted a process evaluation in 2024 (see Section 4).                                                                                                       |
| 2023-Retrofit-R1         | E1 should update the Custom Retrofit logic model to address current barriers and document links to other program offers such as SEM and On-site Energy Managers (OEMs).                                            | Complete    | E1 updated the Custom Retrofit logic model to include the current program barriers and links to other program offers such as SEM and On-site Energy Managers that have an impact on Custom Retrofit. Changes were updated in the program manual.                                                                                                                                                                                                                                                                                          |



## 1.3 Participation History

This subsection provides a participation overview for the four Custom services.

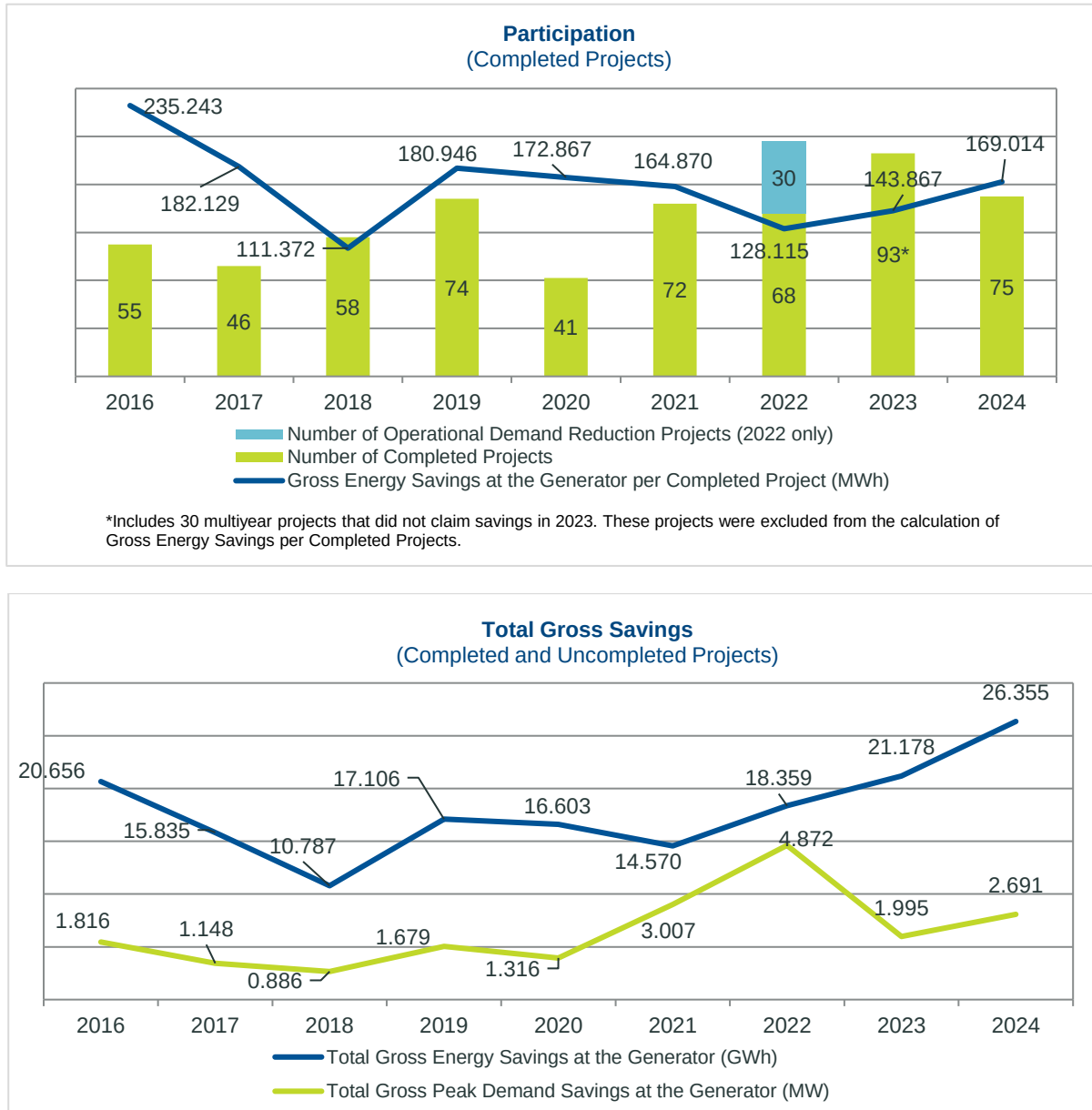
### Retrofit

In 2024, energy and/or demand savings were generated by a total of 88 Retrofit projects, including

- › 75 projects completed in 2024
  - › 61 single-year projects
  - › 14 multiyear projects
- › 13 projects that claimed partial savings in 2024 but were not completed:
  - › 10 projects that began in 2024 but were not completed, and for which partial savings were claimed for 2024.
  - › Three multiyear projects that began before 2024, but that were not completed and for which partial savings were claimed for 2024.

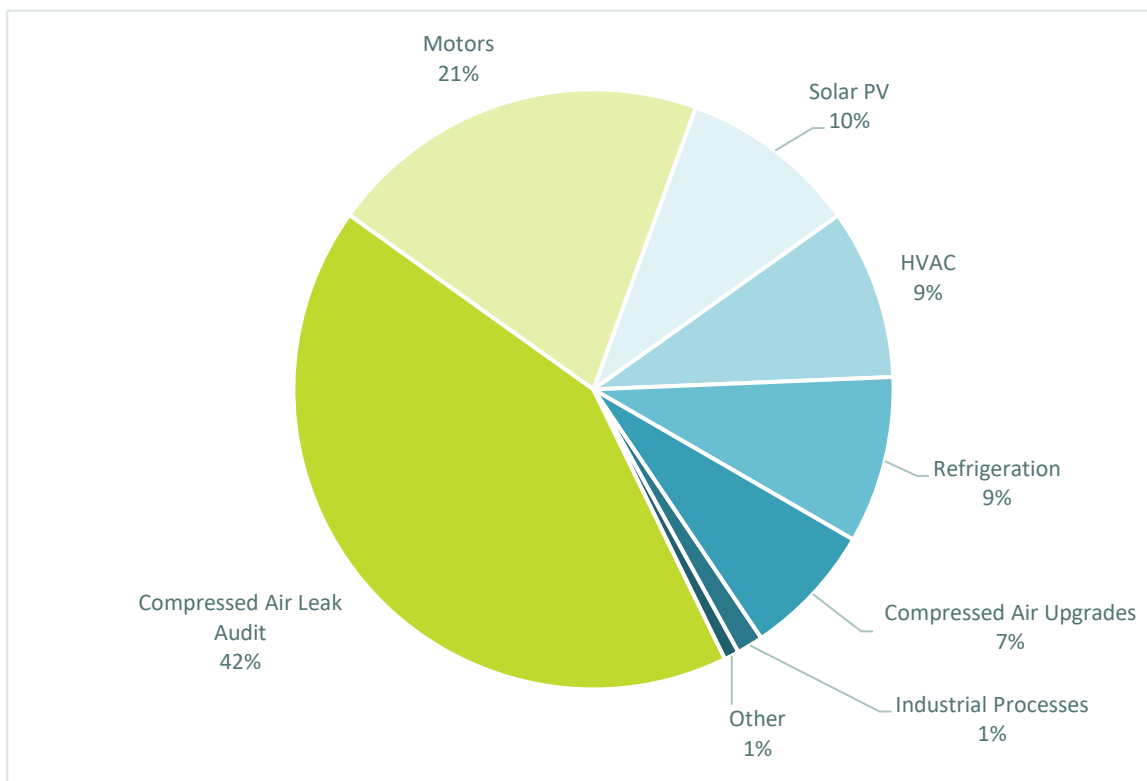
As presented in Figure 2 below, 75 completed projects generated energy savings in 2024, which is 19% lower than the 93 projects completed in 2023. However, average energy savings in 2024 per completed project increased by 17% compared to 2023. Overall, Retrofit projects achieved 24% more gross energy savings and 35% more gross peak demand savings in 2024 compared to 2023.

**Figure 2: Overview of Retrofit Participation, 2016–2024**



As illustrated in Figure 3 below, the three measure types that contributed the most to Retrofit tracked energy savings at the meter were: Compressed air leak audit, motors and solar PV measures. Also noteworthy is that out of the 75 Retrofit projects completed in 2024, eight were completed by a single participant, accounting for 41% of overall gross energy savings.

**Figure 3: Retrofit Energy Savings by Measure Type - Projects Completed in 2024**



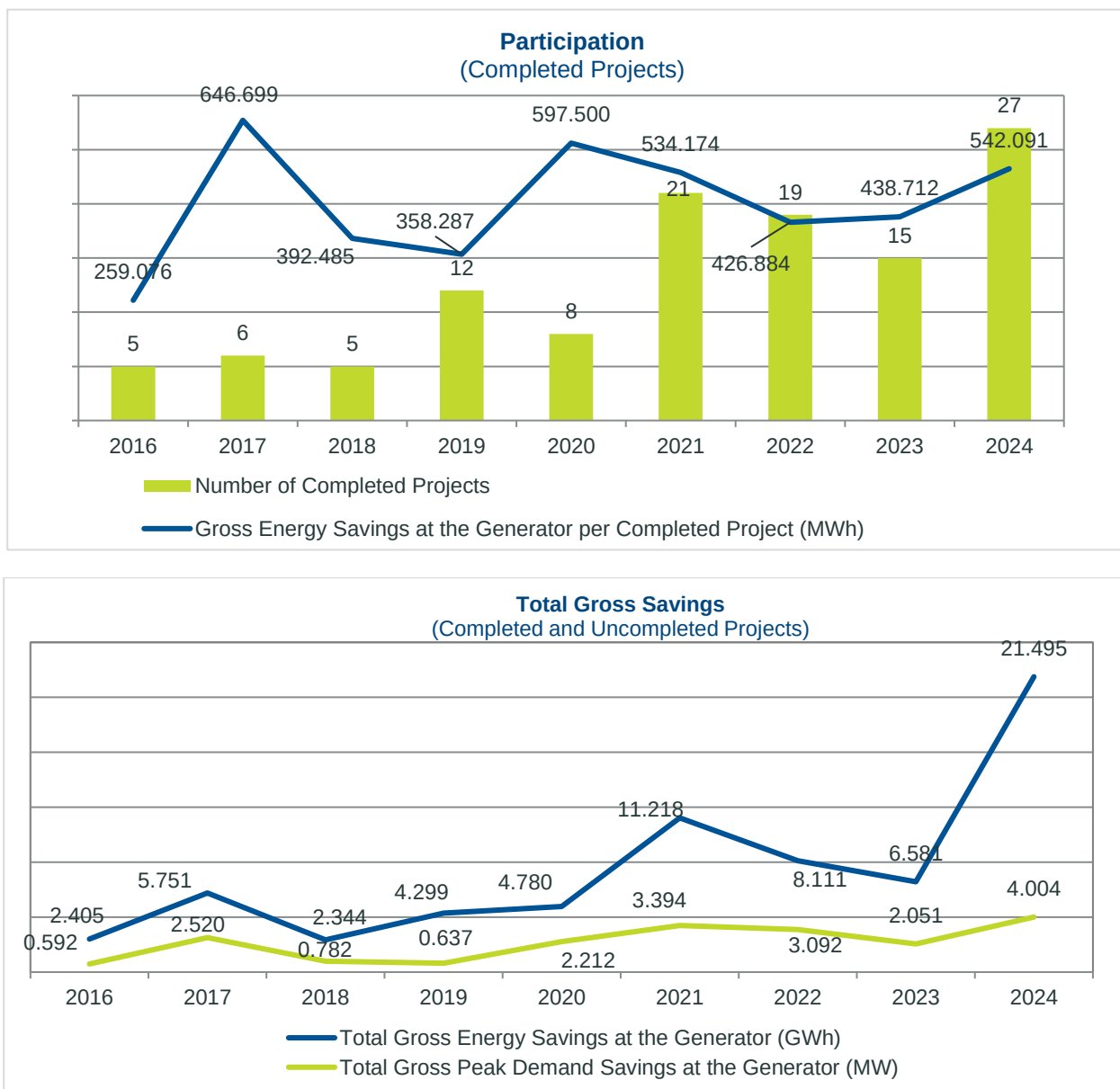
## Pay-for-Performance

No projects generated savings under the Pay-for-Performance (P4P) service in 2024.

## New Construction

In 2024, 28 projects claimed savings under New Construction: 27 complete projects and 1 project, a new industrial facility, that was partially completed and for which savings were claimed because the building was commissioned in 2024. The building is complete and operational; however, there remains one piece of equipment to be installed before the project is finalized in 2025. As shown in Figure 4 below, following a downward trend between 2021 and 2023, the number of completed projects reached a new high in 2024. Average gross savings per project (542.091 MWh) and total program savings also reached new highs in 2024. New Construction projects generated 21.495 GWh and 4.004 MW in gross energy and peak demand savings respectively.

**Figure 4: Overview of Participation in New Construction, 2016–2024**

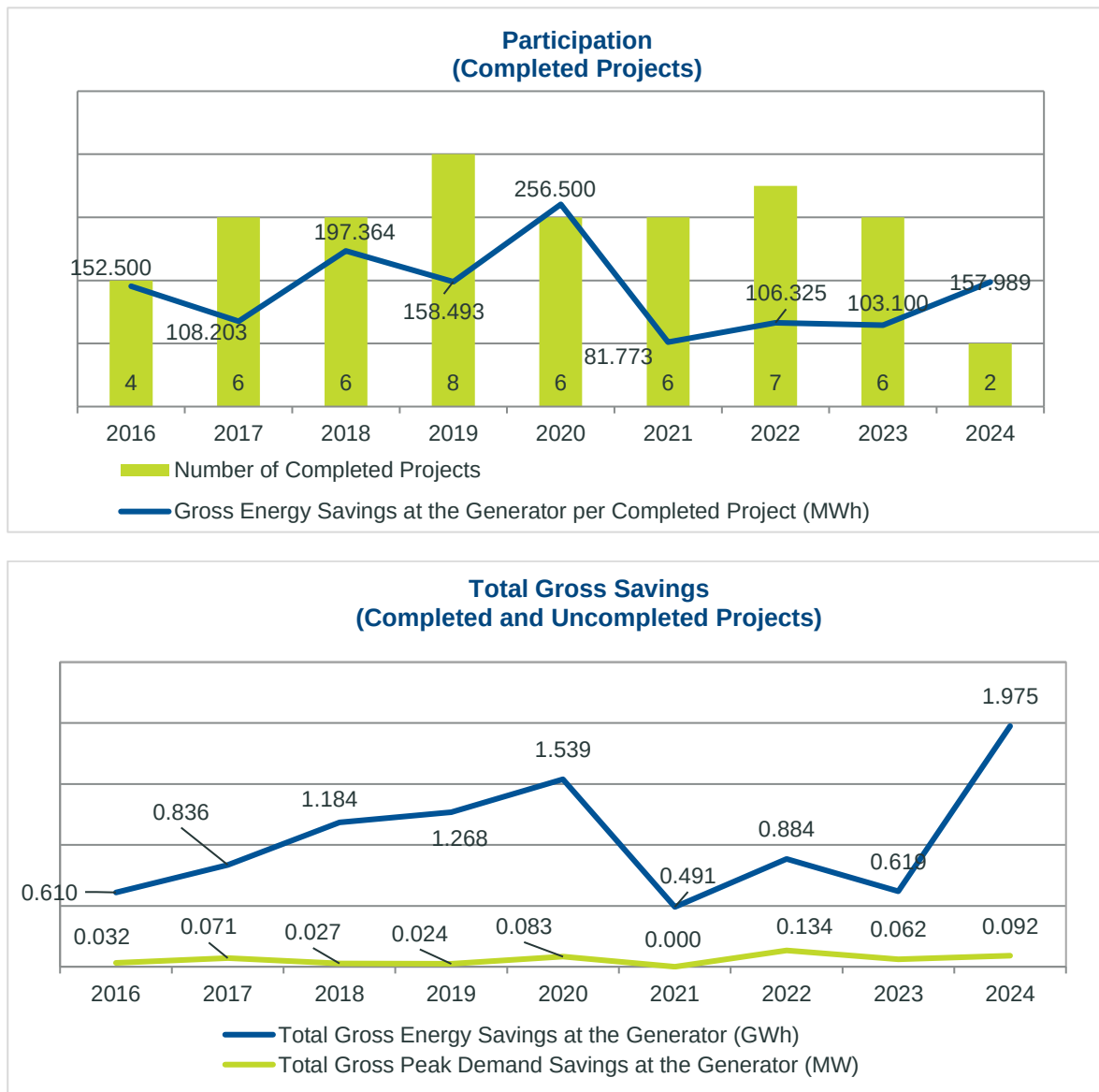


## Building Optimization

A total of three Building Optimization projects reported savings in 2024: two single-year projects and one project that claimed partial savings since it began in 2024 but was not completed. One of the completed projects was for a single building and the other was for the reprogramming of building operation systems for multiple schools in a school district.

While the number of projects completed in 2024 decreased compared to 2023, gross energy savings per project increased by 53%. Total gross energy and peak demand savings increased by 219% and 48% respectively compared to 2023. The large increase in total gross electrical energy savings is attributable to the uncompleted project that had a partial savings claim of 1.6 GWh.

**Figure 5: Overview of Participation in Building Optimization, 2016–2024**







## 2 Custom Evaluation Approach

The 2024 Custom evaluation comprised a comprehensive impact evaluation for Retrofit, Building Optimization, and New Construction. For Building Optimization, given its smaller contribution to Custom savings, NTGR results from 2021 were applied<sup>5</sup>. The main objectives of the 2024 Custom evaluation were as follows:

- › Calculate gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions
- › Collect information on participant and non-participant perspectives for New Construction
- › Analyze program participation for New Construction by sub-sector and by region
- › Review New Construction logic model

The Evaluator identified key research questions aimed at achieving the above objectives. Table 6 below outlines the evaluation objectives and maps them to the research questions, methods, and sample sizes (n) established by the Evaluator. Each method is described further below.

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<sup>5</sup> Given that no projects generated savings under this service in 2024, P4P was not evaluated.

**Table 6: 2024 Custom Evaluation Approach**

| Evaluation Objectives                                                                                         | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Methodology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results                                                                                       | <ul style="list-style-type: none"> <li>› Are the data in the tracking sheet complete, accurate, and consistent?</li> <li>› Are the gross savings calculated for a sample of projects consistent with both E1 savings calculation methods and the measures implemented?</li> <li>› Have the correct EUL values been applied to sampled Retrofit project measures?</li> <li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li> </ul>                | <ul style="list-style-type: none"> <li>› Tracking sheet audits</li> <li>› Retrofit: Project reviews with either a follow-up phone interview or site visit.</li> <li>› Building Optimization: Project reviews with a follow-up phone interview.</li> <li>› New Construction: Project reviews with a follow-up phone call if required.</li> <li>› Savings verification: for Retrofit compressed air leak audit and solar PV projects.</li> <li>› Calculations using evaluation results</li> </ul> |
| Calculate net results                                                                                         | <ul style="list-style-type: none"> <li>› What are the free-ridership and spillover levels for regular Retrofit and New Construction projects?</li> <li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li> <li>› What are the net avoided GHG emissions in CO2 eq for Retrofit?</li> </ul>                                                                                                                                                           | <ul style="list-style-type: none"> <li>› Participant phone interviews for Regular Retrofit, Building Optimization and New Construction</li> <li>› Calculations using evaluation results</li> <li>› Avoided GHG emission reduction calculations</li> </ul>                                                                                                                                                                                                                                       |
| New Construction: Explore opportunities to expand program presence outside of electrically heated MURB market | <ul style="list-style-type: none"> <li>› How has program participation changed over time?</li> <li>› Are projects outside of the Halifax area underrepresented in New Construction?</li> <li>› What is the awareness level about the program among non-MURB energy modellers?</li> <li>› What are the motivations and barriers for non-MURB builders to participate in the program component?</li> <li>› What actions could be taken by Custom staff to target more non-MURB participants?</li> </ul> | <ul style="list-style-type: none"> <li>› Tracking sheet analysis</li> <li>› Secondary data analysis</li> <li>› Interviews with program staff and the BDM</li> <li>› Interviews with non-participant or new energy modellers</li> <li>› Jurisdictional scan</li> </ul>                                                                                                                                                                                                                           |
| New Construction: Update program service logic                                                                | <ul style="list-style-type: none"> <li>› Does the current program logic align with participant barriers?</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>› Logic model update</li> <li>› Interviews with program staff and the BDM</li> <li>› Participant and non-participant interviews</li> </ul>                                                                                                                                                                                                                                                                                                               |



## Participant Phone Interviews

To collect information on participant free-ridership and perspectives, the Evaluator conducted phone interviews with 14 regular Retrofit participants and eight New Construction participants between November 2024 and January 2025. The interview guides are presented in Appendix I for Retrofit and Appendix VIII for New Construction participants.

## Modeller Interviews

To collect information on program awareness, motivations, barriers, and views on NECB 2020 and electrification, the Evaluator conducted phone interviews with three non-participant energy modellers and two newly participating modellers (modellers who had participated for the first time in the 2024 New Construction service) between November 2024 and January 2025. The interview guide is in Appendix IX.

## Secondary Data Analysis

Econoler performed secondary research on new construction building permits in Nova Scotia to inform analysis of New Construction service participation across building types and regions. This research and analysis is summarized in Section 4.1 of this report.

## Jurisdictional Scan

Econoler carried out a scan of five new construction programs in Canada and the U.S. to inform analysis of E1's service criteria against those in other jurisdictions. This research and analysis is summarized in Section 4.7 of this report.

## Program Staff Interviews

The New Construction Program Manager and Business Development Manager were interviewed to inform the Process evaluation. The interview guide is in Appendix X.

## Logic Model Update

The Evaluator reviewed E1's most recent New Construction service logic model and theory of change and analyzed how well these address key barriers to reaching service objectives.

## Tracking Sheet Audit

Prior to performing any savings calculations, the Evaluator conducted an audit of the final 2024 tracking sheets to ensure they were complete and data entry was consistent. The detailed protocols used for the tracking sheet audits and the results obtained are presented in Appendices IV and XIII.



## Project File Reviews and Participant Site Visits or Follow-up Phone Interviews

In the fall of 2024 and January 2025, Econoler and its subcontractor CDM Energy Solutions carried out a full technical review of project documentation for 19 regular Retrofit projects, one compressed air leak regular Retrofit and two Building Optimization projects. Pursuant to the desk reviews, site visits or follow-up phone interviews with participants were conducted to finalize the project reviews. The phone interviews were also used to collect information on free-ridership and spillover for regular Retrofit participants.

In that same time period, Econoler and its subcontractor BPA conducted technical reviews of project documentation and building models for 12 New Construction projects. The information provided in the project files was sufficient to conduct reviews, thus neither follow-up phone calls, nor site visits were necessary for New Construction project reviews. Non-technical phone interviews were conducted for the reviewed New Construction projects to collect free-ridership information.

The protocol presented in Appendix V was used to review Retrofit and Building Optimization projects. The Retrofit participant interview guide is presented in Appendix I. The New Construction project review protocol is presented in Appendix XI, and the participant interview guide is presented in Appendix VIII.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime energy and peak demand savings as per the calculation methodology presented in Sections 3, 5, and 6 below.

## GHG Emission Reduction Calculations

To obtain Custom net avoided GHG emissions in CO<sub>2</sub> eq, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.

### Note on Margins of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>6</sup> of the measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>7</sup>

As part of the 2024 Custom evaluation, the Evaluator calculated the margins of error for savings adjustment ratios for Retrofit and New Construction. No margins of error were calculated for Building Optimization since all completed projects in 2024 were reviewed by the Evaluator. The margins of error are listed alongside results in the applicable sections herein. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary.

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<sup>6</sup> Precision refers to how reproducible a set of measurements is. It does not take into account, however, how close the measured values are to the true values since this would refer to accuracy.

<sup>7</sup> As part of this evaluation, confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.

### 3 Retrofit Impact Evaluation

The objectives of the 2024 Retrofit impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as EUL values and associated lifetime energy savings.

As described in Subsection 1.1 above, Retrofit includes three types of savings: (1) Partial savings (projects to be completed in future years); (2) final savings for single-year 2024 projects; and (3) final savings for multiyear projects. As presented in Table 7, 13 projects achieved partial savings in 2024, 61 single-year projects claimed final savings in 2024, and 14 multiyear projects claimed final savings in 2024.

**Table 7: Evaluated 2024 Retrofit Projects**

| Type of Savings Claimed                          | Number of Projects |
|--------------------------------------------------|--------------------|
| Single-year Projects with Final Savings in 2024  | 61                 |
| Multiyear Projects with Final Savings in 2024    | 14                 |
| <b>Total Projects with Final Savings in 2024</b> | <b>75</b>          |
| Partial Savings in 2024                          | 13                 |
| <b>Total Projects Claiming Savings in 2024</b>   | <b>88</b>          |

Given the range of different project types completed in Retrofit, three distinct project categories were analyzed individually, namely (1) regular Retrofit projects; (2) solar PV projects; and (3) compressed air leak audit projects. For each project category, a distinct evaluation approach was used to determine gross and net savings. A 2024 NTGR was established for regular Retrofit projects, whereas NTGR results from the 2021 and 2023 evaluations were applied to compressed air leak audit projects and solar PV projects respectively.

Table 8 summarizes the impact evaluation approach for each project category under Retrofit. Results for the three project categories are presented below and are then combined as the aggregated results for Retrofit in Subsections 3.2.6 and 3.3.4.

**Table 8: Impact Evaluation Approach per Retrofit Project Category**

| Retrofit Project Category                                                                                                                                                                                                                                                                                                                                                                                                                        | Number of Projects Completed in 2024 | Gross Savings Methodology                                                     | Net Savings Methodology       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------------------|-------------------------------|
| Regular Retrofit*                                                                                                                                                                                                                                                                                                                                                                                                                                | 44                                   | Adjustment ratio determined from a full review of a sample of projects (n=19) | NTGR evaluated in 2024 (n=19) |
| Solar PV                                                                                                                                                                                                                                                                                                                                                                                                                                         | 20                                   | Savings verification, applying adjustment ratios established in 2023**        | NTGR from 2023 applied        |
| Compressed Air Leak Audit                                                                                                                                                                                                                                                                                                                                                                                                                        | 11                                   | Savings verification, applying the adjustment ratio established in 2021       | NTGR from 2021 applied        |
| <p>*The regular Retrofit category includes all projects that are not included in one of the other two categories.</p> <p>**Two different adjustment ratios are applied to solar PV projects, one for projects modelled with PV Watts and one for those modelled with RETScreen Expert. These ratios were established as part of the 2023 evaluation based on modelled and measured energy production data for a sample of solar PV projects.</p> |                                      |                                                                               |                               |



## 3.1 Tracking Sheet Audit

To ensure service results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in detail in Appendix IV. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

## 3.2 Gross Savings

Gross savings correspond to the changes in energy consumption resulting from actions taken by Retrofit participants regardless of why they participated.<sup>8</sup> E1 tracks the annual gross savings of each project. This subsection describes the methodology used by the Evaluator to review the gross savings of Retrofit projects.

E1 calculates gross savings for each individual file in accordance with best measurement and verification practices for commercial and industrial energy efficiency projects. The Evaluator used the information and data made available by participants and E1 and supplemented these with engineering assumptions and professional judgments where necessary.

### 3.2.1 Savings Verification

For compressed air leak audit and solar PV projects, the Evaluator verified savings by validating that the correct input parameters were used to estimate savings and applying a previously established adjustment ratio to tracked savings for each file to determine gross savings.

For compressed air leak audit projects, the Evaluator applied the 2021 evaluated Retrofit adjustment ratios for energy and demand savings. For solar PV projects, the adjustment ratios developed in 2023<sup>9</sup> were applied to energy savings.

### 3.2.2 Project Review Sampling Methodology

For the regular Retrofit project category, the Evaluator used a stratified sampling approach to select 19 projects for review from a total of 44 projects completed in 2024. More specifically, the Evaluator ranked projects based on their energy savings and divided them into strata. In the last stratum, which contained the largest projects, all projects were sampled while the strata of smaller projects were sampled at a lower rate. Within each stratum, projects were selected randomly. The selected sample of 19 projects represented 58% of total tracked energy savings for projects completed in 2024. Only completed projects were considered for sampling, and projects with partially claimed savings were excluded from the project reviews. Those projects will be eligible for review in a future evaluation when they are considered complete (in 2025 or later). The Evaluator obtained gross savings by extrapolating the results of the sampled project reviews to all regular Retrofit projects through a weighted average adjustment ratio.

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<sup>8</sup> Definition adapted from National Renewable Energy Laboratory, "Chapter 23: Estimating Net Savings: Common Practices," The Uniform Methods Project, September 2014, p. 3, available at: [http://energy.gov/sites/prod/files/2015/02/f19/UMChapter23-estimating-net-savings\\_0.pdf](http://energy.gov/sites/prod/files/2015/02/f19/UMChapter23-estimating-net-savings_0.pdf) (last accessed November 19, 2015).

<sup>9</sup> In 2023, two distinct adjustment ratios were developed, one for projects using Retscreen to estimate annual solar PV energy generation, and another for projects using PV Watts.



In addition to the 19 regular retrofit projects reviewed, the Evaluator considered two very large compressed air leak audit projects for review. These projects generated 3.7 GWh and 4.0 GWh in tracked gross electrical energy savings and were completed by the same participant. The savings were established using a different methodology and leak detection device than what are typically used by Retrofit participants carrying out compressed air leak audit and repair projects. Instead of following the typical process through which an E1 staff member conducts the initial and follow-up compressed air audits, the E1 on-site energy manager (OEM) assigned to this project guided the participant to track and report electrical energy savings using an alternative leak detection device. As a result of this deviation from the standard process and given the scale of the savings claimed, these projects were subject to a more thorough review than the other compressed air leak projects that typically undergo a more streamlined evaluation process in the form of a savings verification (as described in Subsection 3.2.1 above). Given that both projects were completed by the same participant and relied on the same type of documentation and savings calculation methodology, the Evaluator conducted an in-depth review of only one of them.

### 3.2.3 Project Review Findings

The Evaluator reviewed the project sample to ensure the best measurement and verification practices were applied for commercial and industrial energy efficiency projects and adjusted the tracked savings accordingly.

#### Regular Retrofit Project Reviews

As a result of the review process, the Evaluator adjusted the savings of eight of the 19 sampled regular Retrofit projects. These are broken down as three projects having a combination of energy and peak demand adjustments, and five projects having only peak demand savings adjustments.

Of the three projects for which both energy and peak demand savings were adjusted:

- › One project involved upgrades to a building envelope. The Evaluator visited this project as part of the project review and noticed that the actual insulation value of what was installed was higher than what was used for the energy savings calculations. The Evaluator thus updated the calculation to use the observed insulation values, resulting in increased energy and demand savings.
- › One project had correctly calculated the energy and demand savings in the M&V project files; however, the savings recorded in the tracking sheet were based on the pre-M&V estimations. The Evaluator updated the savings to reflect what was calculated post-M&V, resulting in a downward adjustment to the energy and demand savings.
- › One project involved replacing an industrial motor with a more efficient version. Originally, the savings were calculated based on the operational energy consumption. However, when reviewing the M&V file, the Evaluator observed energy savings while the motor was in idle mode, as well as savings resulting from the removal of a motor cooling fan. The Evaluator made a slight upward adjustment to the energy savings of this project. The Evaluator made a downward adjustment to this project's demand savings due to a calculation error; similarly to the energy savings, the demand savings were only considered during the operational period of this project. However, the motor's operational schedule was sporadic, and there was no pattern observed to indicate that it would be consistently operational through the peak demand window. Thus, the Evaluator recalculated the peak demand savings to be the average demand savings.

Many of the projects claimed in retrofit are industrial processes, and therefore often have somewhat random operating schedules. For situations like this, the peak demand savings are best approximated as the average annual savings. For the five projects where only peak demand savings were adjusted, all were adjusted to more accurately estimate demand savings occurring during the peak periods. This resulted in three downward adjustments and two upward adjustments to peak demand savings.





In light of these adjustments, the Evaluator suggests that E1 review the peak demand savings calculation best practices for Retrofit projects to ensure they properly represent demand savings occurring during the peak period.

The Evaluator used the above adjustments to calculate average adjustment ratios for energy and peak demand savings for the project sample (results are provided in Subsection 3.2.6 below).

### Compressed Air Leak Audit Project Review

The Evaluator also conducted an in-depth review of one of two large compressed air leak audit projects completed by the same participant at two different facilities. These projects were conducted using an all-in-one platform for leak locating and repair tracking, which is a different technology than what is typically used for compressed air leak audits. For the project that was reviewed, the process involved three elements:

- › A desktop review of the calculation sheets and leak detection platform documentation
- › A phone interview with the E1 OEM who actively supported the participant through the project to validate project parameters as well as the leak audit and repair process
- › An on-site demonstration of the leak detection device performed by a technician from the participating organization

Following the project review, the Evaluator considers the leak detection and repair process used by the participant to be sound and reliable. The provided project documentation and savings calculation methodology were also found to be accurate and of sufficient detail. The Evaluator also notes that the technical expertise of the OEM and participant staff was appropriate and contributed to the quality of the project and reliability of the estimated savings. As a result, the Evaluator made no adjustments to the electrical energy and peak demand savings tracked by E1, resulting in an adjustment ratio of 1.0 for the reviewed project. This adjustment ratio was also applied to the other large compressed air leak audit project completed by this participant.

### 3.2.4 Interactive Effects

Since interactive effects vary significantly from one Retrofit project to another, they are taken into account in the project engineering calculations used to obtain initial gross savings. Any adjustments required to interactive effects were made as part of the project review.

### 3.2.5 Effective Useful Life

The Evaluator reviewed the EUL values of all sampled projects by selecting an appropriate EUL for each measure implemented. The revised measure level EUL values were selected based on the values outlined in the 2024–2025 Demand-Side Management Measure Assessment (DSM MA).

Following the review of the 19 sampled regular Retrofit projects, the Evaluator found that four of those projects required adjustments to their EUL values. The changes made by the Evaluator stemmed from a better understanding of the measures implemented through project reviews. For example, two projects implemented multiple energy saving measures, such as LED lighting, a central heat plant, and building automation system upgrades, each of which has a different EUL. For both of these projects, the EUL was tracked for only one of the measures, so the Evaluator adjusted the project EUL to be a weighted average of each measure's EUL based on the savings attributed to each measure.

Following the savings verification performed on compressed air leak audit projects, the Evaluator adjusted the EUL of all projects from four years to two years, as presented in the 2024–2025 DSM MA.



For solar PV projects, the Evaluator adjusted the tracked 25-year EUL to 30 years. This is in line with the value tracked in the 2024–2025 DSM MA.

### 3.2.6 Evaluated Gross Savings

Savings for Retrofit are claimed under three defined categories: (1) Partial savings; (2) final savings for single-year 2024 projects; and (3) final savings for multiyear projects. For projects that claimed partial savings in previous years and were completed in 2024, the Evaluator calculated a true-up adjustment. This true-up adjustment is added to the total adjusted gross savings claimed over the years so that the sum is equivalent to the total tracked project savings multiplied by the adjustment ratio determined for the year of project completion. The Evaluator applied a distinct current-year adjustment ratio to the savings of each project category under Retrofit based on the approaches described in Subsections 3.2.1 and 3.2.2 above. These adjustment ratios are presented in Table 9 below. The Evaluator aggregated results from all project categories to determine overall evaluated gross savings for Retrofit.

**Table 9: 2024 Retrofit Adjustment Ratios per Project Category**

| Retrofit Project Category                                                                                                                                                                      | Adjustment Ratio on Energy Savings (Margin of Error) | Adjustment Ratio on Demand Savings (Margin of Error) |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|
| Regular Retrofit                                                                                                                                                                               | 1.021 (±4.9%)                                        | 1.001 (±0.2%)                                        |
| Solar PV - PV Watts                                                                                                                                                                            | 1.101 (±2.3%)                                        | N/A *                                                |
| Solar PV - RETScreen                                                                                                                                                                           | 0.942 (±4.2%)                                        | N/A *                                                |
| Compressed Air Leak Audit                                                                                                                                                                      | 0.981 (±1.2%)**                                      | 1.007 (±4.8%)**                                      |
| *The energy generated by solar PV systems coinciding with the Nova Scotia peak periods is considered nil, and none of the solar PV projects completed in 2024 had tracked peak demand savings. |                                                      |                                                      |
| **Adjustment ratios were not calculated for compressed air leak audit projects in 2024. Instead, the 2021 Retrofit adjustment ratios were used.                                                |                                                      |                                                      |

Table 10 presents an example of how the true-up adjustment was applied to the gross energy savings of a multiyear project completed in 2024.

**Table 10: Example of a 2024 True-up Adjustment**

|                                                                       | 2023    | 2024    | Total          |
|-----------------------------------------------------------------------|---------|---------|----------------|
| Tracked Savings (kWh)                                                 | 469,584 | 108,249 | 577,833        |
| Year-specific Adjustment Ratio                                        | 1.017   | 1.021   |                |
| Revised Savings Prior to True-up (kWh)                                | 477,567 | 110,522 | 588,089        |
| <b>Total Project Revised Savings with 2024 Adjustment Ratio (kWh)</b> |         |         | <b>589,967</b> |
| <b>True-up (kWh)</b>                                                  |         |         | <b>1,878</b>   |

Table 11 below presents the overall evaluated gross savings for Retrofit, which were obtained by applying the appropriate adjustment ratios from Table 9 above to each project's energy savings and peak demand savings and by applying true-up adjustments to the final savings of multiyear projects completed in 2024. The adjustment ratios presented in Table 11 are the resulting adjustment ratios for each type of savings claimed in Retrofit and are obtained by dividing gross savings without true-up adjustments by tracked savings. Savings at the generator were calculated using line loss factors that account for electricity losses occurring between the meter and the generator. For each project, the Evaluator applied energy and peak demand line loss factors corresponding to the relevant rate code based on the values drawn from the

**Table 11: Evaluated 2024 Retrofit Gross Energy and Peak Demand Savings**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Partial Savings Claimed | Final Savings Claimed for Single-Year Projects | Final Savings Claimed for Multiyear Projects | Total          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------------------------|----------------------------------------------|----------------|
| Number of Projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 13                      | 61                                             | 14                                           | 88             |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                         |                                                |                                              |                |
| Tracked Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 13.168                  | 9.525                                          | 2.106                                        | 24.799         |
| Adjustment Ratio for Energy Savings*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0.990                   | 1.012                                          | 1.011                                        | 1.001          |
| Gross Energy Savings Without True-up Adjustment (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 13.041                  | 9.644                                          | 2.129                                        | 24.814         |
| True-up Adjustment for Gross Energy Savings (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -                       | -                                              | 0.211                                        | 0.211          |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>13.041</b>           | <b>9.644</b>                                   | <b>2.339</b>                                 | <b>25.025</b>  |
| Line Loss Factor**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1.0489                  | 1.0597                                         | 1.0499                                       | 1.0532         |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>13.679</b>           | <b>10.220</b>                                  | <b>2.456</b>                                 | <b>26.355</b>  |
| Effective Useful Life (years)***                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 5.9                     | 10.5                                           | 12.1                                         | 8.2            |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>80.305</b>           | <b>106.974</b>                                 | <b>29.712</b>                                | <b>216.991</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                                                |                                              |                |
| Tracked Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.408                   | 0.786                                          | 0.368                                        | 2.561          |
| Adjustment Ratio for Peak Demand Savings*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1.006                   | 1.003                                          | 1.003                                        | 1.005          |
| Gross Peak Demand Savings Without True-up Adjustment (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1.416                   | 0.789                                          | 0.369                                        | 2.573          |
| True-up Adjustment for Gross Peak Demand Savings (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | -                       | -                                              | -0.010                                       | -0.010         |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>1.416</b>            | <b>0.789</b>                                   | <b>0.359</b>                                 | <b>2.564</b>   |
| Line Loss Factor**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1.0469                  | 1.0533                                         | 1.0514                                       | 1.0495         |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>1.482</b>            | <b>0.831</b>                                   | <b>0.377</b>                                 | <b>2.691</b>   |
| <p>* The adjustment ratios listed in this table are the averages obtained by dividing gross savings without true-up adjustments by tracked savings. They differ from the values presented in Table 9 above because of the different adjustment ratios applied to each project category.</p> <p>** The line loss factors are average values obtained by dividing gross savings at the generator by gross savings at the meter. Each retrofit project received its own specific line loss factor based on participant rate codes.</p> <p>*** These EULs are average EUL values obtained by dividing gross lifetime energy savings by gross energy savings. Each retrofit project received its own specific EUL to obtain lifetime savings.</p> |                         |                                                |                                              |                |

As presented in Table 12 below, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>12</sup> for GHG emissions generated by electricity production to Retrofit gross savings.

<sup>10</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

<sup>11</sup> For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed.

<sup>12</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO<sub>2</sub> eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

**Table 12: Evaluated 2024 Retrofit Gross GHG Emission Reductions**

|                                                                                             | Total         |
|---------------------------------------------------------------------------------------------|---------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>26.355</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2         |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>12,445</b> |

### 3.3 Net Savings

The Evaluator determined net energy and peak demand savings, that is, the electrical energy and peak demand savings that can be reliably attributed to a service, by estimating an NTGR. Specifically, the NTGR includes effects such as free-ridership and spillover that positively or negatively affect the energy savings generated by a service. For Retrofit, free-ridership and participant spillover are both considered in the NTGR.

For each of the three Retrofit project categories, the Evaluator determined a distinct NTGR. Table 13 describes the approach used to determine the NTGR for each project category.

**Table 13: 2024 NTGR Approach per Retrofit Project Category**

| Retrofit Project Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Number of Projects Completed in 2024 | NTGR Methodology                                                                                    | Sample Size (Unique Participant Interviews) * |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Regular Retrofit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 44                                   | Free-ridership and spillover were measured by conducting phone interviews with sampled participants | 14**                                          |
| Solar PV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 20                                   | NTGR from 2023 evaluation applied                                                                   | N/A                                           |
| Compressed Air Leak Audit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 11                                   | NTGR from 2021 evaluation applied                                                                   | N/A                                           |
| <p>*If a participant completed more than one project sampled for review, only one interview was conducted. The associated NTGR was applied to all projects completed by that participant unless they indicated that their decision-making process differed across projects, in which case a distinct NTGR was calculated for each project.</p> <p>**Although the evaluation methodology included a sample size of n=19, only 14 of the sampled participants from 16 projects were reached, despite multiple efforts to contact participants.</p> |                                      |                                                                                                     |                                               |

#### 3.3.1 Free-ridership

In the case of Retrofit, free-ridership occurs when participants would have still implemented energy efficiency upgrades and measures in the absence of the service.

For compressed air leak audit projects, the NTGR was not measured in 2024; therefore, the 2021 NTGR was applied since the 2021 project sample used to assess free-ridership included compressed air leak audit projects. Similarly, the free-ridership level was not measured for solar PV projects in 2024; however, it was measured in the 2023 evaluation using a self-report approach. Therefore, the 2023 solar PV free-ridership level was used in the 2024 evaluation.

For the regular Retrofit project categories, the corresponding 2024 free-ridership level was assessed using a self-report approach that involved asking participants a set of questions during phone interviews. The questionnaire included questions for all applicable variables in the decision-making process, including planning, efficiency, timing, cost, and E1 influence through financial incentives or participant support from program staff or OEMs. Certain questions were also used to determine the extent to which participant decisions about whether to implement measures or not had been influenced by previous participation in an E1 program component or E1 efforts to raise awareness about energy efficiency. When participant answers indicated that they had been significantly influenced by one of these two factors, the free-ridership level was adjusted downward to better reflect the overall influence of E1 activities on participant decisions. The feedback collected from participant interviews was converted into an overall free-ridership level using the algorithm presented in Appendix II.

The free-ridership level calculated for each project category is presented in Table 14 along with the corresponding margin of error.

**Table 14: 2024 Retrofit Free-ridership Level per Project Category**

| Retrofit Project Category                                                                                                                                                 | Free-ridership Level | Margin of Error |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------|
| Regular Retrofit                                                                                                                                                          | 15%                  | 2.90%           |
| Solar PV                                                                                                                                                                  | 38%*                 | 9.5%*           |
| Compressed Air Leak Audit                                                                                                                                                 | 16%**                | 10.6%**         |
| *Free-ridership for solar PV projects was not measured in 2024; the free-ridership level from the 2023 evaluation is presented here for reference only.                   |                      |                 |
| **Free-ridership for compressed air leak audit projects was not measured in 2023; the free-ridership level from the 2021 evaluation is presented here for reference only. |                      |                 |

For regular Retrofit projects, the free-ridership level was established at 15% for 2024, representing a 10% decrease compared with 2023. E1 influence on participant decision-making was the most significant factor contributing to the decrease in the free-ridership level, with 12 of the 14 unique regular Retrofit respondents indicating that E1 influence was very important in their decision to implement their project.

For regular Retrofit projects, the project sampling methodology is based on energy savings because incentives for these projects have historically been paid based on energy savings. Therefore, consistent with past evaluations, free-ridership was calculated based on the energy savings for these project categories, and the resulting NTGR was applied to both energy and demand savings to establish net savings for both parameters.

As in previous evaluations, the Evaluator considered the free-ridership level for each project category to be representative of the balance of projects in the project tracking sheet given that the margins of error were below the 10% target for this parameter.

### 3.3.2 Spillover

For Retrofit, participant spillover occurs when participants implement eligible energy efficiency measures due to the influence of previous participation in the service without receiving any kind of additional support<sup>13</sup>. The Evaluator used phone interviews to question participants directly about any potential spillover effects. The algorithm used to determine the level of participant spillover is presented in Appendix III.

<sup>13</sup> Participant spillover may also include measures implemented by past Retrofit participants. No projects from past participants were brought forward from E1 for consideration in 2024.

Among the 14 unique respondents from regular Retrofit participants, one mentioned having implemented energy efficiency measures on their own and that their participation in Custom Retrofit was “somewhat influential” on their decision to implement the measures. The participant mentioned that the project was a motor retrofit, and that the associated energy savings were estimated at under 10,000 kWh. Using these findings, the Evaluator calculated the spillover level to be nil for regular Retrofit.

### 3.3.3 Net-to-gross Ratio Calculation

The NTGR was calculated using the following equation:

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Participant Spillover})$$

Table 15 outlines the free-ridership and spillover levels established for Retrofit along with the NTGR values calculated for each project category.

**Table 15: Evaluated 2024 Retrofit NTGRs**

| Project Category                                                                                                                                                       | Free-Ridership Level | Spillover Level | NTGR |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------|------|
| Regular Retrofit                                                                                                                                                       | 15%                  | 0%              | 0.85 |
| Solar PV*                                                                                                                                                              | 38%                  | 1%              | 0.63 |
| Compressed Air Leak Audit**                                                                                                                                            | 16%                  | 0%              | 0.84 |
| *Free-ridership and spillover solar projects were not measured in 2024; the values from the 2023 evaluation are presented here for reference.                          |                      |                 |      |
| **Free-ridership and spillover for compressed air leak audit projects were not measured in 2023; the values from the 2021 evaluation are presented here for reference. |                      |                 |      |

### 3.3.4 Evaluated Net Savings

Net savings are defined as changes in energy use that are specifically attributable to Retrofit. Net Retrofit impacts are calculated by applying the NTGR value to gross savings as illustrated in the following equation:

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR}$$

The Evaluator applied the corresponding NTGR to the gross savings generated in each project category under Retrofit. The evaluated NTGRs are presented in Table 15 above. The Evaluator aggregated results from all project categories to determine overall evaluated net savings for Retrofit.

The Evaluator applied a true-up adjustment to the net energy savings of multiyear projects completed in 2024 so that the total revised net savings over the complete duration of each project are equivalent to the total revised gross project savings multiplied by the appropriate NTGR for 2024. This approach is similar to the one described in Subsection 3.2.6 above.

The results are listed in Table 16 below. The average EUL was established at 8.5 years, and the net energy savings resulted in 10,567 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions.

**Table 16: Evaluated 2024 Retrofit Net Energy and Peak Demand Savings**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Partial Savings Claimed | Final Savings Claimed for Single-year Projects | Final Savings Claimed for Multiyear Projects | Total          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------------------------|----------------------------------------------|----------------|
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                                                |                                              |                |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 13.041                  | 9.644                                          | 2.339                                        | 25.025         |
| NTGR*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.84                    | 0.81                                           | 0.85                                         | 0.83           |
| Net Energy Savings Without True-up Adjustment (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 10.981                  | 7.815                                          | 1.982                                        | 20.777         |
| True-up Adjustment for Net Energy Savings (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | -                       | -                                              | 0.762                                        | 0.762          |
| <b>Net Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>10.981</b>           | <b>7.815</b>                                   | <b>2.743</b>                                 | <b>21.539</b>  |
| Line Loss Factor**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1.049                   | 1.059                                          | 1.052                                        | 1.053          |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>11.518</b>           | <b>8.274</b>                                   | <b>2.885</b>                                 | <b>22.677</b>  |
| Effective Useful Life***                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5.9                     | 10.4                                           | 12.9                                         | 8.4            |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>67.785</b>           | <b>85.942</b>                                  | <b>37.209</b>                                | <b>190.936</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                                                |                                              |                |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1.416                   | 0.789                                          | 0.359                                        | 2.564          |
| NTGR*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.84                    | 0.85                                           | 0.85                                         | 0.84           |
| Net Peak Demand Savings Without True-up Adjustment (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.192                   | 0.669                                          | 0.304                                        | 2.166          |
| True-up Adjustment for Net Peak Demand Savings (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -                       | -                                              | 0.015                                        | 0.015          |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>1.192</b>            | <b>0.669</b>                                   | <b>0.320</b>                                 | <b>2.181</b>   |
| Line Loss Factor**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1.047                   | 1.053                                          | 1.051                                        | 1.049          |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>1.248</b>            | <b>0.705</b>                                   | <b>0.336</b>                                 | <b>2.289</b>   |
| <p>*The NTGRs listed in this table match the rounded averages obtained by dividing net savings by gross savings. They differ from the values presented in Subsection 3.3.3 above because of true-up adjustments and the different NTGRs applied to each project category.</p> <p>**The line loss factors are average values obtained by dividing gross savings at the generator by gross savings at the meter. Each retrofit project received its own specific line loss factor depending on participant rate codes.</p> <p>***These are average EUL values obtained by dividing gross lifetime energy savings by gross energy savings. Each retrofit project received its own specific EUL to obtain lifetime savings.</p> |                         |                                                |                                              |                |

### 3.4 Realization Rate

Table 17 below compares the total 2024 tracked and evaluated savings for Retrofit. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 17: Comparison of 2024 Retrofit Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                                                                                                                                         | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                                                                                                                                                                         | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings                                                                                                                                                                                                                                                          |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                                                                                                                                   | 26.115        | GWh  | 0.79  | 20.719      | GWh  | 109%             |
| Evaluation Results                                                                                                                                                                                                                                                      | 26.355        | GWh  | 0.86  | 22.677      | GWh  |                  |
| Peak Demand Savings                                                                                                                                                                                                                                                     |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                                                                                                                                                                                   | 2.688         | MW   | 0.81  | 2.169       | MW   | 106%             |
| Evaluation Results                                                                                                                                                                                                                                                      | 2.691         | MW   | 0.85  | 2.289       | MW   |                  |
| * The NTGRs listed in this table match the rounded averages obtained by dividing net savings by gross savings. They differ from the values presented in Subsection 3.3.3 above because of true-up adjustments and the different NTGRs applied to each project category. |               |      |       |             |      |                  |

Evaluated gross energy savings were higher than the tracked gross energy savings primarily due to the adjustment ratio being above one. Evaluated net energy and peak demand savings were higher than tracked savings because the 2024 evaluated NTGR was higher than the NTGR tracked by E1.

## 4 New Construction Process Evaluation

Results from the New Construction process evaluation are presented below. Subsection 4.1 provides an overview of the evolution of service participation during 2019–2024. Subsections 4.2–4.6 cover awareness, motivations, barriers, participant satisfaction, and perspectives on market factors that could impact the service, notably upcoming changes to the building code and decarbonization. Subsection 4.7 summarizes a jurisdictional scan of New Construction programs and finally, Subsection 4.8 focuses on a review of the logic model.

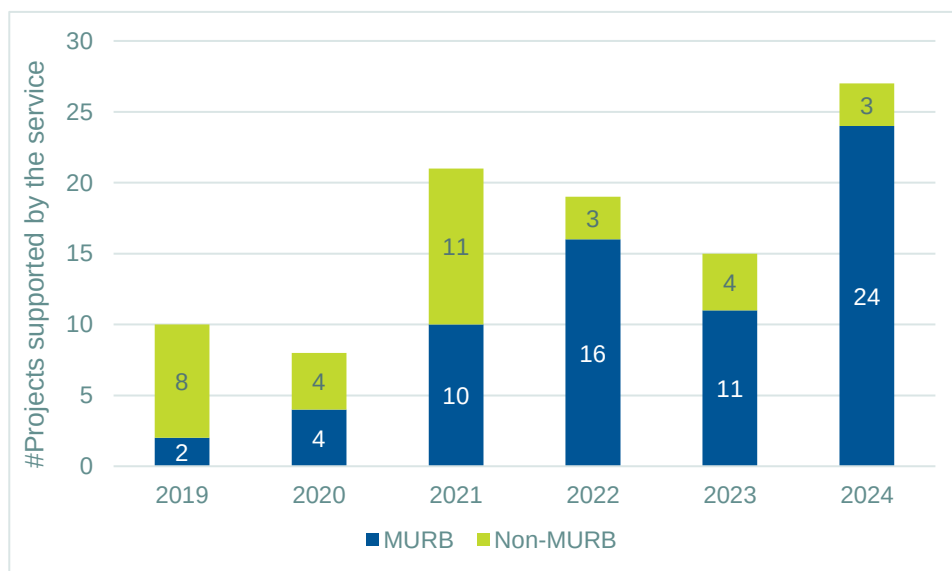
### 4.1 Evolution of Program Participation

The New Construction service supported a total of 100 completed new construction projects over the 2019–2024 period, with an average of 17 projects per year. The year 2024 saw the greatest number of projects since 2019, with 27 completed projects and one partially completed project for which savings were claimed. The Evaluator reviewed the program tracking data to investigate the characteristics of New Construction projects over time, notably the number of multi-residential buildings (MURBs) as compared to non-MURBs, and the number of projects inside and outside the Halifax Regional Municipality (HRM). This analysis was used to determine whether there are underrepresented markets that could be opportunities for the program service.

#### 4.1.1 Subsector Participation

As shown in Figure 6,<sup>14</sup> MURBs have made up most of the New Construction projects since 2022. MURB and non-MURB participation was about equal during 2020 and 2021, then non-MURB participation decreased in 2022 while MURB participation grew. Even as overall participation slightly declined, the proportion of projects that were MURBs remained high in 2023 and remained high as participation significantly grew in 2024.

**Figure 6: Participation by MURB and Non-MURB Building Types, 2019–2024**



<sup>14</sup> Figure includes projects completed in 2024. It does not include projects for which the service claimed partial savings.





Econoler reviewed available secondary data to assess trends in MURB and non-MURB new construction in Nova Scotia. Multiple publicly available datasets were investigated; however, data providing information on building size, building type, and region for Nova Scotia was not found. Nevertheless, HRM building permit data for 2021–2024 that includes building size and type was identified from the Halifax Data, Mapping and Analytics Hub.<sup>15,16</sup> Econoler identified records for buildings larger than 15,000 sq ft<sup>17</sup> (in line with service eligibility requirements) and categorized permits as MURB or non-MURB. The data does not include building heating sources. According to these data, MURBs accounted for a large majority of eligible newly permitted buildings in the HRM over the 2021–2024 period. The data also show that while they comprise a lower portion of permits than MURBs, the number of permits for non-MURB buildings has also significantly increased. Statistics Canada also collects new construction permit data,<sup>18</sup> though this data does account for building size and therefore includes permits for buildings less than 15,000 sq ft that would be ineligible for the service. This data shows that two-thirds of all new permits inside the HRM during 2019–2023 were MURBs, with little variation year-over-year. Neither data source on building permits is definitive; therefore, results should be interpreted with caution. The share of completed projects participating in the NC service that were MURBs significantly increased from 48% in 2021 to 89% in 2024, indicating that the program is generally following the MURB market in the HRM, although there may be additional opportunities to capture the growing non-MURB market. To enable this, the service could conduct an analysis to identify high-opportunity non-MURB sectors, including relevant stakeholders, and develop targeted outreach and engagement plans for these sectors.

E1 program staff explained that population growth inside the HRM has encouraged the construction of more and more large MURBs, and these have gained traction in the service. Program staff said that industry groups such as architecture and engineering firms tend to drive non-MURB design, and working with these firms early in the design phase could lead to more non-MURB participation. According to program staff, the service has hired more Energy Managers with non-MURB experience, and there was more interest in the service from the education sector and industry in 2024 than in previous years.

There was limited data available for areas outside the HRM. Over 2019–2024, the service reached 10 non-MURB buildings and 7 MURB buildings outside the HRM. E1 staff explained that one reason why fewer MURBs outside the HRM are reached than inside the HRM is that these buildings tend to be at the smaller end of program size eligibility requirement, and for these buildings' developers the cost of energy modelling could be high relative to the total service incentive. Program staff believe that public sector buildings are the biggest non-MURB opportunity outside the HRM. The breakdown of inside versus outside the HRM is discussed further below.

### 4.1.2 Regional Participation

Econoler reviewed program tracking data and identified which projects occurred inside and outside the HRM. There were 83 projects inside and 17 outside the HRM during the 2019–2024 period.

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<sup>15</sup> Halifax Data, Mapping and Analytics Hub: [https://data-hrm.hub.arcgis.com/datasets/f0736e6d03364a348f402c73663e503d\\_0/explore](https://data-hrm.hub.arcgis.com/datasets/f0736e6d03364a348f402c73663e503d_0/explore).

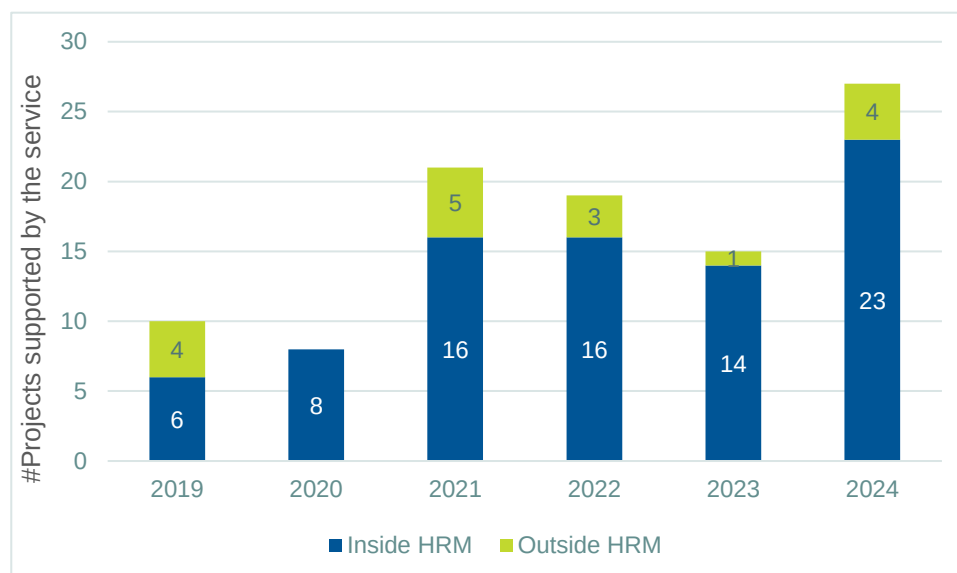
<sup>16</sup> Analysis of older permit data (2019–2020) showed that building area was missing for 86% of applicable records; therefore, it was not included.

Halifax Data, Mapping and Analytics Hub: [https://data-hrm.hub.arcgis.com/datasets/9f7705cb4ca643a7941a6273d2214750\\_0/explore](https://data-hrm.hub.arcgis.com/datasets/9f7705cb4ca643a7941a6273d2214750_0/explore)

<sup>17</sup> Building footprint data is included in the 2021–2024 dataset. The building footprint is the ground-level area covered by a building, including walls but excluding open spaces like yards. Building area is the total floor area of a building, including all stories. Building area was estimated by multiplying the building footprint area by the number of stories.

<sup>18</sup> Statistics Canada: <https://www.statcan.gc.ca/en/subjects-start/construction>.

**Figure 7: Participation Inside and Outside the HRM, 2019–2024**



The HRM contains 50% of Nova Scotia's population so, given the population density, a higher proportion of projects inside the HRM would be expected. The Evaluator found minimal data on new construction outside the HRM. Statistics Canada has new construction data for Nova Scotia from 2019–2023,<sup>19</sup> but it does not include information on building size or fuel type and, therefore, contains permit information for certain buildings that would not be eligible for the service. Because of this, results should be interpreted with caution.

Permit data shows that between 2019 and 2023 there has been significant growth in the number of building permits issued both inside and outside the HRM.<sup>20</sup> Over the five-year period, the service reached a higher share of permitted new construction projects in the HRM (5%) than outside of the HRM (<1.0%).<sup>21</sup> The Evaluator believes that this is partly due to a larger portion of the new buildings outside the HRM being smaller, and thus ineligible for the service. For example, E1 staff explained that building rules inside the HRM streamline permitting processes and encourage larger and faster-built buildings, whereas conditions outside the HRM are unfavourable for larger buildings. Larger buildings outside the HRM already tend to participate in the service, according to staff. Overall, and although program eligibility requirements and municipal building rules limit these opportunities to some degree, this information indicates that there may be some opportunity for the service to widen its reach outside the HRM.

While insufficient modelling support could be seen as a barrier outside the HRM, all five energy modellers interviewed for this evaluation confirmed that they conduct modelling for projects outside the HRM. To increase participation outside the HRM, non-participant energy modellers recommend improving outreach efforts and tailoring messaging to the specific needs of rural builders; for example, oil-based systems are common outside the HRM, and builders are less experienced with heat pumps. They claim that program awareness is lower outside the HRM due to limited client-facing engagement and advocate for in-person outreach, such as program representatives visiting developer offices or municipalities. Other recommendations include creating platforms or roadshows to directly present the service's benefits to rural builders, as many are too busy to independently seek out information (see Subsections 4.2-4.4 for analysis of energy modeller interviews).

<sup>19</sup> Statistics Canada: <https://www.statcan.gc.ca/en/subjects-start/construction>.

<sup>20</sup> On average, 24% growth per year inside the HRM and 15% per year outside the HRM.

<sup>21</sup> Calculated as the total number of program projects completed inside the region during the period, divided by the total number of permits issued during the period. The total number of permits includes buildings of <15,000 sq ft



## 4.2 Awareness and Motivations

This section presents the findings from interviews with two newly participating modellers and three non-participant modellers to understand their awareness of the program, and perspectives on the motivation of their non-participating builder clients for completing high-efficiency buildings. Below is a brief profile of the modellers interviewed:

- › Two modellers reported that the majority of their energy modelling business in Nova Scotia is for MURBs, whereas the other three modellers conduct most or the majority of their work for institutional and government clients.
- › Three modellers complete energy modelling almost equally between organizations located within the HRM and those outside the HRM, while one modeller conducts most of its work in the HRM (though still does some work outside the HRM), and the other focuses on clients outside the HRM.
- › Two modellers said that all the buildings they model are larger than 15,000 square feet, while the others report their work being equally divided between buildings of that size and smaller.
- › Three modellers do the majority or all of their energy modelling for electrically-heated buildings, while one non-participant modeller focuses on gas-heated buildings, and another modeller's business is divided between heating sources.

All three non-participant modellers were aware of Custom New Construction, either being very (n=1) or somewhat (n=2) familiar with the program. Two non-participant modellers said they could not recall how they heard about the program, and one said they had spoken with an E1 representative. There was no difference in awareness levels between modellers who work more with MURBs versus those who work more with non-MURBs.

Of the three modellers that never took part in Custom New Construction, only one discussed the program with the builders they work with, while the others did not. This modeller said they typically bring up the topic with clients, but that the idea is usually quickly dismissed. By contrast, the two modellers new to the program reported a different experience: one noted the program is typically mentioned by clients, while another new modeller suggested that the idea usually arises from a discussion between their business and the client.

Modellers reported that their clients complete an energy model for a variety of reasons, notably to increase long-term investment value through more energy efficient design (n=4), but also to identify systems that provide the lowest operational costs (n=2) as a requirement for energy efficiency incentive programs (n=2) or for code compliance<sup>22</sup> (n=2). One modeller also mentioned clients use modelling in support of meeting organizational energy savings or GHG reduction targets.

According to modellers interviewed, there are several reasons why builders decide to design higher energy efficiency buildings that exceed building code requirements. All believe that clients are motivated by the prospect of reducing or controlling their building's operational costs and/or to protect against rising energy costs. Sustainability and climate change are important drivers: most mentioned that their clients are following corporate sustainability values, whether it be achieving net-zero or reducing GHG emissions (n=4). Two non-participant modellers also said some clients are looking to satisfy market demand for sustainable or green buildings, and two said that some clients want to meet government mandates and/or climate goals. Builders also want to achieve higher rent potential, and/or enhance tenant comfort or satisfaction. One modeller suggested that some clients are also motivated to design energy efficient properties that exceed building codes to access financing or incentives.

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<sup>22</sup> NECB 2017 Performance Path requirement.



### 4.3 Barriers to High-Efficiency Buildings and Program Participation

Participating builders, non-participant modellers, and new energy modellers were asked about concerns and barriers related to building high-efficiency buildings.

When asked what their primary concerns were when considering building high-efficiency buildings, participating builders mostly cited financial factors (n=8), including measure costs, profits, payback period or return on investment (ROI), construction costs, and operational costs. The performance of energy efficient technologies was cited by three builders, particularly equipment reliability given the region's cold climate. Concerns were also raised about a lack of local expertise in the design, installation, and operation of efficient technologies (n=2).

Participant builders were also asked if there were any additional higher-efficiency technologies they would have liked to have installed, but which were not included in their project. Three of the eight participants considered additional measures in their new construction project that were then dismissed because of cost. Two considered extra solar panels but did not proceed due to the costs of solar technology, anticipated maintenance expenses, and added installation time. The third participant considered air-to-water heat pump water heaters but cited low incentives as the reason for not installing them.

Financial factors were also cited by non-participant and newly participating energy modellers as an important barrier for the clients they work with (n=4). At the same time, modellers reported that builders may not realize the value proposition of building above the minimum code, especially because energy efficiency code requirements have become more stringent, and some builders do not see the value added in exceeding code (n=3). In addition, builders may lack a clear understanding of the range of measures and their respective impacts on energy efficiency, beyond heating systems. One modeller also mentioned that builders—given their lack of understanding of the value proposition related to a more efficient building—seem more focused on including better fixtures and finishes in their design than on enhancing energy efficiency. Another modeller believed that energy efficiency, or sustainable building, is not a primary focus for some builders. Note that the responses were generally consistent between modellers working mostly for MURBs and those working mostly for non-MURBs.

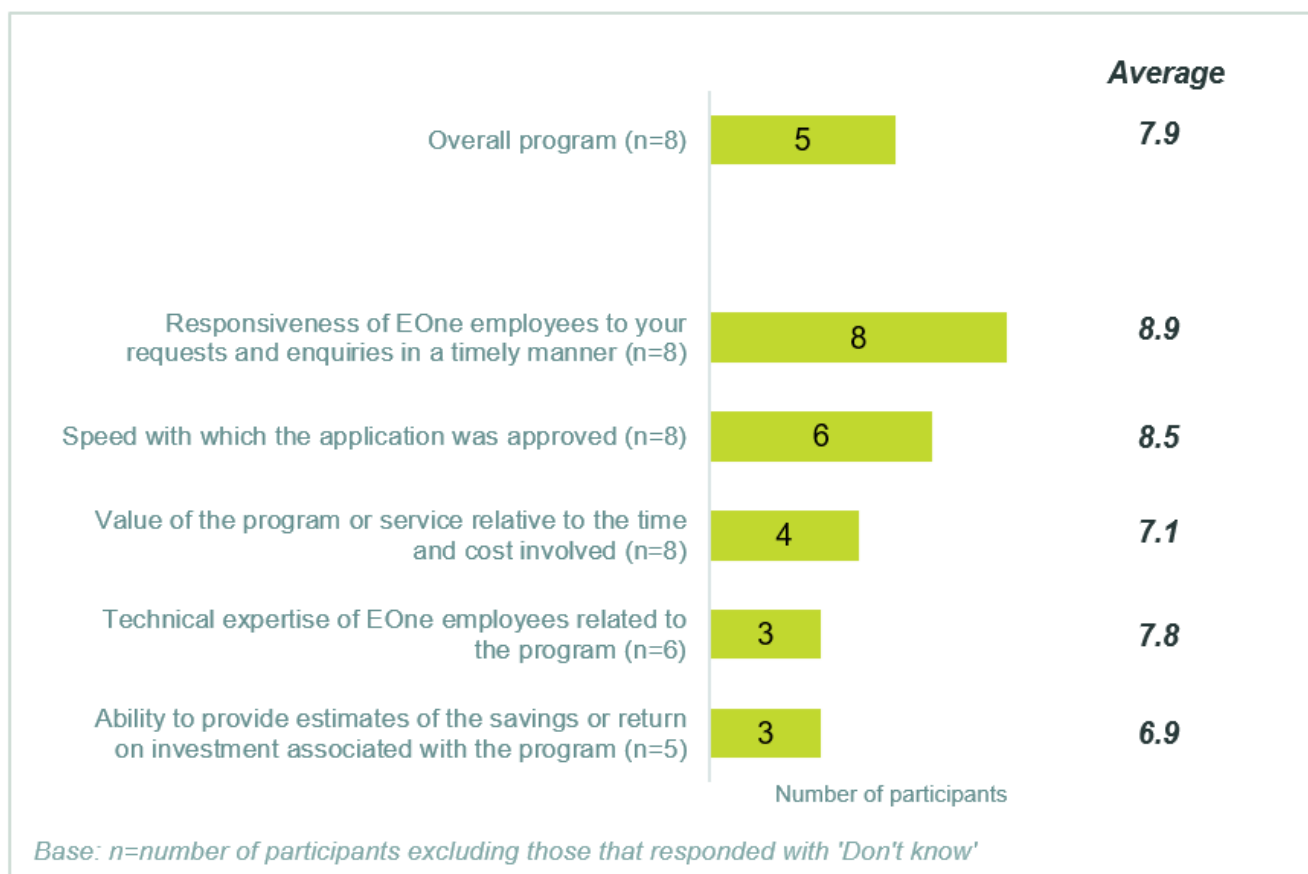
Cost is also a key barrier for energy modelling. Most non-participant and new energy modellers believed that some builders chose not to complete an energy model for their building primarily because modelling is too expensive (n=4). Two energy modellers said that builders think the additional time for modelling will cause project delays, and two said that builders are unaware of the benefits of energy modelling.

The three non-participant modellers interviewed mentioned gave several reasons for not participating in the program. Reasons cited include that clients did not mention they were taking part in Custom New Construction, that the builders they work with do not feel incentivized to exceed code requirements, that modelling incentives do not account for the time spent by the modeller coordinating between the program and the client, and that the cost of energy modelling is disproportionately high compared to building costs for smaller projects. One of the modellers mentioned a lack of awareness about the program and uncertainty about the next steps as a consultant, which stalled their participation.

## 4.4 Participant Satisfaction

There is a relatively high level of participant satisfaction with Custom New Construction overall, leading to an average satisfaction score of 7.9 out of 10, on a scale where a score of 1 means “not at all satisfied” and 10 means “very satisfied”. Satisfaction is highest with E1 employees’ responsiveness to requests and inquiries in a timely manner (average score of 8.9), the speed with which the application was approved (8.5), and E1 employees’ technical expertise related to the program (7.8). There is also satisfaction with the value of the program or service in relation to the time and cost (7.1) and the ability to estimate the savings or return on investment associated with the program (6.9), although to a lesser extent.

**Figure 8: Satisfaction With Custom New Construction, 2024**  
Highly Satisfied (Marks of 8–10)



Participants’ dissatisfaction was mainly related to the low level of implementation incentive (n=4), especially for larger, more complex projects such as geothermal, the desire for more timely application approvals, and the need for more information on energy consumption savings.

### 4.4.1 Challenges Encountered

Only two participants reported that their company had experienced challenges with Custom New Construction in the past year. One of them said there was a delay in guidance from E1 on the eligibility of a measure for a project, and that the final decision to allow the measure was not communicated by E1 to them in time for them to adapt their building design accordingly. The other participant felt that the program does not adequately incentivize the construction of “hyper”-efficient buildings.



## 4.5 Modeller and Participant Suggestions for Improvements

Participants shared a number of suggestions for improving Custom New Construction, including conducting outreach to developers and builders to inform them of available incentives; focusing on energy efficiency more broadly, rather than only incentivizing electric savings; implementing a tiered approach that pays higher incentives for larger and more complex buildings; and ensuring that incentives are distributed to project developers in a timely and consistent manner.

Non-participant and newly participating modellers were asked how the program could support the modelling industry and encourage builder participation.

Two energy modellers' feedback was that the program could increase awareness through targeted marketing efforts, such as utilizing platforms like LinkedIn and organizations such as BOMA.<sup>23</sup> One modeller recommended reducing barriers to entry and simplifying program processes to make participation easier for building owners. One modeller suggested engaging more government clients in the program and fostering connections between builders and energy modellers could help drive participation, especially for large-scale projects with significant energy savings potential. One modeller also suggested increasing the level of incentives and reducing the minimum building size requirement to allow smaller properties to take part.

Four modellers provided suggestions on how E1 could support the building energy modelling industry in Nova Scotia. Suggestions included determining the modelling incentive based on the complexity of the building and promoting Custom New Construction and the benefits of energy modelling among developers. Other suggestions included offering and encouraging training on energy modelling (i.e. workforce development) and providing more opportunity for builders and energy modellers to connect, conducting better outreach to private sector developers, and raising awareness about energy modelling. One modeller did not see a specific role for E1 in supporting the modelling industry.

## 4.6 Market Factors

### 4.6.1 Adoption of NECB 2020

Program participants and non-participating and new energy modellers were asked about the impact of the adoption of the National Energy Code of Canada for Buildings (NECB) 2020 in April 2025 on program participation.

Six of the eight participating builders answered questions about the code change. Two participants believed that, if adopted, NECB 2020 would increase the likelihood of their future participation in Custom New Construction to offset the additional costs associated with increased code requirements. One participant anticipated that the more stringent code would be more difficult to meet, potentially reducing their likelihood of incorporating even higher-efficiency measures thereby limiting their participation in the program. The other three participants said that the changes would not impact their decision to participate, as they already exceed, or intend to exceed, NECB 2020 efficiency requirements.

Two energy modellers interviewed said that as efficiency requirements become more stringent under NECB 2020, builders will likely need to adopt heat pumps and enhance insulation levels to comply. One modeller said stricter requirements could result in more costs and regulatory burdens, possibly discouraging investment in higher-efficiency building upgrades. Another modeller said many builders already prioritize high-efficiency systems, so the impact of NECB 2020 will mainly affect those who have yet to adopt these higher standards.

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<sup>23</sup> <https://bomacanada.ca/#>





Two of the five modellers have discussed NECB 2020 with their builder clients. These clients expressed concerns about the tight timeline to adjust to the new code, and the difficulty in ensuring code compliance quickly. While some builders may face challenges with timeline and compliance, as noted above, modellers expect many to adopt cost-effective measures like heat pumps to meet NECB 2020 Tier 1 standards, and the impact on those already building with high-efficiency systems may be minimal.

#### 4.6.2 Decarbonization and Electrification

Program participants and non-participating and new energy modellers were also asked about the importance of reducing GHG emissions and the electrification in building design.

Six of the eight participants answered questions about decarbonization and electrification. Five participants mentioned that reducing GHG emissions was very important (n=4) or important (n=1) to their company, while one said it was of little importance. Three participants whose companies value decarbonization said that it influenced their company's participation in Custom New Construction. The commitment of these companies to lowering GHG emissions led them to evaluate the equipment and systems planned for new buildings and identify potential upgrades based on the financial incentives available from E1. For example, one respondent said that the program makes it more financially viable to reduce GHG emissions in the long-term.

Four participants said electrification is either very important (n=2) or important (n=2) to their company, while one believed it is of little importance, and one indicated that it is not at all important. Three of the participants whose company values electrification said that it influenced their participation in Custom New Construction for the potential financial benefits of ensuring upgrades were efficient.

Four modellers have discussed GHG emissions reductions with their builder clients, and four have discussed electrification. When asked what concerns builders might have about GHG emissions reductions and electrification, modellers reported that builders are mostly concerned about high upfront costs and potential financial risks. They also expressed concerns about the adequacy and reliability of electric grid infrastructure, particularly in regions with constrained grids. Additionally, navigating complex and evolving regulations adds to builders' concerns, as does uncertainty about future energy prices and market demand for energy efficient buildings.

Builder concerns cited by energy modellers specific to electrification include longer lead times (n=2), especially for air-to-water heat pumps and equipment using alternatives to the refrigerant R-410A,<sup>24</sup> and the potential unreliability of the utility grid (n=2) as demand increases, or for facilities that require a reliable power source (e.g. hospitals, nursing homes).

### 4.7 Jurisdictional Scan

The evaluator reviewed commercial new construction programs in five jurisdictions and compared them to E1's Custom New Construction service. The jurisdictions and programs reviewed were:

- › BC Hydro/FortisBC (British Columbia) – Clean BC Commercial New Construction
- › NB Power (New Brunswick) – Commercial New Construction
- › Efficiency Manitoba (Manitoba) – New Buildings Program
- › Hydro Québec (Quebec) – Innovative Projects Program
- › Mass Saves (Massachusetts) – Commercial New Construction or Major Renovation Program

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<sup>24</sup> R-410A is a hydrofluorocarbon (HFC) refrigerant with high global warming potential (GWP). The Canadian government, under the Kigali Agreement, is reducing HFC use 85% by 2036, which compels the HVAC industry to use refrigerants with lower GWP.



A summary of the findings is presented in Table 18 below.

Two key takeaways from the scan are that several jurisdictions researched have no building size requirement or have a lower size requirement than E1, and that while E1's modelling incentive cap is comparable to that of several jurisdictions, the modelling incentive level (as a % of modelling costs) is low compared to some other jurisdictions' (Efficiency Manitoba, National Grid Massachusetts).

Three out of five jurisdictions scanned have adopted NECB 2020, as will Nova Scotia in 2025. Quebec's baseline code is NECB 2015 and Massachusetts' is IECC 2021, which is comparable to NECB 2017. E1's minimum eligibility is 25% better than NECB 2017, which is a lower requirement than New Brunswick Power's requirement of NECB 2020 Tier 3, but higher than Hydro Québec's minimum eligibility of 25% above NECB 2015. A direct comparison to other jurisdictions is difficult because of the differences in baseline code (Efficiency Manitoba) or in the unit of comparison (BC Hydro has a GHG savings minimum).

E1 requires buildings to be larger than 15,000 sq ft, while three jurisdictions have no building size requirement. Hydro Québec focuses on larger facilities, those bigger than 50,000 sq ft. Massachusetts' size requirement varies by path: the New Zero and Low Energy Use Intensity (EUI) Buildings path allows buildings that are 10,000 sq ft or greater, whereas the Whole Buildings EUI Approach path, for larger, complex projects, is for buildings that are 50,000 sq ft or greater.

E1's maximum modelling incentive of \$15,000 is inline with several of the jurisdictions reviewed. It is comparable to BC Hydro's, although BC Hydro pays up to 100% of the costs and E1 pays 50%. Efficiency Manitoba also pays up to 100% of modelling costs, capped at \$12,000. New Brunswick Power offers lower modelling incentives. National Grid Massachusetts offers higher modelling incentives than E1, including a technical assistance incentive of 75%, capped at USD 20,000 (CAD 28,000) plus a 50% verification incentive capped at USD 10,000 (CAD 14,000). Hydro Québec offers up to \$50,000, or \$0.01 per kwh, albeit targeting larger projects.

E1's implementation incentives cannot be directly compared to those of jurisdictions scanned because E1 calculates these on a per kWh saved basis, and other jurisdictions use other structures. BC Hydro bases implementation incentives on GHG savings, and three jurisdictions calculate incentives based on building area. E1's implementation incentive cap of \$750,000 is higher than BC Hydro's (\$500,000) and New Brunswick Power's (\$250,000) but is much lower than Hydro Québec's (\$12,000,000), although Hydro Québec only targets large scale developments and allows multiple buildings to be considered under the same claim.

Also of interest is that two programs, Efficiency Manitoba<sup>25</sup> and National Grid Massachusetts,<sup>26</sup> both have program elements that incentivize operational building performance.

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<sup>25</sup> As part of Efficiency Manitoba's program's Performance Path, participants must integrate commissioning activities throughout the design and construction phases to verify that building systems are installed and operate according to the intended design specifications. Creating a comprehensive manual detailing the building's systems can also qualify participants for an additional incentive—a 10% bonus on top of the eligible Performance Path incentive amount, up to \$12,000.

<sup>26</sup> A post-occupancy incentive is also available for the National Grid program Path 1: \$2.14 per square foot upon meeting EUI targets after one year of occupancy.



**Table 18: Comparison program of building codes, eligibility, and incentives**

| Jurisdiction                | Equivalent Baseline Code            | Minimum Eligibility (% Better Than Code)                                   | Building Size Requirement                                                                                                                                  | Modelling Incentive                                                                                                                                                                                                              | Implementation Incentive Structure                                   | Maximum Implementation Incentive |
|-----------------------------|-------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------|
| Efficiency Nova Scotia      | NECB 2017 (NECB 2020 in 2025)       | 25%                                                                        | >15,000 sq ft                                                                                                                                              | Up to \$15,000, 50% of eligible costs, upon pre-approval                                                                                                                                                                         | \$0.13-\$0.18/kWh                                                    | \$750,000                        |
| BC Hydro                    | NECB 2020                           | N/A - Minimum GHG savings requirement                                      | No size requirement but building owner must have a key account manager and result in a minimum level of GHG savings, which implies a certain building size | 100% of the energy study funding to a maximum of \$15,000                                                                                                                                                                        | Between \$30/t CO <sub>2</sub> e to \$120/t CO <sub>2</sub> e abated | \$500,000                        |
| New Brunswick Power         | NECB 2020                           | NECB Tier 3 (50% better than NECB Tier 1)                                  | None, but must be classified as an NECB 2020 Part 3 or Part 9 building                                                                                     | 40–50% of eligible costs up to \$10,000                                                                                                                                                                                          | \$75 per sq. m.                                                      | \$250,000                        |
| Efficiency Manitoba         | NECB 2020                           | 5% above NECB Tier 1 Higher incentives for 25% or better above NECB Tier 2 | None, but must be classified as a NECB 2020 Part 3 building                                                                                                | \$12,000 or total cost of modelling                                                                                                                                                                                              | Between \$0.60 and \$3.50/sq ft, depending on EUI target             | Up to \$3.50/sq ft               |
| Hydro-Québec                | NECB 2015                           | 25%                                                                        | >50,000 sq ft                                                                                                                                              | \$0.01/kWh up to \$50,000                                                                                                                                                                                                        | \$ Per kWh <sup>27</sup>                                             | \$12,000,000                     |
| National Grid Massachusetts | IECC 2021 (comparable to NECB 2017) | 10%                                                                        | Path 1: Net Zero and Low EUI Buildings ≥10,000 sq ft<br><br>Path 2: Whole Building EUI Reduction Approach ≥50,000 sq ft                                    | Path 1: 50% of modelling costs up to \$10,000, plus verification Incentive 50% of the fee up to \$10,000<br><br>Path 2: 75% of modelling costs (capped at \$20,000) Verification Incentive 50% of modelling costs up to \$10,000 | Up to \$2.80/sq ft                                                   | Up to \$2.80/sq ft               |



## 4.8 Logic Model Review

The main objective of the logic model is to link program objectives to barriers and identify actions to address the barriers. The purpose of the logic model review is to assess how well the program's logic and theory of change addresses barriers to achieving program objectives. The Evaluator reviewed the most recent program logic model<sup>28</sup> and underlying theory provided by E1 examining program objectives and barriers. The section concludes with an analysis of how the program logic addresses barriers, and recommendations for updating the logic model and theory of change.

### 4.8.1 Program Objectives

The program objectives stated in the Custom program manual that are most specific to the New Construction service are provided below.

- 1) Influence electrical energy efficiency and system-peak demand reduction projects within Nova Scotia.
- 2) Help BNI customers overcome the barriers to implementing large, complex energy efficiency projects.
- 3) Increase developer and builder awareness of cost-effective options for improving new buildings' energy efficiency.
- 4) Increase the number of new buildings adopting high efficiency design techniques.

The first and fourth objectives are reflected properly in the logic model. However, the second and third objectives are not sufficiently considered. As discussed in more detail below, New Construction does help customers overcome the barriers to implement large and complex new construction projects, but those barriers are not sufficiently presented in the logic model. Awareness-raising activities are in the logic model but these activities are not explicitly tied to a "lack of awareness" barrier.

Further, the long-term outcomes noted in the logic model—develop new program offers, robust custom program, market transformation—are difficult to tie back to program objectives. Within the framework of a logic model and theory of change, outcomes lead to objectives; therefore, the program's logic model and theory should reflect this by showing how outcomes lead to achieving specific objectives.

### 4.8.2 Barriers

Based on interviews with program staff, participating builders, and non-participant and new energy modellers, the evaluator found that high measure costs, modelling costs, and limited developer awareness are the primary barriers to achieving service objectives. Cost and awareness barriers are related. For example, the costs of energy modelling and energy efficiency measures are hard to justify to builders who are not aware of modelling benefits and of energy efficiency measures. Another important barrier is insufficient modeller participation. While E1 has worked to increase the number of participating modellers, according to program staff these modellers do not have enough capacity to support the number of projects coming through the service. Therefore, more participating modellers are needed. These barriers are further described below, followed by a comparison of the barriers presented in the current logic model.

**High costs of energy modelling:** E1 staff reported that the rising cost of energy modelling is a key barrier to achieving service objectives. Modellers also emphasized that the cost of energy modelling, especially for smaller buildings, was the main reason builders decide not to complete an energy model.

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<sup>27</sup> Program web site unavailable at time of research.

<sup>28</sup> Dated October 28, 2024.



**High measure costs:** E1 staff also said that high upfront costs for efficiency measures is a key barrier, reporting that it can be hard to convince developers to participate when the service can only cover 2% or less of total project costs. Modellers also reported that that high measure costs are also a key barrier to high-efficiency building design. Participating builders worry most about the financial aspects of building high-efficiency buildings and how the costs compare to incentive levels.

**Lack of builder awareness:** Lack of builder awareness of the benefits of building better than code is also a key barrier. E1 staff reported that lack of builder awareness, particularly of long-term cost savings from energy efficient building design, and low familiarity with electric building systems, is a challenge. As noted in Section 4.3, some participant builders have doubts about heat pumps and other measure performance and therefore lack awareness of how well these technologies actually work. Furthermore, the complexity of energy modelling leads to a limited understanding of its value among developers. Modellers also commented that builders may not have a clear understanding of the range of measures and their respective impact on energy efficiency beyond heating systems.

**Insufficient modeller participation:** Insufficient capacity of participating energy modellers was also noted as an issue by program staff. Participating modellers do not have enough time to support all potential service participants. Therefore, another important barrier is an insufficient number of participating modellers.

In the program logic model provided by E1, the barriers to achieving service objectives are:

- 1) Difficulties in meeting program eligibility requirements;
- 2) High incremental cost of energy efficiency measures;
- 3) Lack of technical support in the market for builders to understand efficiency opportunities.

The first stated barrier is a legitimate concern for builders, particularly with respect to the cost of energy modelling, which is required for the service. For clarity, the Evaluator recommends that this barrier be renamed “High energy modelling costs.”

The second barrier was found in the evaluation as noted above. The third barrier is the lack of technical support in the market for builders to understand efficiency opportunities. However, lack of awareness is not directly noted as a barrier. This should be added to the logic model as: “Limited developer awareness of the benefits of energy modelling and high efficiency building design”. Insufficient modeller participation should also be added to the logic model as a barrier.

### 4.8.3 Alignment of Program Logic With Barriers

The service addresses the high costs barrier through financial inputs in the form of modelling and implementation incentives, which result in financial benefits to developers that encourage the construction of energy efficient buildings. Four out of five non-participant and new energy modellers interviewed believed that some builders chose not to complete an energy model for their building primarily because the cost of modelling is too high. E1’s modelling incentives are higher than those offered by New Brunswick Power, but lower than other jurisdictions’ (see Table 18 in Section 4.7); the share of modelling costs covered by E1 (50%), in particular, is low by comparison. Furthermore, 30% of projects reached the modelling cap in 2024, meaning that for 3 out of 10 participants, the modelling incentive will not cover half of their modelling costs.

Some non-participating and new energy modellers suggested higher implementation incentives would further increase participation. It is not clear whether modellers were referring to incentive levels (\$/kWh) or the \$750,000 incentive cap, but there is no direct evidence to support increasing the cap. E1’s cap is already higher than most jurisdictions scanned. Further, analysis of program tracking data shows that the average implementation incentive paid in 2024 was much lower than the cap, and that none of the project incentives reached the cap.



Nevertheless, the shift to NECB 2020 will further increase the cost of high-efficiency buildings, which could prompt a need for E1 to reconsider its incentive structure. One way to do this would be to realign the implementation incentive tiers to reward performance relative to NECB 2020 Tiers 1, 2, and 3. Such incentives would need to evolve as the new code is phased in: Tier 1 will soon be adopted in Nova Scotia in April 2025, followed by Tier 2 in April 2027, and Tier 3 in April 2029.

Limited awareness among developers is also a key barrier, particularly with regard to the long-term cost savings of energy efficient building design and low familiarity with electric building systems. The service addresses the awareness barrier through technical and information service inputs in the form of education, training, and support activities, and human inputs in the form of customer marketing and outreach. Program staff highlighted that the service educates developers and mechanical designers and installers on the benefits of high-efficiency electric technologies. Three participants interviewed said that the performance of energy efficient technologies was a barrier to building high-efficiency buildings, particularly the reliability of equipment given the region's cold climate. The service could help to overcome this barrier by providing evidence to builders to address their lack of awareness on the performance of heat pumps and other measures.

All modellers interviewed said clients are motivated to build energy efficient buildings by the prospect of reducing or controlling their building's operating costs and/or protecting against rising energy costs. Most modellers also reported that their clients complete an energy model to increase the long-term value of their investment through more energy efficient design, and financial implications are the main concern for high-efficiency buildings. E1 reported that program staff meet with new customers early in the design process to discuss the short- and long-term service benefits of energy and cost savings, as well as potential GHG reductions that align with provincial climate targets. The service also educates customers on the benefits of energy modelling, which some developers avoid because they see it as complex or because they do not understand how the costs are justified by the benefits.

Modellers help build a pipeline of participants through relationships with program staff and developers, but there is an insufficient number of energy modellers working with the service. Program staff reported that E1 has positive relationships with participating energy modellers, but that participating modellers currently cannot keep up with market demand. Historically, service participation was limited by the number of participating modellers (most projects were modelled by one modelling firm), but the service has actively recruited energy modellers in recent years (in 2024, five energy modellers participated in the program) and continues to do so. E1 is also considering offering a program training to modellers. E1 reported that the service is actively working to further expand the number of modellers supporting the program, for both MURBs and other building types.

## 4.8.4 Logic Model Summary

To summarize, the evaluator identified four important barriers that the service is working to overcome. These barriers are addressed by and aligned with the program logic model and theory of change to varying degrees. Overall, the service is carrying out activities that address these barriers, though some barriers and related activities are not included in the logic model or theory of change. **Recommended updates to the logic model are specified below.**

- 1) High energy modelling costs: This barrier is not included in the current program logic model or the theory of change. The barrier is addressed by the program through financial inputs in the form of modelling incentives. The logic model and theory of change should be updated to include this barrier.
- 2) High upfront costs of energy efficiency measures: This barrier is included in the logic model and theory of change and is addressed by the service in the form of implementation incentives.
- 3) Limited developer awareness of the benefits of energy modelling and high efficiency building design: This barrier is not explicitly included in the program logic model, though the service carries out multiple awareness raising and educational activities to address a related barrier, “Lack of technical support in the market for builders to understand efficiency opportunities.” The theory of change also notes that the service conducts awareness-raising activities. The program logic model should be updated to include the awareness barrier and ensure program inputs and activities in the logic model and theory of change are aligned with addressing the barrier.
- 4) Insufficient modeller participation is not included in the program logic model, but program staff recognize this barrier and are carrying out service activities to address it (the number of modellers participating has increased in recent years). The theory of change notes that the program tracks the number of energy modellers engaged, and the quality of models submitted. The logic model should be updated accordingly.

## 4.9 Process Evaluation Highlights

Process evaluation highlights are summarized below.

| 2024 Custom NC Process Highlights                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| › There is a relatively high level of participant satisfaction with Custom New Construction overall.                                                                                                                                                                  |
| › The service has been more successful in reaching MURBs than non-MURBs inside the HRM.                                                                                                                                                                               |
| › There are further opportunities for the service to reach outside the HRM, although program eligibility requirements and municipal building rules limit these opportunities to some degree.                                                                          |
| › Participating builders see financial impacts as the main concern when considering building high efficiency buildings.                                                                                                                                               |
| › Builders’ primary concerns about decarbonization and electrification are high upfront costs and financial risks.                                                                                                                                                    |
| › Some builders expressed concerns about the tight timeline to adjust to NECB 2020 and the difficulty in ensuring code compliance quickly.                                                                                                                            |
| › Several jurisdictions scanned have no building size requirement for participation or allow buildings smaller than 15,000 sq ft. Instead of size requirements, two jurisdictions only allow building types specified in NECB 2020 as Part 3 and/or Part 9 buildings. |
| › E1’s incentives for energy modelling, as a share of total modelling costs, are low compared to some jurisdictions.                                                                                                                                                  |
| › High modelling and project costs, lack of developer awareness, and an insufficient number participating modellers were identified as the key barriers to achieving service objectives.                                                                              |
| › Overall, the service is carrying out activities that address these barriers, though some barriers and related activities are not included in the logic model or theory of change.                                                                                   |



## 5 New Construction Impact Evaluation

The objective of the 2024 New Construction impact evaluation was to determine gross and net electrical energy and peak demand savings. In 2024, two types of savings were claimed: (1) partial savings (projects to be completed in future years), and (2) final savings for single-year 2024 projects.

### 5.1 Tracking Sheet Audit

To ensure service results were reliably compiled, the Evaluator first performed a tracking sheet audit intended to verify the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in detail in Appendix XIII. Therefore, the tracked savings results presented in this report refer to the corrected tracked savings obtained by the Evaluator.

### 5.2 Gross Savings

This subsection describes the methodology used by the Evaluator to review the gross savings of New Construction projects.

For New Construction, gross savings for each participating building are calculated using energy models developed with building energy simulation software. Savings are calculated as the difference between the modelled electricity consumption of the baseline and proposed cases. The baseline case corresponds to the reference building as defined in the National Energy Code for Buildings (NECB) Part 8 and the guidelines developed by E1. The proposed case refers to final building design that includes the energy efficiency measures that reduce electricity consumption.

The gross savings evaluation approach for New Construction is conducted through energy model reviews.

#### 5.2.1 Sampling Methodology

For the energy model review, the evaluator selected 12 of the 27 completed projects. The selected sample of 12 projects represented 68% of total tracked energy savings for projects completed in 2024. Only completed projects were considered for sampling, and the one project with partially claimed savings was excluded from the project reviews. This project, an industrial processing facility, will be reviewed in a future evaluation when it is complete (expected in 2025). The Evaluator calculated gross savings by extrapolating the results of the sampled project reviews to all New Construction projects through a weighted average adjustment ratio.

#### 5.2.2 Project Review Findings

The 12 project reviews were intended to validate the energy models developed for the baseline and proposed cases of each project and the resulting savings. The Evaluator based the review mainly on the project files provided by E1. Pictures, mechanical plans, specification sheets, and other documents available in the project files included enough detail to confirm energy efficiency measure installations and validate the input data of the energy models. The most common simulation software remains eQuest; however, compared to previous years, there is more diversity in modelling software being used by participants. In 2024, project models were submitted in IESVE, HAP, Hot2000, and EnergyPlus.





The Evaluator noted one of the 27 completed projects that was modelled in EnergyPlus; however, there was only a calculation file available for this project, and no corresponding visual editor software file. The Evaluator notes that reviewing projects without a visual editor file requires a substantial amount of additional effort. If more projects start being submitted via EnergyPlus models, this issue could hinder the timeliness of future evaluations. **The Evaluator recommends requiring participants to submit visual editor software files when submitting projects modelled in EnergyPlus.** Several visual editing software for EnergyPlus are available for free online, so this requirement should not be a barrier for participant participation.

Of the 12 reviewed projects, 11 were modelled in eQuest and one was modelled in IESVE.

The quality of the information available in the project files continues to be very good. The project files that were provided to the Evaluator were well documented with photos, E1 site visit results, explanatory notes, etc. As a result, no telephone calls to participants were required to complete the 2024 energy model reviews. E1 has implemented a more thorough document tracking procedure to ensure that all files are provided to the Evaluator. This procedure facilitated a much smoother evaluation process compared to previous years. However, for one project, the Evaluator was unable to find the model weather file referenced in the E1 documentation in any online database. **For consistency purposes, the Evaluator recommends that E1 add the model weather file to project documentation as opposed to referencing a file that is stored online.**

There was one project, an industrial facility, for which partial savings were claimed in 2024. This project's building is complete and operational, but the participant is still waiting for an industrial dryer to be installed. The Evaluator worked with E1 to review the calculation approach for this project and determined that the savings generated by the building could be claimed in 2024, while the savings associated with the dryer can be claimed in a future evaluation following commissioning of the equipment. Although not a current program requirement, the Evaluator recommends that E1 staff conduct M&V of the dryer to verify the heating and cooling loads on the building, as well as energy use. The Evaluator will review this project once completed and apply any required corrections to the energy and demand savings that have been claimed in 2024 to future evaluations.

**For future industrial projects, the evaluator recommends adding M&V requirements to section 7.10 of the NC program guide.** The following subsections summarize the adjustments to energy and peak demand savings resulting from the project reviews.

## Energy Savings

Positive or negative adjustments were made to the tracked gross energy savings of all 12 projects reviewed by the Evaluator for 2024.

The energy model reviews resulted in an average adjustment ratio of 1.028 for gross energy savings with a margin of error of 8.3%. The adjustments made were as follows:

- › The most frequent adjustment made was matching the modelled specifications of building systems with the specifications of installed building systems. In many of these cases, the participant building modeller had followed the design specifications. However, upon inspection of the site visit photos, the Evaluator found discrepancies between the as-built and original designs. This type of adjustment was also made several times in the 2023 evaluation; however, the accuracy of as-built models has improved this year thanks to the more diligent document control implemented by E1. Corrections were also made to HVAC and building envelope characteristics.

- 
- › For one project, savings had been claimed prior to the energy recovery ventilators (ERVs) being selected and installed. Savings claimed by E1 were based on the proposed design plans; however, the Evaluator requested that E1 confirm ERV installation with the participant. After reviewing site photos and specifications provided by the participant, the Evaluator found a different ERV to the one originally specified was actually installed in the units. The Evaluator updated the model accordingly, resulting in a downward adjustment to the savings.
  - › Several adjustments were made due to clerical errors in the models, which, upon adjustment by the Evaluator, resulted in savings reductions.

## Peak Demand Savings

In previous evaluations, to establish peak demand savings, the Evaluator extracted the hourly results of the revised building energy model and averaged the monthly peak demand reduction for the months of December, January, and February. For projects modelled in eQuest, which constitute the majority of projects modelled, E1 has been using a script that directly extracts the demand savings from the models. The Evaluator reviewed this script and determined that the savings produced by the script should have been equivalent to those calculated by the previous method (described above) used by the Evaluator. However, minor discrepancies were observed between the results of the two methods. The cause of the discrepancies could not be determined within the timeframe of the evaluation, so for the 2024 evaluation, the Evaluator adopted the method used by E1, using the eQuest script to calculate the evaluated demand savings. **The Evaluator recommends that E1 investigate the cause of the above-mentioned discrepancies and consider updating the demand savings calculation methodology to ensure consistency in calculation methods across the various types of modelling software.**

The differences between tracked peak demand savings and evaluation results were mainly due to the adjustments made to the energy models for energy savings calculations. The average adjustment ratio for gross peak demand savings was 1.003 with a margin of error of 6.9%.

### 5.2.3 Interactive Effects

Since New Construction savings are based on the results of simulation models that model the total electricity consumption of both proposed and reference buildings, interactive effects are already accounted for. No further interactive effects factor was therefore applied to savings.

### 5.2.4 Effective Useful Life

The NC tracking sheet records savings on a measure-by-measure basis for each project. The Evaluator reviewed the EUL values of all measures in the tracking sheet as part of the Tracking Sheet Audit and selected the correct EUL for each measure based on the values outlined in the 2024–2025 DSM Measure Assessment.



## 5.2.5 Evaluated Gross Savings

The 2024 gross energy and peak demand savings calculated for New Construction are presented in Table 19 below. They were obtained by applying the average adjustment ratios of 1.028 on energy savings and 1.003 on peak demand savings for all projects claimed in 2024. To obtain savings at the generator, the line loss factor was applied specifically for each project based on the rate code and corresponding line loss factor provided by NS Power.<sup>29</sup>

**Table 19: Evaluated 2024 New Construction Gross Energy and Peak Demand Savings**

|                                                               | Partial Savings Claimed | Final Savings for Projects Fully Claimed in 2024 | Total          |
|---------------------------------------------------------------|-------------------------|--------------------------------------------------|----------------|
| Number of Projects                                            | 1                       | 27                                               | 28             |
| <b>Energy Savings</b>                                         |                         |                                                  |                |
| Tracked Gross Energy Savings – at the Meter (GWh)             | 6.273                   | 13.340                                           | 19.613         |
| Adjustment Ratio for Energy Savings                           | 1.028                   | 1.028                                            | 1.028          |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>6.451</b>            | <b>13.720</b>                                    | <b>20.171</b>  |
| Line Loss Factor                                              | 1.063                   | 1.067                                            | 1.066          |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>6.858</b>            | <b>14.636</b>                                    | <b>21.495</b>  |
| Effective Useful Life (years)                                 | 20.0                    | 18.5                                             | 19.0           |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>137.132</b>          | <b>271.372</b>                                   | <b>408.504</b> |
| <b>Peak Demand Savings</b>                                    |                         |                                                  |                |
| Tracked Gross Peak Demand Savings – at the Meter (MW)         | 0.716                   | 3.003                                            | 3.719          |
| Adjustment Ratio for Peak Demand Savings                      | 1.003                   | 1.003                                            | 1.003          |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.718</b>            | <b>3.012</b>                                     | <b>3.730</b>   |
| Line Loss Factor                                              | 1.0700                  | 1.0742                                           | 1.0734         |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.769</b>            | <b>3.236</b>                                     | <b>4.004</b>   |

As presented in Table 20 below, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>30</sup> for GHG emissions generated by electricity production to New Construction gross savings.

**Table 20: Evaluated 2024 New Construction Gross GHG Emission Reductions**

|                                                                                             | Total         |
|---------------------------------------------------------------------------------------------|---------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        | <b>21.495</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2         |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              | <b>10,150</b> |

<sup>29</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1. For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed.

<sup>30</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO2 eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).



## 5.3 Net Savings

The NTGR is applied to calculate net savings, that is, the savings that can be reliably attributed to a service. For New Construction, the NTGR was established by considering free-ridership. Spillover was assumed to be zero because a building developer who participated in this program is unlikely to implement energy efficiency measures in other projects without being a repeat participant in the program due to familiarity with the program and the financial incentive to participate, and the 2022 evaluation showed the potential for non-participant spillover is low. Thus, spillover was not measured as part of this evaluation.

### 5.3.1 Free-Ridership

In the case of New Construction, free-ridership occurs when participants would have still implemented energy efficiency measures in their new building in the absence of the service. The free-ridership level was assessed using a self-report approach that involved asking decision-makers a set of questions during phone interviews. The questionnaire used included questions for all applicable variables in the decision-making process, including planning, efficiency, and cost.

To determine free-ridership the Evaluator used a free-ridership questionnaire developed as part of the 2024 evaluation designed to accurately capture all influence factors that can have an impact on building design decisions, such as the energy model, modelling and implementation incentives, as well as technical assistance provided by the energy modeller, BDMS, and New Construction staff. Other factors such as participating organizations' internal energy efficiency policies and market demand for energy efficient buildings were also factored into the calculation.

Certain questions served to determine the extent to which participant decisions to have efficient products installed were influenced by previous participation in an E1 program component or E1 efforts to raise awareness about energy efficiency. When participant answers indicated that they had been significantly influenced by one of these two factors, the free-ridership level was adjusted downward to better capture the overall influence of E1 activities on participant decisions.

The algorithm used to calculate the overall free-ridership level is presented in Appendix XII. The Evaluator attempted to measure free-ridership for the 12 sampled projects in the project review. The Evaluator was able to contact decision-makers for eight of the 12 sampled projects.

The weighted average free-ridership level was measured at 28% with a margin of error of 14.0%, thus representing a decrease compared to the free-ridership level of 31% in 2023. While the margin of error is higher than the standard of 10%, given the small population size, the Evaluator considers this margin of error to be acceptable.

It should be noted that no significant difference was observed in the average free-ridership levels weighted with the energy savings versus peak demand savings. Therefore, the 28% free-ridership level was applied to both total gross energy and peak demand savings.

### 5.3.2 Net-to-gross Ratio Calculation

The NTGR is calculated using the following equation:

$$NTGR = (1 - \% \text{ Free-ridership})$$

Table 21 outlines the free-ridership level established for New Construction along with the calculated NTGR value. Participant spillover is not included as it was assumed to be nil.

**Table 21: Evaluated 2024 New Construction NTGR**

| Projects Fully Claimed in 2024 |             |
|--------------------------------|-------------|
| Free-Ridership Level           | 28%         |
| <b>NTGR</b>                    | <b>0.72</b> |

### 5.3.3 Evaluated Net Savings

Net savings represent the savings that can be reliably attributed to a service. For New Construction, net savings are calculated by applying the NTGR value in the following equation:

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR}$$

The results are listed in Table 22 below. The average EUL was established at 19.0 years, and the net energy savings resulted in 7,308 tonnes of CO2 eq in net annual GHG emission reductions.

**Table 22: Evaluated 2024 New Construction Net Energy and Peak Demand Savings**

|                                                             | Partial Savings Claimed | Final Savings for Projects Fully Claimed in 2024 | Total          |
|-------------------------------------------------------------|-------------------------|--------------------------------------------------|----------------|
| <b>Energy Savings</b>                                       |                         |                                                  |                |
| Gross Energy Savings – at the Meter (GWh)                   | 6.451                   | 13.720                                           | 20.171         |
| NTGR                                                        | 0.72                    | 0.72                                             | 0.72           |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>4.645</b>            | <b>9.878</b>                                     | <b>14.523</b>  |
| Line Loss Factor                                            | 1.0631                  | 1.0668                                           | 1.0656         |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>4.938</b>            | <b>10.538</b>                                    | <b>15.476</b>  |
| Effective Useful Life (years)                               | 20.0                    | 18.5                                             | 19.0           |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>98.735</b>           | <b>195.388</b>                                   | <b>294.123</b> |
| <b>Peak Demand Savings</b>                                  |                         |                                                  |                |
| Gross Peak Demand Savings – at the Meter (MW)               | 0.718                   | 3.012                                            | 3.730          |
| NTGR                                                        | 0.72                    | 0.72                                             | 0.72           |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>0.517</b>            | <b>2.169</b>                                     | <b>2.686</b>   |
| Line Loss Factor                                            | 1.0700                  | 1.0742                                           | 1.0734         |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>0.553</b>            | <b>2.330</b>                                     | <b>2.883</b>   |

## 5.4 Realization Rate

Table 23 below compares the total 2024 tracked and evaluated savings for New Construction. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 23: Comparison of 2024 New Construction Tracked and Evaluated Savings at the Generator**

|                       | Gross Savings |      | NTGR  | Net Savings |      | Realization Rate |
|-----------------------|---------------|------|-------|-------------|------|------------------|
|                       | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings        |               |      |       |             |      |                  |
| Tracked Savings by E1 | 20.900        | GWh  | 0.72  | 14.421      | GWh  | 107%             |
| Evaluation Results    | 21.495        | GWh  | 0.72  | 15.476      | GWh  |                  |
| Peak Demand Savings   |               |      |       |             |      |                  |
| Tracked Savings by E1 | 3.992         | MW   | 0.72  | 2.754       | MW   | 105%             |
| Evaluation Results    | 4.004         | MW   | 0.72  | 2.883       | MW   |                  |

Evaluated energy and peak demand savings were higher than those tracked by E1 because of adjustments made to the energy models, which resulted in an overall upward adjustment to gross savings. Slightly lower free-ridership in 2024 compared to tracked, also increased the realization rate.



## 6 Building Optimization Impact Evaluation

The objectives of the 2024 Building Optimization impact evaluation were to determine gross and net electrical energy and peak demand savings, annually avoided GHG emissions, as well as EUL values and associated lifetime energy savings. Like Retrofit, Building Optimization includes three types of savings: (1) partial savings (projects to be completed in future years); (2) final savings for single-year projects completed in 2024; and (3) final savings for multiyear projects completed in 2024. In 2024, two single-year projects claimed final savings.

### 6.1 Tracking Sheet Audit

To ensure service results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in detail in Appendix IV. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 6.2 Gross Savings

Gross savings correspond to changes in energy consumption resulting from actions taken by Building Optimization participants regardless of why they participated. This subsection describes the review methodology used for all Building Optimization projects and the adjustments made to specific projects.

The Evaluator calculated the gross savings for each individual Building Optimization project file in accordance with best measurement and verification practices for commercial and industrial energy efficiency projects. This was achieved by using the information and data made available by participants and E1 as well as by supplementing the data with engineering assumptions and judgments where necessary.

#### 6.2.1 Project Review Findings

The Evaluator reviewed both completed Building Optimization projects. Following the review, the Evaluator revised the energy savings of one project, and the demand savings of both projects.

- › One project involved reprogramming the building HVAC system for 15 separate schools. The energy savings of this project were adjusted slightly upward, because the original energy saving calculation did not capture the full operational schedule of the HVAC systems.
- › The demand savings were adjusted downward for both reviewed projects because the demand saving calculation did not accurately reflect the demand that occurs during the peak demand window.

Since all completed projects were reviewed and adjusted on a case-by-case basis, no average adjustment ratio was established. As such, the Evaluator obtained the total Building Optimization gross energy and peak demand savings by summing the evaluated savings for each project.

Projects that claimed partial savings will have to be reviewed once complete, and any adjustments to the energy savings will be made following individual reviews.

#### 6.2.2 Interactive Effects

Since interactive effects vary significantly from one Building Optimization project to another, they are either accounted for in the project engineering calculations used to establish gross savings or included when using whole building consumption data. For all six projects, the measures implemented did not generate interactive effects. Therefore, no other adjustment was made to the gross savings of reviewed projects.



### 6.2.3 Effective Useful Life

The Evaluator validated the EUL values based on the 2024–2025 DSM MA.

There were no adjustments made to the EUL values of reviewed projects.

### 6.2.4 Evaluated Gross Savings

Table 24 below presents the overall evaluated gross savings for Building Optimization, which were obtained by applying project-specific adjustments to energy and peak demand savings as a result of project reviews. The adjustment ratios in Table 24 are the resulting adjustment ratios for each type of savings claim and are obtained by dividing gross savings without true-up adjustments by tracked savings. The resulting peak demand adjustment ratios were not calculated since peak demand savings were not tracked. However the Evaluator calculated peak demand savings for each Building Optimization project and added them to gross savings. Savings at the generator were calculated using line loss factors that account for electricity losses occurring between the meter and the generator. For each project, the Evaluator applied energy and peak demand line loss factors corresponding to the relevant rate code based on the values drawn from the 2014 Cost of Service Study Progress Update<sup>31</sup> provided by NS Power.<sup>32</sup>

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<sup>31</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

<sup>32</sup> For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed.

**Table 24: Evaluated 2024 Building Optimization Gross Energy and Peak Demand Savings**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Partial Savings Claimed | Final Savings Claimed for Single-Year Projects | Total        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------------------------|--------------|
| <b>Number of Projects</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2                       | 2                                              | 4            |
| <b>Energy Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                         |                                                |              |
| Tracked Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1.540                   | 0.297                                          | 1.838        |
| Adjustment Ratio for Energy Savings*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1.000                   | 1.068                                          | 1.011        |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>1.540</b>            | <b>0.318</b>                                   | <b>1.858</b> |
| Line Loss Factor**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1.0631                  | 1.0631                                         | 1.0631       |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>1.638</b>            | <b>0.338</b>                                   | <b>1.975</b> |
| Effective Useful Life (years)***                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1.5                     | 3.0                                            | 1.8          |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>2.456</b>            | <b>1.013</b>                                   | <b>3.469</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                         |                                                |              |
| Tracked Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | -                       | 0.095                                          | 0.095        |
| Adjustment Ratio for Peak Demand Savings*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                       | 0.899                                          | 0.899        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | -                       | <b>0.086</b>                                   | <b>0.086</b> |
| Line Loss Factor**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | -                       | 1.0700                                         | 1.0700       |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                       | <b>0.092</b>                                   | <b>0.092</b> |
| <p>*The adjustment ratios listed in this table are the averages obtained by dividing gross energy savings without true-up adjustments by tracked gross energy savings.</p> <p>**The line loss factors are average values obtained by dividing gross savings at the generator by gross savings at the meter. Each Retrofit project received its own specific line loss factor depending on participant rate codes.</p> <p>***These are average EUL values obtained by dividing gross lifetime energy savings by gross energy savings. Each retrofit project received its own specific EUL to obtain lifetime savings.</p> |                         |                                                |              |

As presented in Table 25 below, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>33</sup> for GHG emissions generated by electricity production to Building Optimization gross savings.

<sup>33</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO<sub>2</sub> eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

**Table 25: Evaluated 2024 Building Optimization Gross GHG Emission Reductions**

|                                                                                             | Total |
|---------------------------------------------------------------------------------------------|-------|
| Gross Energy Savings – at the Generator (GWh)                                               | 1.975 |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2 |
| Gross Annual GHG Emission Reductions (tonnes of CO2 eq)                                     | 933   |

## 6.3 Net Savings

The Evaluator determined the net energy and peak demand savings, that is, the electrical energy and peak demand savings that can be reliably attributed to a service, by estimating the NTGR. For Building Optimization, free-ridership and spillover are accounted for in the NTGR calculation.

Given the smaller contribution of Building Optimization to Custom savings, free-ridership and spillover levels were not measured in 2024. To obtain net energy and peak demand savings, the Evaluator applied the NTGR results from the 2021 Custom evaluation to gross savings.

### 6.3.1 Net-to-gross Ratio Calculation

The NTGR was calculated using the following equation:

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Participant Spillover})$$

Table 26 outlines the free-ridership and spillover levels established for Building Optimization along with the NTGR value.

**Table 26: Evaluated 2024 Building Optimization NTGR**

|                                                                                                                       | Value for Savings Claimed in 2024 * |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Free-Ridership Level                                                                                                  | 9% (±7.2%)                          |
| Participant Spillover Level                                                                                           | 0%                                  |
| <b>NTGR</b>                                                                                                           | <b>0.91</b>                         |
| *Free-ridership and spillover levels were not measured in 2024, results from the 2021 Custom evaluation were applied. |                                     |

### 6.3.2 Evaluated Net Savings

Net savings represent the savings that can be reliably attributed to a service. For Building Optimization, net savings are calculated by applying the NTGR value in the following equation:

$$\text{Net Savings} = \text{Gross Savings} \times \text{NTGR}$$

The detailed net savings results are presented in Table 27. The average EUL was established at 7.9 years, and the net energy savings resulted in 311 tonnes of CO2 eq in net annual GHG emission reductions.



**Table 27: Evaluated 2024 Building Optimization Net Energy and Peak Demand Savings**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Partial Savings Claimed | Final Savings Claimed for Single-Year Projects | Total        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------------------------------------------------|--------------|
| Number of Projects                                                                                                                                                                                                                                                                                                                                                                                                                               | 2                       | 2                                              | 4            |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                         |                                                |              |
| Gross Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                        | 1.540                   | 0.318                                          | 1.858        |
| NTGR                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.91                    | 0.91                                           | 0.91         |
| Net Energy Savings – at the Meter (GWh)                                                                                                                                                                                                                                                                                                                                                                                                          | 1.402                   | 0.289                                          | 1.691        |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                | 1.0631                  | 1.0631                                         | 1.0631       |
| <b>Net Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                               | <b>1.490</b>            | <b>0.307</b>                                   | <b>1.797</b> |
| Effective Useful Life (years)**                                                                                                                                                                                                                                                                                                                                                                                                                  | 1.5                     | 3.0                                            | 1.8          |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                                                                                                                                                                                                                                      | <b>2.235</b>            | <b>0.922</b>                                   | <b>3.157</b> |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |                         |                                                |              |
| Gross Peak Demand Savings – at the Meter (MW)                                                                                                                                                                                                                                                                                                                                                                                                    | -                       | 0.086                                          | 0.086        |
| NTGR                                                                                                                                                                                                                                                                                                                                                                                                                                             | -                       | 0.91                                           | 0.91         |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                               | <b>-</b>                | <b>0.078</b>                                   | <b>0.078</b> |
| Line Loss Factor*                                                                                                                                                                                                                                                                                                                                                                                                                                | -                       | 1.0700                                         | 1.0700       |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                                                                                                                                                                                                                                           | <b>-</b>                | <b>0.083</b>                                   | <b>0.083</b> |
| <p>*The line loss factors are average values obtained by dividing gross savings at the generator by gross savings at the meter. Each Retrofit project received its own specific line loss factor depending on participant rate codes.</p> <p>**These EULs are average EUL values obtained by dividing Gross Lifetime Energy Savings by Gross Energy Savings. Each Retrofit project received its own specific EUL to obtain lifetime savings.</p> |                         |                                                |              |

## 6.4 Realization Rate

A comparison of the energy and peak demand savings values established through this evaluation and those tracked by E1 is presented in Table 28 below. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 28: Comparison of 2024 Building Optimization Tracked and Evaluated Savings at the Generator**

|                       | Gross Savings |      | NTGR  | Net Savings |      | Realization Rate |
|-----------------------|---------------|------|-------|-------------|------|------------------|
|                       | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings        |               |      |       |             |      |                  |
| Tracked Savings by E1 | 1.954         | GWh  | 0.91  | 1.778       | GWh  | 101%             |
| Evaluation Results    | 1.975         | GWh  | 0.91  | 1.797       | GWh  |                  |
|                       |               |      |       |             |      |                  |
| Tracked Savings by E1 | 0.102         | MW   | 0.91  | 0.093       | MW   | 90%              |
| Evaluation Results    | 0.092         | MW   | 0.91  | 0.083       | MW   |                  |

Evaluated energy savings were higher than those tracked by E1 due to a slight upward adjustment made to the energy savings for one project. Evaluated peak demand savings were lower than those tracked by E1 due to the correction made to the peak demand savings methodology.

## 7 Overall Savings for Custom

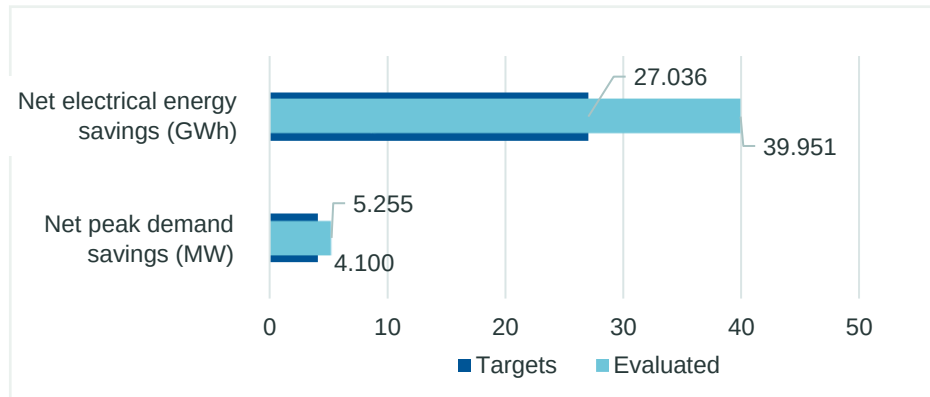
A comparison of the energy and peak demand savings values established through this evaluation and those tracked by E1 is presented in Table 29. The realization rate, representing the ratio of evaluated net savings to tracked net savings, was established at 108% for energy savings and at 105% for peak demand savings.

**Table 29: Comparison of 2024 Custom Tracked and Evaluated Savings at the Generator**

|                                                                                                                                                 |                       | Gross Savings |      | NTGR* | Net Savings |       | Realization Rate |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------|------|-------|-------------|-------|------------------|
|                                                                                                                                                 |                       | Value         | Unit | Value | Value       | Value | Unit             |
| Retrofit                                                                                                                                        | Energy Savings        |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 26.115        | GWh  | 0.79  | 20.719      | GWh   | 109%             |
|                                                                                                                                                 | Evaluation Results    | 26.355        | GWh  | 0.86  | 22.677      | GWh   |                  |
|                                                                                                                                                 | Peak Demand Savings   |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 2.688         | MW   | 0.81  | 2.169       | MW    | 106%             |
|                                                                                                                                                 | Evaluation Results    | 2.691         | MW   | 0.85  | 2.289       | MW    |                  |
| New Construction                                                                                                                                | Energy Savings        |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 20.900        | GWh  | 0.69  | 14.421      | GWh   | 107%             |
|                                                                                                                                                 | Evaluation Results    | 21.495        | GWh  | 0.72  | 15.476      | GWh   |                  |
|                                                                                                                                                 | Peak Demand Savings   |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 3.992         | MW   | 0.69  | 2.754       | MW    | 105%             |
|                                                                                                                                                 | Evaluation Results    | 4.004         | MW   | 0.72  | 2.883       | MW    |                  |
| Building Optimization                                                                                                                           | Energy Savings        |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 1.954         | GWh  | 0.91  | 1.778       | GWh   | 101%             |
|                                                                                                                                                 | Evaluation Results    | 1.975         | GWh  | 0.91  | 1.797       | GWh   |                  |
|                                                                                                                                                 | Peak Demand Savings   |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 0.102         | MW   | 0.91  | 0.093       | MW    | 90%              |
|                                                                                                                                                 | Evaluation Results    | 0.092         | MW   | 0.91  | 0.083       | MW    |                  |
| Total Custom                                                                                                                                    | Energy Savings        |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 48.969        | GWh  | 0.77  | 36.918      | GWh   | 108%             |
|                                                                                                                                                 | Evaluation Results    | 49.825        | GWh  | 0.8   | 39.951      | GWh   |                  |
|                                                                                                                                                 | Peak Demand Savings   |               |      |       |             |       |                  |
|                                                                                                                                                 | Tracked Savings by E1 | 6.782         | MW   | 0.71  | 5.017       | MW    | 105%             |
|                                                                                                                                                 | Evaluation Results    | 6.774         | MW   | 0.79  | 5.255       | MW    |                  |
| * NTGRs differ for each service. The NTGRs listed in this table match the rounded averages obtained from dividing net savings by gross savings. |                       |               |      |       |             |       |                  |

As outlined in Figure 9 below, Custom surpassed its electrical energy savings target by 48% and its peak demand savings target by 29%. Custom achieved 628.964 GWh and 486.215 GWh in gross and net lifetime electrical energy savings respectively, resulting in a weighted average EUL of 12.6 years for gross electrical energy savings and 12.2 for net electrical energy savings. The reason evaluated electrical energy and peak demand savings were much higher than the targets was likely due to partial claims made in 2024 after the targets had been set. Two compressed air leak Retrofit projects and one New Construction project with partial claims in 2024 accounted for 13.560 GWh of evaluated electrical energy savings.

**Figure 9: 2024 Custom Targets and Evaluated Results**





## 8 Custom Key Findings and Recommendations

The main objectives of the 2024 Custom evaluation were as follows:

- › Calculate gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions.
- › Collect information on participant and non-participant perspectives for New Construction.
- › Collect information on participation motivations, barriers, and the decision-making process for New Construction.

This section provides the Evaluator's key findings and recommendations in relation to these objectives. The first key findings and recommendations apply to Custom in general, while the others are specific to certain Custom services. The recommendations are also outlined in Appendix XIV.

### General Custom Key Findings and Recommendations

#### **2024 Custom-Finding: Custom net electrical energy and peak demand savings surpassed targets in 2024.**

Custom achieved 39.951 GWh in net electrical energy savings and 5.225 MW in net peak demand savings at the generator in 2024, thereby surpassing the planned electrical energy savings of 27.036 GWh by 48% and the planned peak demand savings of 4.101 MW by 28%.

#### **2024 Custom-Finding: Compared to 2023, Custom participation decreased in 2024.**

With 104 projects completed across the four Custom services,<sup>34</sup> the 2024 participation level for Custom was lower than 2023 with 114 completed projects. The number of completed projects decreased from 93 in 2023 to 75 in 2024 for Retrofit, and it decreased from 6 in 2023 to 2 in 2024 for Building Optimization. New Construction saw a large increase in participation in 2024, with 27 projects completed compared to 15 in 2023.

#### **2024 Custom-Finding: Following the project reviews, the Evaluator adjusted the energy and peak demand savings for Retrofit, New Construction, and Building Optimization.**

For Retrofit, the Evaluator adjusted energy or peak demand savings, which varied for each project category (regular Retrofit, solar PV, and compressed air leak audit projects). These adjustments resulted in an adjustment ratio of 1.012 for energy savings and 1.002 for peak demand savings.

For Building Optimization, the Evaluator adjusted the energy savings of one project and the demand savings of both reviewed projects, resulting in an adjustment ratio of 1.068 for electrical energy savings and 0.899 for peak demand savings.

For New Construction, resulting adjustment ratios for gross energy and peak demand savings were 1.028 and 1.003 respectively.

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<sup>34</sup> Custom includes four services: Retrofit (75 projects completed), New Construction (27 projects completed), Pay-for-Performance (no projects completed), and Building Optimization (two projects completed).



**2024 Custom-Finding: Retrofit free-ridership level decreased for regular Retrofit projects. New Construction free-ridership decreased slightly compared to the 2023 level.**

The overall free-ridership level for regular Retrofit projects was established at 15%. Free-ridership levels were not measured for compressed air leak audit and solar PV projects, and were therefore maintained at 38% (value from 2023) and 16% (value from 2021), respectively. Free-ridership was not measured for Building Optimization and was maintained at 9% (value from 2021).

The 2024 free-ridership level for New Construction was established at 28%, down from 31% in 2023.

Retrofit spillover was established at nil for regular Retrofit projects. Spillover was not measured for Building Optimization and therefore maintained as nil (value from 2021).

**2024 Custom-Finding: Both the evaluated net energy and peak demand savings determined by the Evaluator were higher than the savings tracked by E1.**

Evaluated net energy and peak demand savings were 8% and 5% higher than the values tracked by E1.

## **New Construction Key Findings and Recommendations**

**2024 New Construction-Finding: The demand savings calculation approach used by E1 for projects modelled in eQuest can generate results that are difficult to confirm.**

The Evaluator found minor discrepancies in demand savings when comparing results of the modelling approach used by the Evaluator to those resulting from E1's approach for projects modelled in eQuest. The approach used by E1 involves running a script directly in the eQuest modelling software, an approach not applied to projects modelled using other software.

**2024 New Construction Recommendation #1:** Review the demand savings script used for projects modelled in eQuest to ensure accurate results and favour an approach that can be applied consistently across a variety of modelling software.

**2024 New Construction-Finding: E1 expects a large industrial New Construction project to be closed in 2025.**

The Evaluator reviewed the proposed calculation methodology for this industrial project and determined that savings could be claimed for the building portion of the project prior to the final pieces of industrial equipment being installed. To support the agreed upon calculation methodology, E1 staff will conduct M&V to confirm the heat load added to the building by the installed equipment. The whole project will be evaluated following final installation of the equipment.

**2024 New Construction Recommendation #2:** Amend section 7.10 of the New Construction program guide to require M&V for large industrial New Construction projects.



**2024 New Construction-Finding: The share of completed projects supported by the service that are MURBs has increased in recent years, consistent with the growth of the MURB market inside the HRM.**

MURBs have comprised the majority of New Construction projects since 2022, and MURBs made up 24 of the 27 completed projects in 2024. Analysis of HRM building permits suggests that this participation trend generally follows the growing size of the MURB market, though there may be further opportunities to capture more non-MURB buildings, the market for which has also grown.

**New Construction-Finding: The service has a higher portion of projects inside the HRM, which is to be expected. Targeting a higher number of buildings outside the HRM may require a change in building size eligibility criteria.**

The HRM contains about half of the province's population, so a higher proportion of projects inside the HRM is expected given the density of the population in the city. In addition, building rules inside the HRM streamline permitting processes and encourage larger and faster-built buildings, whereas conditions outside the HRM are less favourable for larger buildings. The jurisdictional scan found some programs with smaller building size requirements (i.e. aligned with NECB 2020 Part 9 buildings); such an approach could be considered by E1 if the program wishes to capture a higher proportion of projects outside the HRM.

**2024 New Construction-Finding: Participants are satisfied with the program overall, particularly in terms of E1's responsiveness, and are moderately satisfied with the value of the program for their business.**

E1's responsiveness and speed of application approval received the highest satisfaction ratings. Participants reported lower satisfaction on elements related to the value of the program given the time and costs requirements for builders, and the ability to estimate a return on investment associated with the program.

**2024 New Construction-Finding: Non-participant modellers are aware of and somewhat familiar with New Construction service, including those that work on non-MURB projects.**

All three non-participant modellers interviewed work on buildings that would be eligible for New Construction (i.e. electrically heated and 15,000 square feet or larger). Only one of the three non-participant modellers said they had discussed the service with their clients.

**2024 New Construction-Finding: Decarbonization is a motivator for participating in New Construction service.**

Almost all participants answering questions about decarbonization (five out of six) reported that GHG emissions were important to their company and three said that it motivated them to participate in the service.

**2024 New Construction-Finding: Financial factors are the primary barriers for energy efficient new construction projects (higher costs of energy efficient measures, cost of energy modelling), as well as builder awareness and understanding of the benefits of energy efficient construction, and insufficient modeller participation in the service.**

These barriers appear to be consistent across both MURB and non-MURB markets.



**2024 New Construction-Finding: The share of modelling costs covered by the program's modelling incentive may be insufficient to motivate some builders.**

Both staff and modellers noted that modelling costs are increasing and that these costs can be a barrier, notably for smaller eligible projects. Further, 30% of projects hit the modelling cap in 2024, implying that for 3 out of 10 participants, the modelling incentive is not covering half their modelling costs. The jurisdictional scan indicated that several jurisdictions have higher modelling incentive offers (either in portion of costs covered or cap) than E1.

**New Construction Recommendation #3:** Investigate the impact of increasing modelling incentives (the share of modelling costs covered as well as the incentive cap) on the service.

**2024 New Construction-Finding: The program component would benefit from additional supporting energy modellers.**

Historically one energy modeller supported most of the New Construction service projects. E1 has worked to bring in more modellers to the program and in 2024, five energy modellers participated in the program. Further efforts should be taken to ensure a diverse group of modellers are aware of and engaged in the program.

**New Construction Recommendation #4:** Endeavour to recruit new energy modellers through targeted outreach; modellers put a premium on networking opportunities with builders.

**New Construction Recommendation #5:** Consider collaborating with educational institutions and professional associations for energy modelling to build a stronger pipeline of qualified and engaged energy modellers across Nova Scotia.

**2024 New Construction-Finding: The service should prepare for the shift to NECB 2020 in Nova Scotia. Builders will need to adjust designs, plan for higher efficiency technologies and higher upfront costs, and work closely with energy modellers under the new code.**

Nova Scotia will phase in Tiers 1, 2, and 3 of NECB 2020 over 2025–2029. The jurisdictional scan noted three programs that have aligned with NECB 2020 code adopted in their province. Participants and modellers are mixed in terms of how the code could impact program participation. Three jurisdictions scanned (BC Hydro, New Brunswick Power, and Efficiency Manitoba) all do this.

**New Construction Recommendation #6:** The program should increase targeted outreach and educational activities for builders and energy modellers related to the code shift and its impacts, particularly those involving technologies (including electrification), costs, and energy efficiency improvements. By providing practical guidance on meeting new requirements and exceeding them with the program's support, the program can position itself as a valuable resource while increasing program awareness and encouraging more participation.

**New Construction Recommendation #7:** Review the program guidelines and update to align with NECB 2020, which will be adopted in April 2025.

**New Construction Recommendation #8:** Investigate aligning implementation incentives with NECB 2020 Tiers. Such alignment would need to consider the phased-in adoption of NECB 2020 Tiers 1–3 over 2025–29.



**2024 New Construction-Finding:** The logic model is out of date and does not sufficiently document the program barriers or the activities currently being undertaken by the program to address these barriers.

The Evaluator found that the program's activities are aligned with the barriers identified in the evaluation. However, the logic model and theory of change do not reflect this and needs to be updated to capture the reality of the market barriers and program activities today.

**New Construction Recommendation #9:** E1 should update the Custom New Construction logic model to document and address current barriers and update the theory of change to include all activities being carried out to address these barriers.



## 9 SEM Overview

This section describes the Strategic Energy Management (SEM) program component, follows up on past evaluation recommendations, and provides an overview of participation history.

### 9.1 SEM Description

SEM provides industrial and institutional participants with funding and support to implement energy management practices within their organizations. It also provides participants with energy management information system (EMIS) implementation support.

SEM helps participants achieve continuous energy savings by offering a structured approach to identifying, prioritizing, and completing energy-saving actions through the implementation of energy management policies and processes. To be eligible, participants must possess the necessary resources to implement energy efficient improvements, demonstrate commitment to energy management, and identify committed personnel to work in collaboration with E1 throughout the duration of projects.<sup>35</sup> Activities are conducted through a third-party Service Provider that delivers the program component. Participants commit to participating for 12 months, although E1 offers additional years to participants who want to continue operating the energy management system. SEM participants can also obtain funding for an EMIS, which is an additional tool that assists participants in using energy consumption data from metered systems to inform decisions about their processes. This funding may be used to conduct an EMIS audit, develop and implement an EMIS plan that involves the configuration of metering and monitoring equipment, as well as procure training and organizational support.

SEM provides participants with energy Kaizens<sup>36</sup> and mapping, treasure hunts,<sup>37</sup> energy management assessments, as well as performance monitoring and reporting tools. SEM also provides employee training and organizational support for the implementation of energy management engagement activities that use energy performance information to prompt actions aimed at achieving behavioural change and operation and maintenance related energy-saving measures. Ultimately, SEM helps develop an energy management plan focused on changing business practices to enhance long-term energy performance.

Figure 10 below illustrates the SEM participation process along with details about the program component.

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<sup>35</sup> An SEM project is defined as the implementation of a strategic energy management system in a facility.

<sup>36</sup> Energy Kaizens are activities aimed at continuously improving energy consumption by identifying waste and focusing on eliminating it.

<sup>37</sup> These consist of walkthroughs of plants aimed at identifying energy-saving opportunities.

**Figure 10: 2024 SEM Participation Process Summary**



Starting in 2021, SEM participants have been offered performance-based incentives for the savings achieved through the program component. The objectives of this incentive are to facilitate recruitment and encourage the completion of energy efficiency projects. SEM participants may enroll in the Large Industrial initiative aimed at filling energy management capacity gaps for large industrial customers; as such, they receive additional support in the form of a dedicated industrial energy manager (IEM), and the savings they achieve through SEM are incentivized at \$0.06/kWh. SEM participants who are not part of the Large Industrial initiative also receive a performance-based incentive although at a lower rate of \$0.04/kWh.

SEM was aimed at generating net electrical energy savings of 4.222 GWh and peak demand savings of 0.470 MW at the generator in 2024.

## 9.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated SEM in previous years and issued improvement recommendations. Table 30 provides a summary of the implementation status of the recommendations presented in the Executive Summary section of the 2023 SEM Evaluation Report.

**Table 30: Implementation Status of Past Recommendations for SEM**

| #           | Recommendations                                                                                                                                                   | Status      | Comments                                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2023-SEM-R1 | Consider including plant-level key performance indicators (KPIs) and tracking their progression since program component inception in participant reporting.       | In progress | In 2024, E1 program staff worked with the SEM service provider to determine which plant-level KPIs to include in participant reporting. In 2025, E1 staff will continue to work with the SEM service provider to determine and implement plant-level KPIs in participant reporting.                                                                    |
| 2023-SEM-R2 | Track the number of projects implemented by SEM participants and the resulting savings from capital projects incented in Business Energy Rebates (BER) or Custom. | Complete    | In 2024, E1 program staff tracked projects implemented by Strategic Energy Management (SEM) participants and detailed the resulting savings from capital projects incented in BER or Custom. Details on projects, savings, and incentives were provided in the final SEM tracking sheet submitted for the 2024 evaluation process.                     |
| 2023-SEM-R3 | Better communicate the value of energy management to both participants and non-participants, including its decarbonization potential.                             | In progress | In 2024, E1 program staff worked with other departments to ensure messaging on decarbonization was clear and that participants fully understood all of the benefits associated with SEM. In addition, program staff discussed this recommendation with the SEM Service Provider that subsequently added this topic to their regular customer meetings. |

## 9.3 Participation History

There were 12 active participants in SEM in 2024, nine continuing participants and three new participants. Moreover, seven of the 12 active participants achieved savings in 2024. The electrical energy savings level was at its highest since program inception in 2015, slightly above 2023 results; this can be attributed to two participants who in total contributed 69% of total electrical energy savings. Figure 11 and Figure 12 below illustrate the participation and savings trends since 2018 respectively.

Figure 11: Overview of SEM Participation, 2018-2024<sup>38</sup>

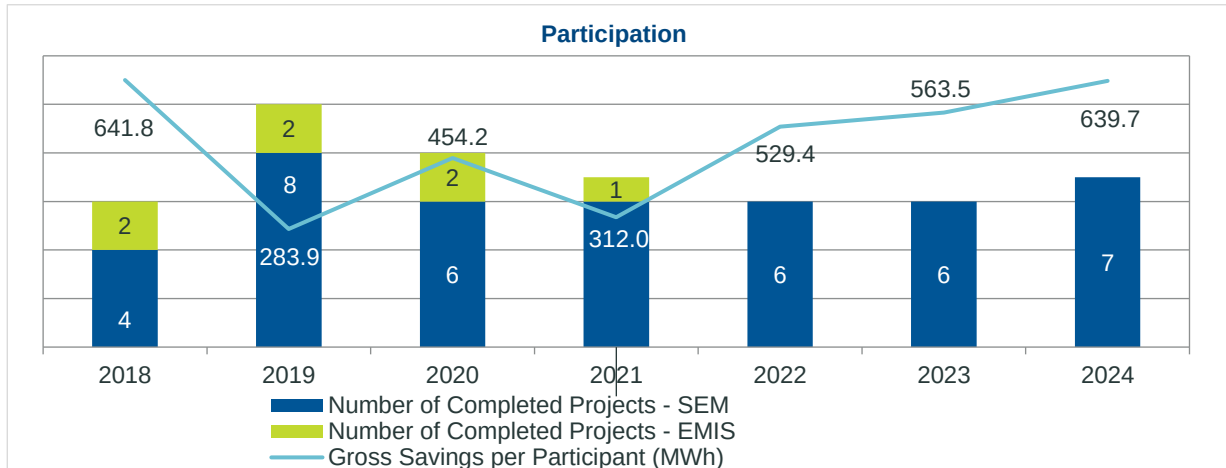
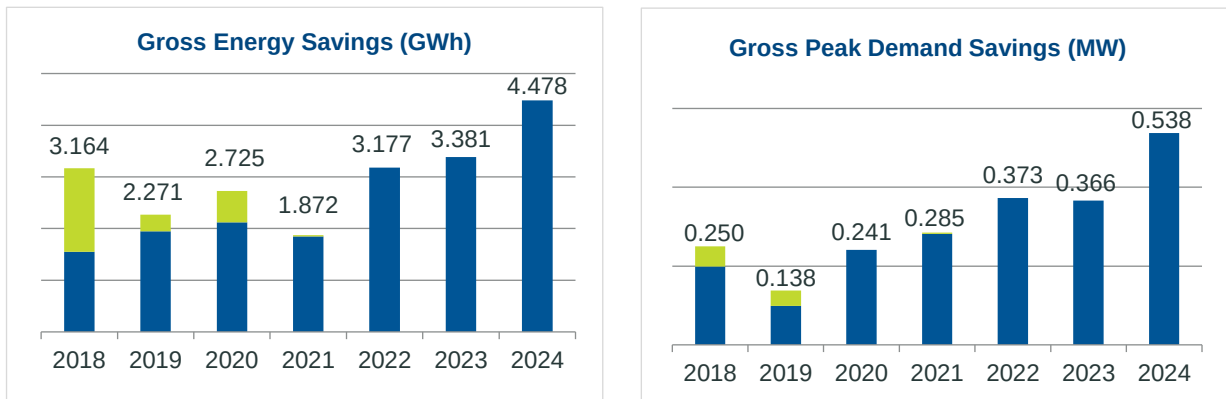


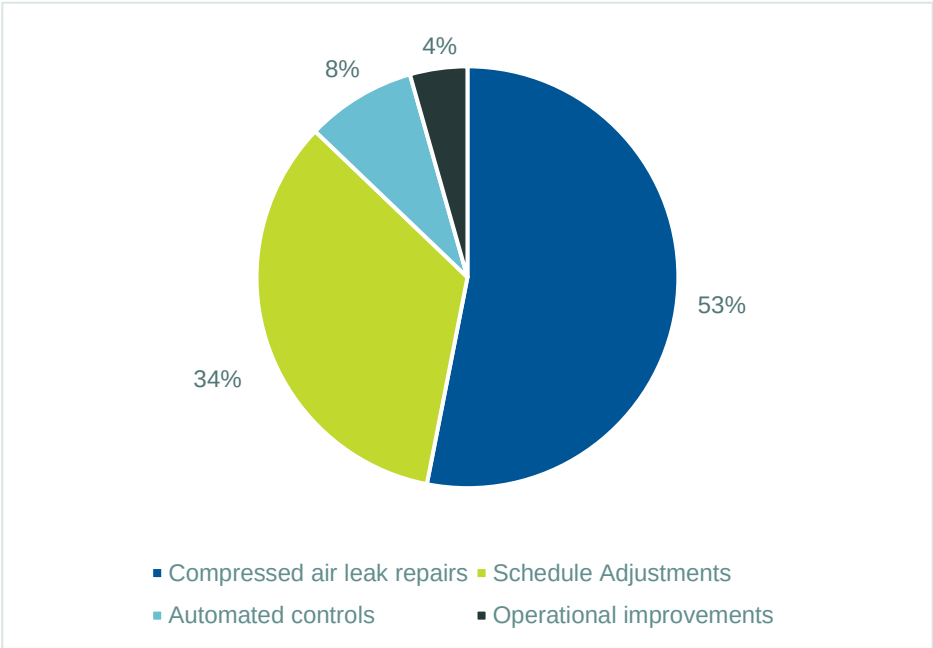
Figure 12: Evolution of SEM Gross Savings, 2018-2024



Similarly to 2023, most SEM electrical energy savings are the result of compressed air leak repair measures as illustrated in Figure 13 below. Of the 21 measures implemented by participants in 2024, five were compressed air leak repairs, 53% of which contributed to 2024 electrical energy savings.

<sup>38</sup> The 2019 savings values per participant are based only on the savings that occurred in 2019. In this graph and the following, EMIS savings were included in historical data – they are presented in green.

Figure 13: Distribution of 2024 SEM Energy Savings per Measure Category



## 10 SEM Evaluation Approach

The 2024 SEM evaluation comprised a comprehensive impact evaluation. The main objectives of the SEM evaluation were as follows:

- › Calculate SEM gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, and avoided GHG emissions.

The Evaluator identified key research questions aimed at achieving these objectives. Table 31 outlines the evaluation objectives and maps them to the Evaluator's research questions, methods, and sample sizes (n). Each method is described further below.

**Table 31: 2024 SEM Evaluation Approach**

| Evaluation Objectives   | Research Questions                                                                                                                                                                                                                                                                                                                                                             | Methodology                                                                                                                                                                                               |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› Are the gross savings for each project accurately calculated?</li><li>› Have the correct EUL values been applied to each measure?</li><li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Project file reviews with participant follow-up interviews or site visit</li><li>› Calculations using evaluation results</li></ul> |
| Calculate net results   | <ul style="list-style-type: none"><li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li><li>› What are the net avoided GHG emissions in CO2 eq?</li></ul>                                                                                                                                                                    | <ul style="list-style-type: none"><li>› Calculations using evaluation results</li><li>› Avoided GHG emission reduction calculations</li></ul>                                                             |

### Tracking Sheet Audit

Prior to performing the savings review, the Evaluator audited the final 2024 tracking sheet to ensure it was complete and data entry was consistent. The detailed protocol used for the tracking sheet audit and the results obtained are presented in Appendix XV.

### Project File Reviews

In January 2024, a total of seven project reviews were conducted, one for each participant that generated savings. Of these project reviews, three were supported by phone interviews, while site visits were conducted for one other participant – the other projects did not require clarifications from participants; therefore, no interview was needed. The desk reviews and phone interviews were conducted by Econoler. Equilibrium Engineering conducted one site visit for the only new participant that generated savings in 2024; the participant questions and equipment visited during that visit were guided by the results of the project review performed by the Evaluator ahead of the visit. The Evaluator also contacted the Service Provider for clarifications where necessary.

The protocol used to conduct the interviews and project reviews is presented in Appendix XVI, while detailed project review adjustments are provided in Appendix XVI.

### Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime gross energy and peak demand savings as per the calculation methodology presented in Section 11 below.

## GHG Emission Reduction Calculations

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for SEM, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.





## 11 SEM Impact Evaluation

The objectives of the 2024 SEM comprehensive impact evaluation were to determine project gross and net electrical energy and peak demand savings as well as annually avoided GHG emissions, EUL values, and associated lifetime electrical energy savings.

### 11.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The results obtained from the tracking sheet audit are presented in Appendix XV. The tracked savings results presented in this report therefore refer to the corrected tracked savings obtained by the Evaluator.

### 11.2 Gross Savings

For SEM, gross savings correspond to the change in energy consumption resulting from actions taken by participants regardless of their reasons for participating.<sup>39</sup> The subsections below provide a description of the methodology used to review the seven SEM projects that generated savings in 2024 and a summary of the review findings. Interactive effects, EUL values, and revised gross electrical savings were also assessed.

#### 11.2.1 Project Review Findings

The Evaluator reviewed the calculation methodologies for the seven projects based on project documentation and information from interviews with participants and the Service Provider. All but two projects used a bottom-up approach to quantifying savings by applying a distinct M&V methodology for each measure, which is consistent with how Custom Retrofit savings are typically measured. While the bottom-up approach to quantifying savings has been the preferred approach since 2022, a top-down approach is appropriate in cases where a measure impacts the entire facility, making interactive effects difficult to quantify or when monitoring individual components is not feasible. In these cases, savings are determined by continuously measuring the energy consumption and demand at the whole facility level during the reporting period. The Service Provider selected a bottom-up or top-down approach in a manner that is consistent with the M&V procedure developed by the Service Provider and approved by the Evaluator.

The M&V reports for each measure were complete and provided a clear understanding of the measures and the savings quantification approach. In nearly all cases, the Evaluator found the overall M&V methodology to be thorough and in alignment with best practices, including the usage of pre- and post-measurements at the measure level (in the case of bottom-up approaches) or at the facility level (in the case of top-down approaches). For compressed air measures specifically, the M&V approach applied by participants involved measuring the airflow of each leak using an ultrasound leak detector and validating that the leak was no longer detectable after the repair. As part of the review, the Evaluator ensured that no leaks were reported twice and that the conversion from cubic feet per minute of compressed air to kW was performed using a conservative compressor efficiency if no compressor efficiency measurement specific to the given facility was available. No adjustments were made to the electrical energy or peak demand savings of any compressed air leak projects since they all followed this methodology correctly.

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<sup>39</sup> Definition adapted from National Renewable Energy Laboratory, The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices, September 2014, p. 3.



The exception to M&V being aligned with best practices was the calculation of peak demand savings for the two projects that used a top-down approach to measure savings. In these cases, the Evaluator concluded that dividing the energy savings by the total number of hours in the year (i.e. 8,760 hrs) produced a conservative estimate of peak demand savings. For one of these projects, it was found that, by analyzing the hourly interval data to determine peak demand savings, the Evaluator was able to increase the savings by a factor of three.

The Evaluator made a few adjustments to electrical energy and peak demand savings in addition to a change in methodology for the top-down peak demand savings calculation. The Evaluator adjusted electrical energy savings for three measures across two separate projects. For one project, a calculation error in the spreadsheet led to a 0.5% decrease in measure electrical energy savings. A second measure in the same project was updated due to an overestimation of operating hours, resulting in an 8.5% decrease in measure electrical energy savings. The second project, to which a top-down M&V approach was applied, underestimated the electrical energy savings from a non-routine adjustment relating to a new pump installation. This adjustment resulted in a 0.1% decrease in project electrical energy savings.

The Evaluator also adjusted the peak demand savings claimed for four projects, with three downward and one upward adjustment. One project had adjustments made to account for how data was processed in a spreadsheet, which resulted from the use of an extra interval of energy data in the calculations. For this project, peak demand savings were decreased by 3% from 54.4 kW to 53.0 kW. In another project, an operational change in how scrap material was reintroduced led to decreased energy consumption on the weekends and a slight increase in peak demand during the week. This resulted in a downward adjustment to peak demand savings from 0 kW to -1.2 kW as the measure led to an overall increase to demand during the peak coincident period. Another downward adjustment was made to the peak demand savings for two vacuum pump sequencing measures. In both cases, the interval data was not collected during the winter peak months of December to February. Although the peak demand savings calculated included data from peak hours between 5 p.m. to 7 p.m., the data included values collected from holidays and weekends. Since the collected interval data was limited and did not align with the coincident peak hours, the Evaluator updated the peak demand savings to ensure the estimated savings were conservative. In this case, assuming a peak coincidence factor of 1 resulted in an 18% decrease in peak demand savings for the project. The last adjustment resulted in a 301% increase to peak demand savings. In this project, an operational change allowed for two molding machine lines to be decommissioned. The Evaluator based this adjustment on facility hourly interval data for the coincident peak demand period during the reporting period as opposed to using an engineering calculation to estimate savings.

Overall, the adjustment ratios for both the gross and net electrical energy and peak demand savings were 1.000 and 1.002 respectively.

### 11.2.2 Interactive Effects

For each project reviewed, the Evaluator validated if interactive effects should have been considered and concluded that no interactive effects impacted the concerned measures. Hence, no additional interactive effects were applied to measured savings.

### 11.2.3 Effective Useful Life

As part of the 2024-2025 Demand-side Management Measure Assessment (DSM MA)<sup>40</sup> activities, the Evaluator reviewed the EUL values for all measure categories to ensure they were still valid and revised them where appropriate. For all projects, the Evaluator estimated the proportion of savings achieved by measure and assigned a measure-specific EUL in accordance with the EUL values found in the 2024-2025 DSM MA. This resulted in a weighted average EUL of 2.6 years.

### 11.2.4 Evaluated Gross Savings

The 2024 evaluated SEM gross energy and peak demand savings at the generator are listed in Table 32 below.

The gross energy and peak demand savings at the generator were estimated by using different line loss factors between the meter and the generator for energy and peak demand savings based on each facility rate code and line loss factor values drawn from the 2014 Cost of Service Study Progress Update.<sup>41</sup>

**Table 32: Evaluated 2024 SEM Gross Electrical Energy and Peak Demand Savings**

|                                                               | New Projects | Continuing Projects | Total         |
|---------------------------------------------------------------|--------------|---------------------|---------------|
| <b>Number of Projects</b>                                     | <b>1</b>     | <b>6</b>            | <b>7</b>      |
| <b>Energy Savings</b>                                         |              |                     |               |
| Tracked Gross Energy Savings (GWh)                            | 1.186        | 3.083               | 4.269         |
| Adjustment Ratio for Energy Savings                           | 1.000        | 0.999               | 1.000         |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>1.186</b> | <b>3.081</b>        | <b>4.267</b>  |
| Line Loss Factor                                              | 1.0547       | 1.0473              | 1.0493        |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>1.251</b> | <b>3.227</b>        | <b>4.478</b>  |
| Equivalent Effective Useful Life (years)                      | 3.0          | 2.4                 | 2.6           |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>3.753</b> | <b>7.829</b>        | <b>11.581</b> |
| <b>Peak Demand Savings</b>                                    |              |                     |               |
| Tracked Gross Peak Demand Savings (MW)                        | 0.135        | 0.377               | 0.512         |
| Adjustment Ratio for Peak Demand Savings                      | 1.000        | 1.003               | 1.002         |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.135</b> | <b>0.378</b>        | <b>0.513</b>  |
| Line Loss Factor                                              | 1.0558       | 1.0457              | 1.0484        |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.143</b> | <b>0.395</b>        | <b>0.538</b>  |

As presented in Table 33, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>42</sup> for GHG emissions generated by electricity production to SEM gross savings.

<sup>40</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through EfficiencyOne's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the remainder of the evaluations to be conducted during the 2023-2025 DSM cycle, the Evaluator will refer to the values presented in the 2024-2025 DSM MA

<sup>41</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1. For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed.

<sup>42</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO<sub>2</sub> eq tonnes) and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27,

**Table 33: Evaluated 2024 SEM Gross GHG Emission Reductions**

|                                                                                             | Total |
|---------------------------------------------------------------------------------------------|-------|
| Gross Energy Savings – at the Generator (GWh)                                               | 4,478 |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) | 472.2 |
| Gross Annual GHG Emission Reductions (tonnes of CO2 eq)                                     | 2,114 |

## 11.3 Net Savings

The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to the program component, by estimating the NTGR. More precisely, the NTGR represents the positive or negative impacts of spillover and free-ridership effects on gross savings.

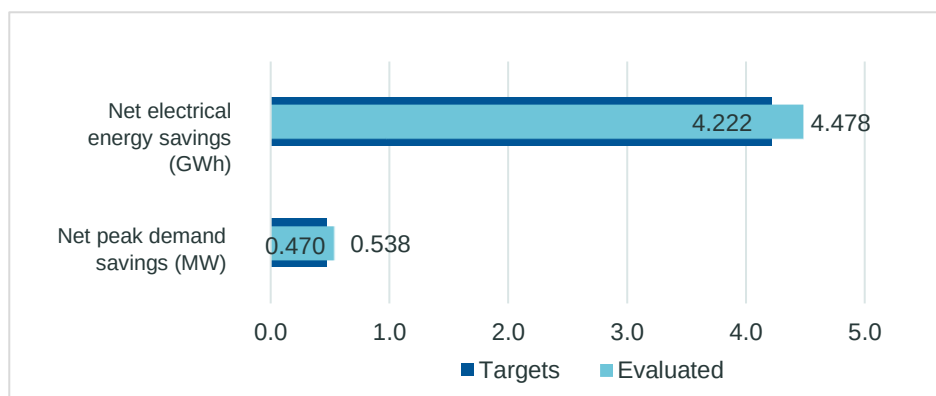
As recommended in the 2023 evaluation, the Evaluator applied the assumption that the SEM NTGR was equal to 1.

### 11.3.1 Evaluated Net Savings

Since spillover and free-ridership effects were considered nil, net SEM impacts are equal to the gross savings generated by the program component. The 2024 SEM net electrical energy and peak demand savings were estimated at 4.478 GWh and 0.538 MW at the generator respectively. The net electrical energy savings resulted in 2,114 tonnes of CO2 eq in net annual GHG emission reductions.

As outlined in Figure 14 below, SEM surpassed its electrical energy and peak demand savings targets by 6% and 14% respectively.

**Figure 14: 2024 SEM Targets and Evaluated Results**



## 11.4 Realization Rate

A comparison of the electrical energy and peak demand savings established through this evaluation and those tracked by E1 is presented in Table 34 below. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both electrical energy savings and peak demand savings.

2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).

**Table 34: Comparison of 2024 SEM Tracked and Evaluated Savings at the Generator**

|                                                                                                                     | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|---------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                     | Value         | Unit | Value | Value       | Unit | Value            |
| Energy Savings                                                                                                      |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                               | 4.480         | GWh  | 1.00  | 4.480       | GWh  | 100%             |
| Evaluation Results                                                                                                  | 4.478         | GWh  | 1.00  | 4.478       | GWh  |                  |
| Peak Demand Savings                                                                                                 |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                               | 0.537         | MW   | 1.00  | 0.537       | MW   | 100%             |
| Evaluation Results                                                                                                  | 0.538         | MW   | 1.00  | 0.538       | MW   |                  |
| * The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for SEM. |               |      |       |             |      |                  |

The evaluated net electrical energy savings were less than 1% below the tracked value due to two projects whose savings were slightly adjusted downward.

The evaluated peak demand savings were less than 1% above the tracked value due to three projects that saw their peak demand savings decreased and one project that saw its peak demand increased.



## 12 SEM Key Findings and Recommendations

As mentioned previously, the main objectives of the 2024 SEM evaluation were as follows:

- › Calculate SEM gross and net results, namely electrical first-year and lifetime energy savings, peak demand savings, and avoided GHG emissions.

This section presents the Evaluator's key findings related to the above objectives. The Evaluator has no recommendations pursuant to the 2024 SEM evaluation.

### **2024 SEM-Finding: SEM exceeded its net electrical energy and peak demand savings targets.**

In 2024, SEM achieved 4.478 GWh and 0.538 MW in net electrical energy and peak demand savings respectively. Electrical energy savings were 6% above the planned energy savings of 4.222 GWh and 14% above the planned peak demand savings of 0.470 MW.

### **2024 SEM-Finding: The SEM participation level has remained stable over the past five years. Electrical energy savings per participant were similar to those in 2023.**

There were 12 participants in SEM in 2024, nine continuing participants and three new participants. Moreover, seven of the 12 participants completed projects with savings in 2024, which corresponds to the average for the previous five years.

### **2024 SEM-Finding: The M&V methodologies applied to quantify savings were generally appropriate and accurate. The quality of peak demand savings estimates was greatly improved compared to previous years.**

While there continued to be adjustments to electrical energy savings and peak demand savings, these adjustments were less than 1%. While not perfect, the Service Provider appears to be more consistently applying the guideline written by E1 for calculating peak demand savings.

## CONCLUSION

Table 35 presents the participation levels, net-to-gross ratios (NTGRs), evaluated gross and net savings at the generator, annual GHG emission reductions, as well effective useful life (EUL) values for each Custom Incentives program component and for the program as a whole.

**Table 35: Overall 2024 Custom Incentives Participation and Evaluated Savings**

|                                                                                                                  | Participation Level |                    | Gross Savings |                  | NTGR* | Net Savings |                  |
|------------------------------------------------------------------------------------------------------------------|---------------------|--------------------|---------------|------------------|-------|-------------|------------------|
|                                                                                                                  | Value               | Unit               | Value         | Unit             | Value | Unit        | Value            |
| Custom                                                                                                           |                     |                    |               |                  |       |             |                  |
| Energy Savings                                                                                                   | 104                 | Projects completed | 49.825        | GWh              | 0.80  | 39.951      | GWh              |
| Lifetime Energy Savings                                                                                          |                     |                    | 628.964       | GWh              | 0.78  | 488.215     | GWh              |
| Peak Demand Savings                                                                                              |                     |                    | 6.774         | MW               | 0.78  | 5.255       | MW               |
| Annual GHG Emission Reductions                                                                                   |                     |                    | 23,527        | Tonnes of CO2 eq | 0.80  | 18,865      | Tonnes of CO2 eq |
| EUL                                                                                                              |                     |                    | 12.6          | Years            |       | 12.2        | Years            |
| SEM                                                                                                              |                     |                    |               |                  |       |             |                  |
| Energy Savings                                                                                                   | 7                   | Projects completed | 4.478         | GWh              | 1     | 4.478       | GWh              |
| Lifetime Energy Savings                                                                                          |                     |                    | 11.581        | GWh              | 1     | 11.581      | GWh              |
| Peak Demand Savings                                                                                              |                     |                    | 0.538         | MW               | 1     | 0.538       | MW               |
| Annual GHG Emission Reductions                                                                                   |                     |                    | 2,114         | Tonnes of CO2 eq | 1     | 2,114       | Tonnes of CO2 eq |
| EUL                                                                                                              |                     |                    | 2.6           | Years            |       | 2.6         | Years            |
| Total                                                                                                            |                     |                    |               |                  |       |             |                  |
| Energy Savings                                                                                                   | 111                 | Projects completed | 54.303        | GWh              | 0.82  | 44.429      | GWh              |
| Lifetime Energy Savings                                                                                          |                     |                    | 640.545       | GWh              | 0.78  | 499.796     | GWh              |
| Peak Demand Savings                                                                                              |                     |                    | 7.312         | MW               | 0.79  | 5.793       | MW               |
| Annual GHG Emission Reductions                                                                                   |                     |                    | 25,641        | Tonnes of CO2 eq | 0.82  | 20,979      | Tonnes of CO2 eq |
| EUL                                                                                                              |                     |                    | 11.8          | Years            |       | 11.2        | Years            |
| * The NTGRs listed in this table match the rounded averages obtained from dividing net savings by gross savings. |                     |                    |               |                  |       |             |                  |

Figure 15 and Figure 16 below respectively illustrate the net electrical energy and peak demand savings targets for each program component and Custom Incentives as a whole as well as whether targets were achieved in 2024. Custom Incentives was aimed at achieving 31.258 GWh in net electrical energy savings and 4.571 MW in net peak demand savings at the generator for 2024. The program surpassed both the net electrical energy and demand savings targets. Custom was the largest contributor to total program net electrical energy and peak demand savings.

**Figure 15: 2024 Custom Incentives Targeted and Evaluated Net Energy Savings**

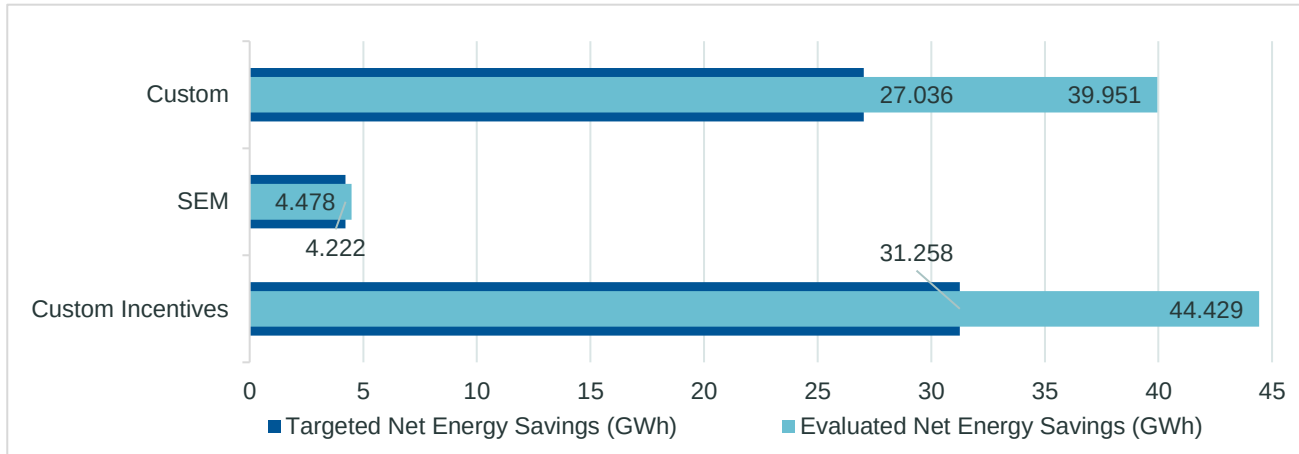
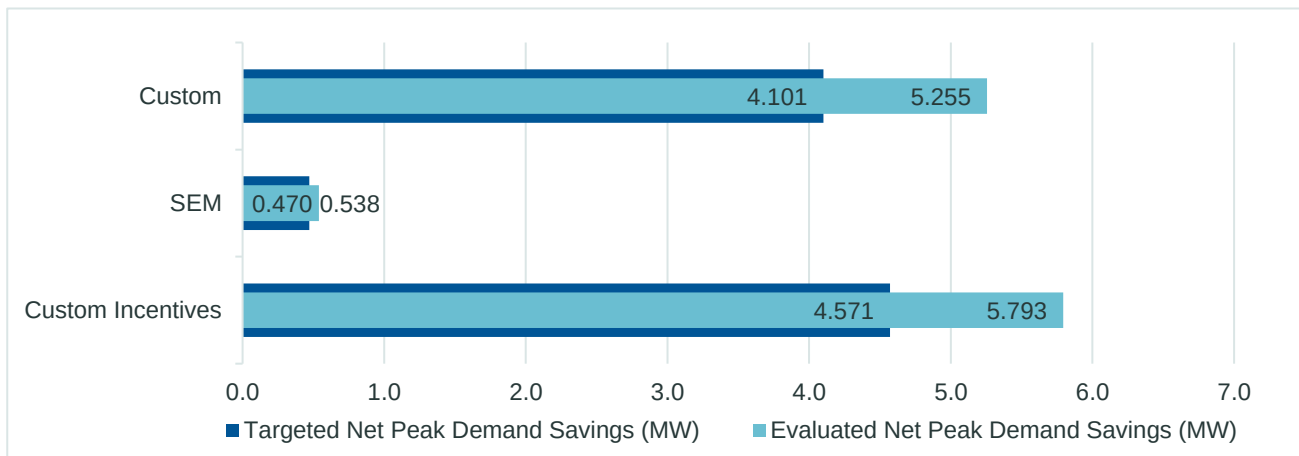


**Figure 16: 2024 Custom Incentives Targeted and Evaluated Net Peak Demand Savings**





## LIST OF APPENDICES

The following are presented in the Custom Incentives Program – Appendices document.

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Appendix II: Retrofit Algorithm for Free-Ridership Calculation

Appendix III: Retrofit Algorithm for Participant Spillover Calculation

Appendix IV: Retrofit and Building Optimization Tracking Sheet Audit

Appendix V: Retrofit and Building Optimization Project Review Protocols

Appendix VI: Custom Adjustment Ratio Calculation Example

Appendix VII: New Construction Participant Phone Interview Guide (CPA Stage)

Appendix VIII: New Construction Participant Interview Guide (Completed Projects)

Appendix IX: New Construction Non-Participant Modeler Guide

Appendix X: New Construction Program Manager and Business Development Manager Interview Guide

Appendix XI: New Construction Energy Model Review Protocol

Appendix XII: New Construction Algorithm for Free-Ridership Calculation

Appendix XIII: New Construction Tracking Sheet Audit

Appendix XIV: Custom 2024 Recommendations

### SEM

Appendix XV: SEM Tracking Sheet Audit

Appendix XVI: SEM Project Review Protocol

Appendix XVII: SEM Detailed Project Review Adjustments

Appendix XVIII: SEM 2024 Recommendations



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EfficiencyOne

# CUSTOM INCENTIVES PROGRAM

Final Appendix Report

2024 DSM EVALUATION

March 26, 2025

In collaboration with:





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## APPENDIX I

### Retrofit Participant Interview Guide

#### CUSTOM RETROFIT

#### PARTICIPANT INTERVIEW GUIDE

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument              |
|---------------------------------|------------------------------|
| Instrument Type                 | Interview                    |
| Estimated Time to Complete      | 30 min.                      |
| Target Audience                 | Custom Retrofit participants |
| Expected Number of Completions  | Retrofit up to 15            |
| Contact List Source             | E1                           |
| Fielding Firm                   | Narrative                    |
| Estimated Timeline for Fielding | October - November           |

Table 2: Research Objectives and Associated Questions

| Research Objectives                 | Section |
|-------------------------------------|---------|
| Identifying Key Decision-makers     | A       |
| Awareness and Participation         | B       |
| Free-ridership                      | C       |
| Cross-influence                     | D       |
| Spillover                           | E       |
| Measurement and Verification        | F       |
| Decarbonization and Electrification | G       |
| Barriers                            | H       |
| Satisfaction                        | I       |

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Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**

## Introduction

I am with \_\_\_\_\_ and we are conducting an evaluation of the Custom Retrofit program offered by Efficiency Nova Scotia.

This interview could take up to 30 minutes. Is this still a good time for you?

We would like to better understand your organization's decision-making process regarding the energy efficiency project you completed as part of the Custom Retrofit program. We are looking to understand how you made the decision to implement your energy efficiency Retrofit\* project for the building located at **[SPECIFY LOCATION\*]**. We will refer to this as your decision "to implement your energy efficiency project" throughout this interview.

**\*[IF MORE THAN ONE COMPLETED PROJECT IS BEING REVIEWED]** This interview specifically refers to the following projects that you have implemented **[SPECIFY PROJECT NAMES AND LOCATIONS]**, so please think of both of/all these projects when answering the questions. Let me know during the interview when and how your responses differ by project.

Your responses will be kept confidential, and results from all interviews will be provided in aggregate format. Your responses will not affect the incentive amount you have or will receive for this project.

### A. Identifying Key Decision-makers

A1. We would like to speak with someone that played a key role in the financial decision to implement the energy efficiency project for your organization. Are you that person?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

A2. **[IF A1=YES OR DK/REFUSE]** Please describe your role in the decision-making process for this project.

96. Specify:

A3. **[IF A1=NO]** Could you provide the name, role, and contact information for someone who played a key role in the decision to implement the energy efficiency project? **[RECORD INFORMATION; THANK & TERMINATE AND REACH OUT TO NEW CONTACT]**

Specify Name:

Specify role:

Specify contact info (email and/or phone):

## B. Awareness and Participation

- B1. Without commenting on your participation in the Custom Retrofit program for now, why did your organization decide to implement the energy efficiency upgrades we are discussing today?  
**[DO NOT READ]**

Specify:

Pre-coded answers **[DO NOT READ]**:

1. Lower operation costs
2. Energy policy in my organization
3. Environmental reasons/energy efficiency
4. Competitors are doing it
98. Don't know
99. Refused

- B2. How did you first hear about the Custom Retrofit program?

Specify

- B3. Why did your organization decide to participate in the Custom Retrofit program?

Specify:

## C. Free-ridership

- C1. Had your organization finalized the design and planning of the energy efficiency project BEFORE knowing that you would receive an incentive from Efficiency Nova Scotia?

1. Yes
2. No
98. Don't know
99. Refused

- C2. **[IF C1=YES]** When you decided to move forward with the energy efficiency project, how confident were you that you would receive an incentive from Efficiency Nova Scotia? Were you **[READ]**?

1. Very confident
2. Somewhat confident
3. Not very confident
4. Not at all confident
98. (Don't know)
99. (Refused)



Efficiency Nova Scotia gave your organization a rebate of \$<STUDY INCENTIVE> for the [INVESTIGATION OR FEASIBILITY] study and \$<IMPLEMENTATION INCENTIVE> for the project implementation, totalling <TOTAL> in incentives for your project.

C3. I would like to understand the impact of this incentive on the financial case for your project. To what extent did these financial incentives improve the payback period for this project?

1. The financial incentives improved the payback period by a **very** significant margin; or
2. The financial incentives improved the payback period by a **somewhat** significant margin; or
3. The financial incentives **DID NOT** improve the payback period by a significant margin

98. (Don't know)

99. (Refused)

C4. Without the implementation incentive, what is the likelihood that you would have paid the full amount for your energy efficiency project? [READ]

1. Definitely would have.
2. Probably would have.
3. Probably would not have.
4. Definitely would not have.

98. (Don't know)

99. (Refused)

**[ASK IF \$<STUDY INCENTIVE> ≥ 0]**

C5. As part of its Custom Retrofit program, Efficiency Nova Scotia gave your organization a \$<STUDY INCENTIVE> incentive for the [Investigation or Feasibility] study. Without this incentive, what is the likelihood that you would have conducted this study? [READ]

1. Definitely would have.
2. Probably would have.
3. Probably would not have.
4. Definitely would not have.

98. (Don't know)

99. (Refused)

C6. **[ASK IF C5 ≠ 98 OR 99]** Did you use the study as a decision-making tool during the planning stage, to compare and select the potential measures for the energy efficiency project?

1. Yes
2. No
98. Don't know
99. Refused



- C7. You received a \$<IMPLEMENTATION INCENTIVE> implementation incentive based on the energy savings achieved by your energy efficiency project once completed. Without the implementation incentive from Efficiency Nova Scotia, which of the following scenarios would have been the most likely? **[READ]**
1. You would have implemented the exact same energy efficiency project.
  2. You would have implemented a project with fewer or less impactful energy efficiency measures.
  3. You would have implemented the exact same energy efficiency **but** delayed the project by at least a year.
  4. You would not have implemented the project at all.
  98. (Don't know)
  99. (Refused)
- C8. Did your organization use the services of an Onsite Energy Manager (OEM) before implementing the project?
1. Yes
  2. No
  98. Don't know
  99. Refused
- C9. **[IF C8 = YES]** How does having an On-site Energy Manager (OEM) add value to your organization?
- C10. I would like you to rate the importance of the following factors on your decision to implement energy efficiency measures through the Custom Retrofit program, as either very important, somewhat important, not very important, not at all important.

| Factor <b>[READ AND RANDOMIZE]</b>                                                                                                                                                                                                | Responses                   |                                  |             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------------|-------------|
| a. The program financial incentive for the <b>[Investigation or Feasibility Study]</b> .                                                                                                                                          | ___ Response                | ___ 98 Don't Know                | ___ Refused |
| b. The program financial incentive for the implementation of the energy efficiency measures.                                                                                                                                      | ___ Response                | ___ 98 Don't Know                | ___ Refused |
| c. The information from the <b>[Investigation or Feasibility Study]</b> on the energy savings associated with each potential measure.                                                                                             | ___ Response                | ___ 98 Don't Know                | ___ Refused |
| d. The recommendations and technical assistance provided by the Business Development Manager, or other Efficiency Nova Scotia staff on the energy efficiency measures.                                                            | ___ Response                | ___ 98 Don't Know                | ___ Refused |
| e. The non-technical information offered by the Business Development Manager or other Efficiency Nova Scotia staff on energy efficiency such as but not limited to market trends, operating costs, and tradespeople availability. | ___ Response<br>___ Refused | ___ 98 Don't Know/Not applicable |             |
| f. <b>[IF C8 = YES]</b> The Onsite Energy Manager (OEM)'s technical support in identifying the measures to implement as part of the project.                                                                                      | ___ Response                | ___ 98 Don't Know                | ___ Refused |
| g. <b>[IF C8 = YES]</b> The OEM's contribution to the business case for your project or support for project management.                                                                                                           | ___ Response                | ___ 98 Don't Know                | ___ Refused |



## D. Cross-Influence

### [READ AND ROTATE (D1 + D2 TO D3) AND (D4 + D5 TO D7) SEQUENCES]

D1. Before participating in the Custom Retrofit program for this project, had your organization already participated in this program or in other Efficiency Nova Scotia program?

1. Yes, Custom Retrofit.
2. Yes, in another Efficiency Nova Scotia program
3. Yes, both
4. No **(GO TO D4)**
98. Don't know **(GO TO D4)**
99. Refused **(GO TO D4)**

For the following two statements, please respond with either “agree” or “disagree”.

D2. **[IF D1 =YES (1 OR 2 OR 3)]** As a result of your past participation in an Efficiency Nova Scotia program and what you learned from it, you asked a technical staff member from your organization (or a supplier/contractor) to examine the energy efficiency options for your project.

1. Agree
2. Disagree
98. Don't Know
99. Refused

D3. **[IF D1 = YES (1 OR 2 OR 3)]** As a result of your past participation in an Efficiency Nova Scotia program and what you learned from it, you considered the cost effectiveness of the energy efficiency for your project by evaluating the different options for your organization.

1. Agree
2. Disagree
98. Don't Know
99. Refused

D4. Before participating in the Custom Retrofit program had you seen energy efficiency promotional materials from Efficiency Nova Scotia through its website or in brochures, newsletters or presentations?

1. Yes
2. No **(GO TO SECTION E)**
98. Don't know/Refuse **(Go to Section E)**

For the following three statements, please respond with either “agree” or “disagree”.

- 
- D5. **[IF D4 = YES]** The Efficiency Nova Scotia energy efficiency promotional materials you saw were a major factor in your decision to implement the energy efficiency project.
1. Agree
  2. Disagree
  98. Don't Know
  99. Refused
- D6. **[IF D4 = YES]** The Efficiency Nova Scotia energy efficiency promotional materials you saw prompted you to ask a technical staff member from your organization (or a supplier/contractor) to examine the energy efficiency options for your project.
1. Agree
  2. Disagree
  98. Don't Know
  99. Refused
- D7. **[IF D4 = YES]** The Efficiency Nova Scotia energy efficiency promotional materials you saw prompted you to consider the cost effectiveness of the energy efficiency measures by evaluating the different options for your organization.
1. Agree
  2. Disagree
  98. Don't Know
  99. Refused

## **E. Spillover**

- E1. Since taking part in the Custom Retrofit program, have you implemented any additional energy efficiency measures outside of the program?
1. Yes
  2. No **[THANK AND TERMINATE]**
  98. Don't know **[THANK AND TERMINATE]**
  99. Refused **[THANK AND TERMINATE]**
- E2. **[IF E1 = 1]** Did you receive or do you plan on requesting financing or rebates from Efficiency Nova Scotia for the energy efficiency upgrades that you implemented outside of the program?
1. Yes **[THANK AND TERMINATE]**
  2. No
  98. Don't know
  99. Refused

- 
- E3. **[IF E2=NO OR DK/REFUSED]** Please describe these measures by providing the following information
- b. Name of measure
  - c. Type of energy source saved If all non-electric **(THANK AND TERMINATE)**
  - d. Location of the facility If not in Nova Scotia **(THANK AND TERMINATE)**
  - e. Quantity of measures (or physical area covered by the measure in sq meters or sq feet)
  - f. Technical information, such as HOU, capacity, efficiency, etc.
  - g. Estimated savings (in kWh or \$)
  - h. If no quantitative information is available, but the measure is the same as the one implemented through Custom Retrofit , probe participant on its relative size with respect to the Custom Retrofit project evaluated (% of size, area covered by measure, price, etc).
- E4. **[IF E2 = NO OR DK/REFUSED]** How influential was your experience with the energy efficiency project implemented through the Custom Retrofit program on your decision to implement these additional energy efficiency measures outside of the program? **[READ]**
- 1. Very influential.
  - 2. Somewhat influential.
  - 3. Not very influential.
  - 4. Not influential at all.
  - 98. (Don't know)
  - 99. (Refused)
- E5. **[IF E2=NO OR DK/REFUSED]** Why did you implement this project without the assistance of an Efficiency Nova Scotia program?
- 96. Specify
  - 98. Don't know/ Refused

**END**

Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day.

## APPENDIX II

### Retrofit Algorithm for Free-Ridership Calculation

| Question                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Answer                                                                                                                                   | Score                                                                           |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| <b>Identifying Key Decision Makers</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                          |                                                                                 |
| A1a                                    | We would like to speak with someone that played a key role in the financial decision to implement the energy efficiency project for your organization. Are you that person?                                                                                                                                                                                                                                                                              | 1) Yes                                                                                                                                   | EMPTY                                                                           |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2) No                                                                                                                                    |                                                                                 |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused                                                                                                                |                                                                                 |
| A1b                                    | [IF A1a=YES OR DK/Refused] Please describe your role in the decision-making process for this project.                                                                                                                                                                                                                                                                                                                                                    | Answer: _____                                                                                                                            | Contextual information to help identify if respondent is a key decision-maker.  |
| A2                                     | [IF A1a=NO] Who played a key role in the decision to implement the energy efficiency project? Can you provide their names, roles, contact information?                                                                                                                                                                                                                                                                                                   | Answer: _____                                                                                                                            | Contextual information to help identify other key decision-makers to interview. |
| <b>INTENTION</b>                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                          |                                                                                 |
| <b>Planning</b>                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                          |                                                                                 |
| C1                                     | Had your organization finalized the design and planning of the energy efficiency project BEFORE knowing that you would receive an incentive from Efficiency Nova Scotia?                                                                                                                                                                                                                                                                                 | 1) Yes                                                                                                                                   | Use C2                                                                          |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2) No                                                                                                                                    | 0%                                                                              |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused                                                                                                                |                                                                                 |
| C2                                     | [IF C1=1] When you decided to move forward with the energy efficiency project, how confident were you that you would receive an incentive from Efficiency Nova Scotia? [READ]                                                                                                                                                                                                                                                                            | 1) Very confident                                                                                                                        | 0%                                                                              |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2) Somewhat confident                                                                                                                    | 25%                                                                             |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3) Not very confident                                                                                                                    | 75%                                                                             |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4) Not at all confident                                                                                                                  | 100%                                                                            |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused                                                                                                                | 50%                                                                             |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Planning Score</b>                                                                                                                    | <b>C1</b>                                                                       |
| <b>Cost</b>                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                          |                                                                                 |
| C3                                     | Efficiency Nova Scotia gave your organization a rebate of \$<STUDY INCENTIVE> for the [Investigation or Feasibility] study and \$<IMPLEMENTATION INCENTIVE> for the project implementation, totalling \$<TOTAL> in incentives for your project.<br><br>I would like to understand the impact of this incentive on the financial case for your project. To what extent did these financial incentives improve the payback period for this project? [READ] | 1) The financial incentive improved the payback period by a <b>very</b> significant margin                                               | NO SCORE<br>(FOR CONTEXT ONLY)                                                  |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2) The financial incentive improved the payback period by a <b>somewhat</b> significant margin                                           |                                                                                 |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3) The financial incentive DID NOT improve the payback period by a significant margin                                                    |                                                                                 |
|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused                                                                                                                |                                                                                 |
| C4                                     | Without the implementation incentive, what is the likelihood that you would have paid the full amount for your energy efficiency project?                                                                                                                                                                                                                                                                                                                | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%)                                                                      |

| Question                                |                                                                                                                                                                                                                                                                                                                  | Answer                                                                                                                                   | Score           |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
|                                         |                                                                                                                                                                                                                                                                                                                  | 98/99) Don't know/Refused                                                                                                                | EMPTY           |
| C5                                      | <b>[ASK IF \$&lt;STUDY INCENTIVE&gt; ≥0]</b><br>As part of its Custom Retrofit program, Efficiency Nova Scotia gave your organization a \$<STUDY INCENTIVE> incentive for the [Investigation or Feasibility] study. Without this incentive, what is the likelihood that you would have conducted this study?     | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | USE C6          |
|                                         |                                                                                                                                                                                                                                                                                                                  | 98/99) Don't know/Refused                                                                                                                | EMPTY           |
| C6                                      | <b>[IF C5 ≠ 98 OR 99]</b> Did you use the study as a decision-making tool during the planning stage, to compare and select the potential measures for the energy efficiency project?                                                                                                                             | 1) Yes                                                                                                                                   | C5 Answer (%)   |
|                                         |                                                                                                                                                                                                                                                                                                                  | 2) No                                                                                                                                    | EMPTY           |
|                                         |                                                                                                                                                                                                                                                                                                                  | 98/99) Don't know/Refused                                                                                                                | EMPTY           |
|                                         |                                                                                                                                                                                                                                                                                                                  | <b>Cost Score</b>                                                                                                                        | <b>(C4, C6)</b> |
| <b>Efficiency, Quantity, and Timing</b> |                                                                                                                                                                                                                                                                                                                  |                                                                                                                                          |                 |
| C7                                      | You received a \$<IMPLEMENTATION INCENTIVE> implementation incentive based on the energy savings achieved by your energy efficiency project once completed. Without the implementation incentive from Efficiency Nova Scotia, which of the following scenarios would have been the most likely?<br><b>[READ]</b> | 1) You would have implemented the exact same energy efficiency project                                                                   | 100%            |
|                                         |                                                                                                                                                                                                                                                                                                                  | 2) You would have implemented a project with fewer or less impactful energy efficiency measures                                          | 50%             |
|                                         |                                                                                                                                                                                                                                                                                                                  | 3) You would have implemented the exact same energy efficiency measures but delayed the project by at least a year                       | 0%              |
|                                         |                                                                                                                                                                                                                                                                                                                  | 4) You would not have implemented the project at all                                                                                     | 0%              |
|                                         |                                                                                                                                                                                                                                                                                                                  | 98/99) Don't know/Refused                                                                                                                | EMPTY           |
|                                         |                                                                                                                                                                                                                                                                                                                  | <b>Efficiency, Quantity, Timing Score</b>                                                                                                | <b>C7</b>       |

| Question                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Answer                                                                                                                                           | Score                                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| INFLUENCE                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | INFLUENCE                                                                                                                                        |                                                                       |
| C8                                                                                                                                                                                                                                                   | I would like you to rate the importance of the following five factors on your decision to implement energy efficiency measures through the Custom Retrofit program.<br><br>a. The program financial incentive for the [Investigation or Feasibility Study].<br>b. The program financial incentive for the implementation of the energy efficiency measures.<br>c. The information from the [Investigation or Feasibility Study] on the energy savings associated with each potential measure.<br>d. The recommendations and technical assistance provided by the Business Development Manager, or other Efficiency Nova Scotia staff on the energy efficiency measures.<br>e. The non-technical information offered by the Business Development Manager, or other Efficiency Nova Scotia staff on energy efficiency, such as, but not limited to, market trends, operating costs, and tradespeople availability.<br>f. [IF C10 = YES] The Onsite Energy Manager (OEM)'s technical support in identifying the measures to implement as part of the project.<br>g. [IF C10 = YES] The OEM's contribution to the business case for the project or support for project management. | For each sub-question:<br>1) Very important (0%)<br>2) Somewhat important (25%)<br>3) Not very important (75%)<br>4) Not at all important (100%) | For each sub-question:<br>(Answer) (%)                                |
|                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 98/99) Don't know/Refused                                                                                                                        | EMPTY                                                                 |
| C9                                                                                                                                                                                                                                                   | Did your organization use the services of an Onsite Energy Manager while the project was being considered for implementation?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1) Yes                                                                                                                                           | To provide context on whether or not proponent had services of an OEM |
|                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2) No                                                                                                                                            | EMPTY                                                                 |
|                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 98) Don't know/Refused                                                                                                                           | EMPTY                                                                 |
| C10                                                                                                                                                                                                                                                  | [IF C9=YES] How does having an On-site Energy Manager (OEM) add value to your organization?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Answer: _____                                                                                                                                    | To provide context                                                    |
| INTENTION SCORE : AVERAGE (C1', C4', C6, C7) <ul style="list-style-type: none"><li>C1: Adjusted with C2 and with Inconsistency Test #1</li><li>C4: Adjusted with Inconsistency Test #2</li><li>C6: No adjustment</li><li>C7: No adjustment</li></ul> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                  |                                                                       |
| INFLUENCE Score (IS): MINIMUM (C8a, C8b, C8c, C81d, C8e,C8f, C8g) Minimum score among influence factors in C8                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                  |                                                                       |
| Inconsistency Test #1 (Planning/Cost)                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | IF C1 = 100% AND C4<70% AND C4 not EMPTY C1' = EMPTY                                                                                             |                                                                       |
| Inconsistency Test #2 (Influence/Cost)                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | IF ABS(C4 – (1-C8b)) ≥ 50% AND C8b not EMPTY, C4'=(C4+(1-C8b)) ÷ 2))                                                                             |                                                                       |
| Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                  |                                                                       |

| Cross-Influence                                                                                          |                                                                                                                                                                                                                                                                                         |                                                                                                                            |                                                                     |
|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| Question                                                                                                 |                                                                                                                                                                                                                                                                                         | Answer                                                                                                                     | Score                                                               |
| <b>Cross-Influence</b>                                                                                   |                                                                                                                                                                                                                                                                                         |                                                                                                                            |                                                                     |
| <b>D1</b>                                                                                                | Before participating in the Custom Retrofit program for this project, had your organization already participated in this program or in another Efficiency Nova Scotia program?                                                                                                          | 1) Yes, Custom Retrofit                                                                                                    | To determine if participants should respond to questions D2 and D3. |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 2) Yes, in another Efficiency Nova Scotia program                                                                          |                                                                     |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 3) Yes, both                                                                                                               |                                                                     |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 4) No (SKIP TO D4)                                                                                                         |                                                                     |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused (SKIP TO D4)                                                                                     |                                                                     |
| For the following two statements, please respond with either "agree" or "disagree".                      |                                                                                                                                                                                                                                                                                         |                                                                                                                            |                                                                     |
| <b>D2</b>                                                                                                | [IF D1 = 1 OR 2 OR 3] As a result of your previous participation in an Efficiency Nova Scotia program and what you learned from it, you asked a technical staff member from your organization (or a supplier/contractor) to examine the energy efficiency options for your project.     | 1) Agree                                                                                                                   | 1                                                                   |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 2) Disagree                                                                                                                | EMPTY                                                               |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                  | EMPTY                                                               |
| <b>D3</b>                                                                                                | [IF D1 = 1 OR 2 OR 3] As a result of your previous participation in an Efficiency Nova Scotia program and what you learned from it, you considered the cost effectiveness of the energy efficiency measures for your project by evaluating the different options for your organization. | 1) Agree                                                                                                                   | 1                                                                   |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 2) Disagree                                                                                                                | EMPTY                                                               |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                  | EMPTY                                                               |
| <b>D4</b>                                                                                                | Before participating in the Custom Retrofit program had you seen energy efficiency promotional materials from Efficiency Nova Scotia on its website, or in brochures, newsletters or presentations?                                                                                     | 1) Yes                                                                                                                     | To determine if participants should answer D5, D6, and D7.          |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 2) No (Thank and terminate)                                                                                                |                                                                     |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                  |                                                                     |
| For the following three statements, please respond with either "agree" or "disagree".                    |                                                                                                                                                                                                                                                                                         |                                                                                                                            |                                                                     |
| <b>D5</b>                                                                                                | [IF D4 = 1] The Efficiency Nova Scotia energy efficiency promotional materials were a major factor in your decision to implement the energy efficiency project                                                                                                                          | 1) Agree                                                                                                                   | 1                                                                   |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 2) Disagree                                                                                                                | EMPTY                                                               |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                  | EMPTY                                                               |
| <b>D6</b>                                                                                                | [IF D4 = 1] The Efficiency Nova Scotia energy efficiency promotional materials prompted you to ask a technical staff member from your organization (or a supplier/contractor) to examine the energy efficiency options for your project                                                 | 1) Agree                                                                                                                   | 1                                                                   |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 2) Disagree                                                                                                                | EMPTY                                                               |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                  | EMPTY                                                               |
| <b>D7</b>                                                                                                | [IF D4 = 1] The Efficiency Nova Scotia energy efficiency promotional materials prompted you to consider the cost effectiveness of the energy efficiency measures by evaluating the different options for your organization                                                              | 1) Agree                                                                                                                   | 1                                                                   |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 2) Disagree                                                                                                                | EMPTY                                                               |
|                                                                                                          |                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                  | EMPTY                                                               |
| <b>Cross-Influence (CI):</b><br><b>IF(D5 =Agree; 1) + IF(D2 OR D6=Agree; 1) + IF(D3 OR D7)=Agree; 1)</b> |                                                                                                                                                                                                                                                                                         |                                                                                                                            |                                                                     |
| <b>Revised Free-Ridership:</b>                                                                           |                                                                                                                                                                                                                                                                                         | <b>IF CI = 0 OR 1: Revised FR = FR</b><br><b>IF CI = 2: Revised FR = FR*0.75</b><br><b>IF CI = 3: Revised FR = FR*0.50</b> |                                                                     |



## APPENDIX III

### Retrofit Algorithm for Participant Spillover Calculation

| Current Algorithm                                                                        |                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                            |                                         |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Question                                                                                 |                                                                                                                                                                                                                                               | Answer                                                                                                                                                                                                                                                                     | Score                                   |
| E1                                                                                       | Since first taking part in the Custom Retrofit program, have you implemented any additional energy efficiency measures outside of the program?                                                                                                | 1) Yes                                                                                                                                                                                                                                                                     | CONTINUE                                |
|                                                                                          |                                                                                                                                                                                                                                               | 2) No                                                                                                                                                                                                                                                                      | Thank and terminate                     |
|                                                                                          |                                                                                                                                                                                                                                               | 98/99) Don't know/Refused                                                                                                                                                                                                                                                  |                                         |
| E2                                                                                       | [IF E1 = 1] For the energy efficiency upgrades that you implemented outside of the program, did you receive or plan on requesting financing or rebates from Efficiency Nova Scotia?                                                           | 1) Yes                                                                                                                                                                                                                                                                     | Thank and terminate                     |
|                                                                                          |                                                                                                                                                                                                                                               | 2) No                                                                                                                                                                                                                                                                      | CONTINUE                                |
|                                                                                          |                                                                                                                                                                                                                                               | 98/99) Don't know/Refused                                                                                                                                                                                                                                                  |                                         |
| E3                                                                                       | [IF E2 = 2 or 98] Can you please describe these measures by providing the following information?                                                                                                                                              | 1. Name of measure                                                                                                                                                                                                                                                         |                                         |
|                                                                                          |                                                                                                                                                                                                                                               | 2. Type of energy source saved<br>If all non-electric, thank and terminate.                                                                                                                                                                                                |                                         |
|                                                                                          |                                                                                                                                                                                                                                               | Location of the facility<br>If not in Nova Scotia, thank and terminate.                                                                                                                                                                                                    |                                         |
|                                                                                          |                                                                                                                                                                                                                                               | 4. Quantity of measures (or physical area covered by the measure in sq meters or sq feet)                                                                                                                                                                                  |                                         |
|                                                                                          |                                                                                                                                                                                                                                               | 5. Technical information, such as HOU, capacity, efficiency, etc.                                                                                                                                                                                                          |                                         |
|                                                                                          |                                                                                                                                                                                                                                               | 6. Estimated savings (in kWh or \$)                                                                                                                                                                                                                                        |                                         |
|                                                                                          |                                                                                                                                                                                                                                               | 7. If no quantitative information is available, but the measure is the same as the one implemented through Custom Retrofit, probe participant on its relative size with respect to the Custom Retrofit project evaluated (% of size, area covered by measure, price, etc). |                                         |
| E4                                                                                       | [IF E2 = 2 or 98/99] How influential was your experience with the energy efficiency project implemented through the Custom Retrofit program on your decision to implement these additional energy efficiency measures outside of the program? | 1) Very influential (100%)<br>2) Somewhat influential (75%)<br>3) Not very influential (25%)<br>4) Not at all influential (0%)                                                                                                                                             | (Answer) (%)                            |
|                                                                                          |                                                                                                                                                                                                                                               | 98/99) DK/Refuse                                                                                                                                                                                                                                                           | EMPTY                                   |
| E5                                                                                       | [IF E2 = 2 or 98] Why did you implement this project without the assistance of an Efficiency Nova Scotia program?                                                                                                                             | Answer: _____                                                                                                                                                                                                                                                              | For contextual information on spillover |
| Spillover Level (SO) = SUM of (E3 x E4) for All Respondents<br>SUM of Respondent Savings |                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                            |                                         |

## APPENDIX IV

### Retrofit and Building Optimization Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by EfficiencyOne (E1)
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1, 2 and 3 present the corrected tracked savings resulting from all changes made by the Evaluator for Retrofit, Building Optimization and the two programs combined.

**Table 1: 2024 Retrofit Corrected Tracked Savings**

| Program Component Result                | Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|-----------------------------------------|---------------|------|-------------------------|------|---------------------|
|                                         | Value         | Unit | Value                   | Unit |                     |
| Gross Energy Savings – at the Generator | 26.198        | GWh  | 26.115                  | GWh  | -0.32%              |
| Gross Demand Savings – at the Generator | 2.688         | MW   | 2.688                   | MW   | 0.00%               |
| Net Energy Savings – at the Generator   | 20.764        | GWh  | 20.719                  | GWh  | -0.21%              |
| Net Demand Savings – at the Generator   | 2.169         | MW   | 2.169                   | MW   | 0.00%               |

**Table 2: 2024 Building Optimization Corrected Tracked Savings**

| Program Component Result                | Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|-----------------------------------------|---------------|------|-------------------------|------|---------------------|
|                                         | Value         | Unit | Value                   | Unit |                     |
| Gross Energy Savings – at the Generator | 1.954         | GWh  | 1.954                   | GWh  | 0.00%               |
| Gross Demand Savings – at the Generator | 0.102         | MW   | 0.102                   | MW   | 0.00%               |
| Net Energy Savings – at the Generator   | 1.778         | GWh  | 1.778                   | GWh  | 0.00%               |
| Net Demand Savings – at the Generator   | 0.093         | MW   | 0.093                   | MW   | 0.00%               |

**Table 3: 2024 Retrofit and Building Optimization Combined Corrected Tracked Savings**

| Program Component Result                | Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|-----------------------------------------|---------------|------|-------------------------|------|---------------------|
|                                         | Value         | Unit | Value                   | Unit |                     |
| Gross Energy Savings – at the Generator | 28.152        | GWh  | 28.068                  | GWh  | -0.30%              |
| Gross Demand Savings – at the Generator | 2.790         | MW   | 2.790                   | MW   | 0.00%               |
| Net Energy Savings – at the Generator   | 22.541        | GWh  | 22.497                  | GWh  | -0.20%              |
| Net Demand Savings – at the Generator   | 2.262         | MW   | 2.262                   | MW   | 0.00%               |

There were no substantial differences between the tracked and corrected tracked energy and demand savings. The minor changes in energy savings were due to adjustments made to line loss factors.

# APPENDIX V

## Retrofit and Building Optimization Project Review Protocols

### Project Review Protocol

The Evaluator used the same project review protocol in 2024 as the one used for the 2023 Custom Retrofit evaluation. The protocol includes questions and assessment fields for measurement and verification (M&V) plans and reports to ensure that the review is consistent with past evaluation recommendations. The protocol also includes dedicated worksheets containing measure specific data fields for individual project measures.

Prior to conducting telephone project review interviews or on-site visits, the Evaluator reviewed all project documentation submitted by EfficiencyOne (E1). Those documents included, although were not limited to, the following: Scoping and/or feasibility studies; energy efficiency measure savings calculations; project development agreements; M&V reports; and email correspondence.

The Evaluator used the protocol form presented below to collect technical data and summarize information such as project details, key parameters to be reviewed during the telephone project review interviews, and previous M&V activities. Other collected technical information includes, although is not limited to, equipment operating schedules, equipment specifications and quantities, baseline conditions, typical equipment loads, and changes that occurred since M&V was conducted.



Custom Retrofit  
Efficiency Nova Scotia  
On-Site Visit Protocol - 2024

1. General Information

Virtual Visit Date:  Team:

Contact Name:

Project ID:

Contact Title:

Project Type (Regular Retrofit (project type) / Compressed Air/ Bopt) :

Role on the project:

Company Name:

Administer FR/SO?

Facility Name:

Alternate FR/SO contact:

Address:

Contact Phone:

Consultant:

Email:

Other people met during the visit:

Type of building: 

|                          |                          |  |
|--------------------------|--------------------------|--|
| Commercial/institutional | Industrial/manufacturing |  |
| Municipal                | Other (specify)          |  |

Specify:

2. Facility and Project Description

Facility Description: *Outline a quick description of the facility and its primary operation/purpose.*  
*NOTE: PC Users "Alt+Enter" for new line in cell. MAC Users "CMD+Option+Enter".*

Project Description: *Indicate the key variables & observations from all available reports. These notes will serve to guide the virtual visit and identify the main information to collect and/or verify.*

Measure #1:

Measure #2:

### 3. M&V Plans and Documentation

1a. Is there any documentation that describes the plan for M&V dated from before the project takes place? (Y/N)

IF ANSWER TO QUESTION 1a. IS "NO", GO TO NEXT SECTION

1b. Does this document provide a description of:

- Selection and substantiation of the project measurement boundary and justification of IPVMP Option? (Y/N)
- Selection and substantiation of the baseline measurement period? (Y/N)
- Selection and substantiation of the performance measurement period? (Y/N)
- Description of the savings calculation methodology? (Y/N)
- Consideration of actual and potential independent variables? (Y/N)
- Consideration of actual and potential interactive effects? (Y/N)
- Description of the data collection approach for capturing relevant dependant and independent variables? (Y/N)
- Consideration of potential operational impacts and non-routine adjustments? (Y/N)
- Consideration of potential COVID impacts and non-routine adjustments? (Y/N)

2. Is the scope and detail of the documentation above commensurate with the energy and demand savings, budget, incentive level or technical complexity of the project in general alignment with the table from tab "M&V Table"?

- For the M&V plan (Y/N)
- For the M&V results (Y/N)

Please see table to the right for definitions of Small to Large projects

3. If an M&V plan was prepared ahead of project completion, was it followed and reflected in the M&V Report? (Y/N)

#### Intermediate M&V score - Pre-evaluation

#DIV/0!

Notes before interview. Include specific questions to be asked (highlight them if needed to be sure not to forget to ask them)

Écrire questions en rouge (pour interview) et les notes en noir

Notes during/after interview

### 4. On-site or Virtual Review

Filled out on subsequent worksheets, one worksheet for each measure.

## 5. Other questionnaires

|                                        |                      |       |
|----------------------------------------|----------------------|-------|
| Market questionnaire filled-in         | <input type="text"/> | (Y/N) |
| Free-ridership questionnaire filled-in | <input type="text"/> | (Y/N) |
| Spillover questionnaire filled-in      | <input type="text"/> | (Y/N) |

Sections below to be filled after the visit

## 6. Estimated Useful Life "EUL" of the project

|                             |                      |                                                         |
|-----------------------------|----------------------|---------------------------------------------------------|
| Type of replacement         | EUL                  |                                                         |
| Measure #1                  | <input type="text"/> | <input type="text"/>                                    |
| Measure #2                  | <input type="text"/> | <input type="text"/>                                    |
| Tracked Project EUL (yrs)   | <input type="text"/> | Refer to project documentation for tracked baseline EUL |
| Evaluated Project EUL (yrs) | <input type="text"/> | Refer to program document for standard EUL to be used   |
| Explanation                 | <input type="text"/> |                                                         |

## 7. Energy and Demand Savings Adjustment: PAR MESURE

|                         |  |                       |                |           |                      |                |              |  |
|-------------------------|--|-----------------------|----------------|-----------|----------------------|----------------|--------------|--|
| Measure #1              |  | *Name of the Measure* |                |           |                      |                |              |  |
|                         |  |                       | Tracking sheet | Evaluator | % of Tracked savings | Project status | Finish month |  |
| Electricity Savings     |  | kWh/yr                |                |           |                      |                |              |  |
| Peak Demand Savings     |  | kW                    |                |           |                      |                |              |  |
| Peak Coincidence Factor |  | -                     |                |           |                      |                |              |  |

|                         |  |                       |                |           |                      |                |              |
|-------------------------|--|-----------------------|----------------|-----------|----------------------|----------------|--------------|
| Measure #2              |  | *Name of the Measure* |                |           |                      |                |              |
|                         |  |                       | Tracking sheet | Evaluator | % of Tracked savings | Project status | Finish month |
| Electricity Savings     |  | kWh/yr                |                |           |                      |                |              |
| Peak Demand Savings     |  | kW                    |                |           |                      |                |              |
| Peak Coincidence Factor |  | -                     |                |           |                      |                |              |

|                         |        |   |                |           |                      |                |              |
|-------------------------|--------|---|----------------|-----------|----------------------|----------------|--------------|
| TOTAL                   |        | 0 |                |           |                      |                |              |
|                         |        |   | Tracking sheet | Evaluator | % of Tracked savings | Project status | Finish month |
| Electricity Savings     | kWh/yr | 0 |                | 0         | #DIV/0!              |                |              |
| Peak Demand Savings     | kW     | 0 |                | 0         | #DIV/0!              |                |              |
| Peak Coincidence Factor | -      |   |                |           |                      |                |              |

|                                                      |                      |       |
|------------------------------------------------------|----------------------|-------|
| Adjustments made to electricity savings?             | <input type="text"/> | (Y/N) |
| Adjustments made to demand savings?                  | <input type="text"/> | (Y/N) |
| Adjustments made to PCF?                             | <input type="text"/> | (Y/N) |
| Changes between PDA and completion?                  | <input type="text"/> | (Y/N) |
| If Yes, was the tracking sheet adjusted accordingly? | <input type="text"/> | (Y/N) |

## 8. Summarize Project Adjustments and Final Savings Values - SUMMARY FOR E1

If any adjustments were made to the energy savings, demand savings or PCF, describe the rationale and provide calculations.

See Templates sheet, the idea is to have uniform language across all project reviews, since these summaries will be used to produce the Summary of Adjustment spreadsheet for E1.

#### 4. On-site or Virtual Review (continued)

Section to be filled out with questions prior to virtual visits, and answers to be included during the call. Create new worksheet and repeat for each measure, as needed.

|                   |                              |
|-------------------|------------------------------|
| <b>Measure #1</b> | <i>*Name of the Measure*</i> |
|-------------------|------------------------------|

##### Validation of the measure

Validate the installation and quantities. Do we have pictures (nameplate) in the file? Can we see it during the call? Is there invoices confirming the quantities?

Notes before interview. Include specific questions to be asked (highlight them if needed to be sure not to forget to ask them)

Notes during/after interview

##### Baseline

4. Does the baseline measurement match what the project says is the baseline, and is it aligned with program rules?

9. Has anything changed between the baseline and reporting period? (Y/N)

a. If #9 is Y, has a non-routine adjustment been applied? (Y/N)

What is the baseline? Existing equipment, new construction? Was the equipment at the end of its useful life?

Notes before interview. Include specific questions to be asked (highlight them if needed to be sure not to forget to ask them)

Notes during/after interview

##### Operating Schedule

Include notes on schedule and seasonal variations. The operating schedule corresponds to the *typical* one (non-COVID).

6. Is the M&V period appropriate? (Y/N)

a. Do both the baseline and reporting periods cover all ranges of operation parameters?

b. Is M&V occurring in a reasonable period before and right after the EE project was implemented?

c. Does the period capture seasonal effects?

## Savings calculation approach - Projects with M&V

5. Are the M&V boundaries capturing all the energy consumption that's impacted by the project? (Y/N)
7. Are M&V results measured in a short period extrapolated to annual results appropriately? (Y/N)
- a. Is the extrapolation consistent with what a "typical year" should be?
- b. Are operating conditions that were not covered in M&V taken into consideration when developing the extrapolation
8. If a regression is used (based on HDD, tons/day...) to build a performance equation as part of the M&V, is it valid?
- a. The Evaluator will want to be satisfied that the regression makes sense when looking at the physics of the situation.
- b. The Evaluator will want to be satisfied that statistical indicators were used to validate the fitness of the regression?

Report the virtual visit and indicate the key observations and findings made during the interview..

Seasonal Load Profile?  (Y/N) Summer Load Variations?  (Y/N)

| Predicted Results<br>(MWh) | M&V Results          | Percent of<br>Expected (%) | M&V Start Date       | M&V<br>Finish<br>Date | Days in Period |
|----------------------------|----------------------|----------------------------|----------------------|-----------------------|----------------|
| <input type="text"/>       | <input type="text"/> | <input type="text"/>       | <input type="text"/> | <input type="text"/>  | 0              |

### Intermediate M&V score - MEASURE #1

####

Notes before interview. Include specific questions to be asked (highlight them if needed to be sure not to forget to ask them)

Notes during/after interview

### COVID Impact for Measure #1

Include notes on how calculated savings are impacted by COVID, if so.

Detail any adjustment, along with the rational, needed to bring back the savings to a typical year.

10. Has this measure been impacted by COVID? (Y/N)
- a.i. Hours of occupancy, or production schedules? (Y/N)
- a.ii. Level of occupancy during occupied hours, or production intensity during production periods? (Y/N)
- b. If so, how has this impacted the selection of the baseline or reporting periods M&V methods? (Y/N)
- c. Is a non-routine adjustment warranted? (Y/N)
- d. Has a non-routine adjustment been appropriately applied? (Y/N)

Notes before interview. Include specific questions to be asked (highlight them if needed to be sure not to forget to ask them)

Notes during/after interview

**Peak Demand Savings?** YES ☐ NO ☐

*Notes on peak demand savings (Nova Scotia Peak Period: weekdays between 5 and 7 p.m. between Dec and Feb)*

**Are demand savings based on measurements?** ☐ (Y/N)

*Notes before interview. Include specific questions to be asked (highlight them if needed to be sure not to forget to ask them)*

*Notes during/after interview*

**Interactive Effects?** YES ☐ NO ☐

*Briefly describe interactive effects for the project and relevant information on **heating/cooling system** as required.*

*Notes before interview. Include specific questions to be asked (highlight them if needed to be sure not to forget to ask them)*

*Notes during/after interview*





## APPENDIX VI

### Custom Adjustment Ratio Calculation Example

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This appendix provides an example of the project review process and calculations used to adjust the energy savings results for a regular Retrofit project. The calculation described below presents the adjustments made to a refrigeration retrofit project that took place at a lobster holding facility. The adjustments were based on information collected during a phone call as well as a review of project documentation carried out by the Evaluator.

The project background is presented first, followed by the savings tracked by E1, revised savings, and the rationale behind the adjustments.

#### Project Background

The participant operates four lobster holding tanks that are fed with seawater, one of which was previously unrefrigerated (Tank #1), while the other three (Tanks #2, #3, and #4) each had a refrigeration unit and a heat exchange system to maintain optimal water temperatures inside the tanks. The Retrofit project consisted of two measures: Replacing the existing R22 refrigerant with a more efficient R449A refrigerant; and adding refrigeration units on Tanks #2 and #4. The participant provided performance data sheets for all refrigeration units, including refrigeration capacity and overall consumption, for both the efficient and baseline cases (for the baseline case, performance data were provided for units using R404 refrigerant that was used as a proxy for the existing R22 refrigerant given their similar properties).

#### Tracked Savings Calculation

For this project, an E1 project engineer created an Excel spreadsheet to calculate electrical energy consumption for all four tanks for both the base cases and efficient cases, using the refrigeration unit performance data from the manufacturer, weather and seawater temperature data, as well as on-site measurements (to validate the efficiency of the heat exchange units). The spreadsheet also calculated peak demand savings that occur during the utility's winter peak demand period (December to February, from 5 pm to 7 pm).

#### Revised Savings Calculation

The Evaluator found that the assumptions and the analysis performed by E1 were generally sound. Moreover, after reviewing the savings calculations, the Evaluator found mistakes in some of the Excel formulas used to calculate the refrigeration load for each of the four tanks. These formulas did not use the correct target temperatures to calculate the temperature difference ( $\Delta T$ ), which in turn is used to calculate the refrigeration load. The Evaluator corrected this mistake, which caused a downward adjustment to the consumption levels and demand savings.

The Evaluator also adjusted the effective useful life (EUL) for this project. Since the refrigerant was changed in a mix of existing and new refrigeration units, the remaining useful life of the measure varies across units (the more efficient refrigerant will stop generating savings when each unit reaches the end of its useful life). Therefore, the Evaluator calculated an average EUL weighted by the first-year savings generated by each unit and applied it to total project savings. Consequently, the EUL was adjusted from 15 years to 11 years.

## Adjustment Ratio Calculation

Adjustment ratios are determined by comparing revised savings values with tracked savings values. Due to the revisions made to this project, the calculated adjustment ratio for energy savings was 0.825.

$$\frac{\text{Revised ES}}{\text{Tracked ES}} = \frac{105,425 \text{ kWh}}{127,826 \text{ kWh}} = 0.825$$

## APPENDIX VII

### New Construction Participant Phone Interview Guide (CPA Stage)

#### CUSTOM – NEW CONSTRUCTION PARTICIPANT PHONE INTERVIEW GUIDE / WEB SURVEY

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------|
| Instrument Type                 | Interview Guide / Web survey (back-up)                                                                |
| Estimated Time to Complete      | 15 minutes                                                                                            |
| Target Audience                 | New Construction participants have completed an agreement at the project agreement stage (CPA stage)) |
| Expected Number of Completions  | Census                                                                                                |
| Contact List Source             | 2022 New Construction tracking sheet                                                                  |
| Fielding Firm                   | Econoler/Narrative                                                                                    |
| Estimated Timeline for Fielding | June 2022 – in continue: Quarterly basis                                                              |

Table 2: Research Objectives and Associated Questions

| Research Objectives                                    | Section |
|--------------------------------------------------------|---------|
| What is the free-ridership level for New Construction? | C, C    |

To be adapted by Econoler [Blue text]

Import variables from database < LIKE THIS >

Skip pattern or programming instructions [LIKE THIS]

Black text: instructions for interviewer [NOTE: xxxx ] / [PROBE: xxxx ]



## Introduction – Telephone IDI

I am with Narrative, and we are conducting an evaluation of the Efficiency Nova Scotia Custom New Construction program. This interview should take about 15-20 minutes. Is this still a good time for you?

The purpose of the interview is to better understand your organization's decision to build an energy efficient building, including your choice of energy efficient materials or equipment that exceed building code requirements. During this interview, I will refer to this as your decision "to build a better-than-code building".

**Your responses will be kept confidential, and your comments will be combined with those of other program participants. Your responses will not affect the incentive amount you will received or you have received for this project.**

## Introduction – Online Survey

Narrative Research and Econoler are currently conducting a formal evaluation of the Efficiency Nova Scotia Custom New Construction program. Your organization recently entered into an agreement in **[CPA ACCEPTED DATE]** with Efficiency Nova Scotia to assist in the design of energy efficient measures for the **[INSERT PROJECT NAME]** project. As part of the evaluation process, we are interested in better understanding your organization's decision to build an energy efficient building (also referred to on the survey as a "better-than-code building"), including your choice of energy efficient materials or equipment that exceed building code requirements.

Please take a few minutes to complete the evaluation survey. This should only take you about 15 minutes of your time.

*This survey is administered by Narrative Research and Econoler. Your responses will be kept confidential, and your comments will be combined with those of other program participants. Your responses will not affect the incentive amount you will receive or you have received for this project.*

### A. Identifying Key Decision-makers

A1. **[SINGLE RESPONSE]** Did you play a key role in your organization's decision to build an energy efficient, or better-than-code, building.

1. Yes
2. No
98. I am unsure

A2. **[IF A1=YES; CAPTURE VERBATIM]** Please briefly describe your role in the decision-making process.

A3. **[IF A1= YES; SINGLE RESPONSE]** Did others within your organization play a key role in the decision to build a better-than-code building?

1. Yes
2. No
98. I am unsure

A4. **[IF A1=YES]** Can you provide the name, role, and contact information (email and/or telephone) of one or two of the key decision-makers?

1. No, I cannot provide this information
2. Yes – Please provide the contact information below

**Contact Person 1:**

Name: **[RECORD]**

Role: **[CAPTURE VERBATIM]**

Email and/or phone number: **[RECORD IN FORMAT]**

**Contact Person 2 [OPTIONAL]:**

Name: **[RECORD]**

Role: **[CAPTURE VERBATIM]**

Email and/or phone number: **[RECORD IN FORMAT]**

**[IF A1=YES OR A3=NO OR A4=NO: GO TO SECTION B]**

A5. **[IF A1= NO OR DK; OPTIONAL RESPONSE FOR CONTACT INFO]** Can you provide the names, roles and contact information of one or two people who played a key role in your organization's decision to build a better-than-code building?

1. No
2. Yes – Please provide the contact information below

**Contact Person 1:**

Name: **[RECORD]**

Role: **[CAPTURE VERBATIM]**

Email: **[RECORD IN FORMAT]**

Phone number: **[RECORD NUMERALS ONLY]**

**Contact Person 2 [OPTIONAL]:**

Name: **[RECORD]**

Role: **[CAPTURE VERBATIM]**

Email: **[RECORD IN FORMAT]**

Phone number: **[RECORD NUMERALS ONLY]**

[IF A1= NO or DK: END] These are all the questions I have for you. Thank you very much for your time and cooperation! [SCHEDULE INTERVIEW WITH KEY DECISION-MAKERS]

## B. Project Stage

B1. [MULTIPLE RESPONSE KEEPING CODE 98 AND 99 EXCLUSIVE] Now thinking of the [INSERT PROJECT NAME] project, at what stage is the project currently in? Please select all that apply.

1. Conceptual
2. Design
3. Construction
4. Building Occupancy
96. Other stage – Please specify: \_\_\_\_\_
98. I am unsure
99. I prefer not to say

## C. Free-ridership

C1. [CAPTURE VERBATIM; KEEP CODE 98 & 96 EXCLUSIVE] Why did your organization decide to build a better-than-code building?

CAPTURE VERBATIM

98. I am unsure
99. I prefer not to say

C2. [SINGLE RESPONSE] Was the design of your better-than-code building finalized BEFORE knowing that your organization would receive an incentive from Efficiency Nova Scotia?

1. Yes
2. No
98. I am unsure
99. I prefer not to say

C3. [IF C1=YES; SINGLE RESPONSE] During the design stage, how confident were you that your organization would receive an incentive from Efficiency Nova Scotia?

1. Very confident
2. Somewhat confident
3. Not very confident
4. Not at all confident
98. I am unsure
99. I prefer not to say

- C4. **[SINGLE RESPONSE]** Which one of the following best represents the impact of the financial incentive offered by Efficiency Nova Scotia on the financing of the new building project?
1. The incentive from Efficiency Nova Scotia reduced the cost of the building's energy efficiency measures, allowing the project to be **within its approved budget**.
  2. The incentive from Efficiency Nova Scotia reduced the cost of the building's energy efficiency measures, significantly **strengthening the case for the overall project from a financial perspective**.
  3. The incentive from Efficiency Nova Scotia reduced the cost of the building's energy efficiency measures, **but even without the financial incentive, you would have included the same measures** for other reasons.
  4. The incentive from Efficiency Nova Scotia did not have a significant impact on the financing of the project.
98. I am unsure  
99. I prefer not to say
- C5. **[SINGLE RESPONSE]** You received an incentive of **<INSERT MODELING INCENTIVE AMOUNT>** from Efficiency Nova Scotia for your building's energy model. Without this incentive, what is the likelihood that you would have hired an energy modeling consultant for your project?
- INSERT 0-10 SCALE WITH END POINTS: 0=VERY UNLIKELY AND 10=VERY LIKELY
98. Don't know  
99. I prefer not to say
- C6. **[SINGLE RESPONSE]** Did the energy modeling consultant help you assess different options available for building envelope and HVAC equipment?
1. Yes
  2. No
98. I am unsure  
99. I prefer not to say
- C7. **[SINGLE RESPONSE]** Your organization will receive an incentive from Efficiency Nova Scotia specifically for the implementation of the energy efficiency measures. Without this incentive, which of the following scenarios would have been the most likely?
1. Your organization would have designed the exact same better-than-code building.
  2. Your organization would have designed a less efficient building but still exceeded the minimum energy efficiency requirements prescribed in the building code.
  3. Your organization would have designed a less efficient building that met the minimum energy efficiency requirements prescribed in the building code.
98. I am unsure  
99. I prefer not to say

C8. **[IF C7=2; SINGLE RESPONSE PER STATEMENT; DO NOT RANDOMIZE]** Without the incentive provided by Efficiency Nova Scotia or the expertise provided by the energy modeler, what is the likelihood that your organization would have:

- a. designed a building with HVAC equipment as efficient as those you installed
- b. designed a building with **an envelope as efficient as the one you built, including insulation levels and glazing performance**
- c. designed a building with **as many efficiency measures as you included**

INSERT 0-10 SCALE WITH END POINTS: 0=VERY UNLIKELY AND 10=VERY LIKELY

98. I am unsure

99. I prefer not to say

C9. **[IF C7=2 AND IF AVERAGE (C8a, C8b and C8c)  $\geq$  8; CAPTURE VERBATIM; KEEP CODE 98 AND 99 EXCLUSIVE]** You mentioned that, without an incentive from Efficiency Nova Scotia or the energy modeler, you would have designed a less efficient building than your current design. Please explain how your building would have been different than what it is right now.

CAPTURE VERBATIM

98. I am unsure

99. I prefer not to say

C10. **[SINGLE RESPONSE PER STATEMENT; DO NOT RANDOMIZE]** Rate the influence of the following factors in your decision to build a better-than-code building.

- a. The program financial incentive for energy modeling.
- b. The program financial incentive for implementation of energy efficiency measures.
- c. The insights gained from the energy modeling regarding the energy savings associated with each potential measure.
- d. The recommendations and technical assistance provided by the energy modeler, Business Development Manager, onsite energy manager, or other Efficiency Nova Scotia staff.
- e. The non-technical information offered by the energy modeler, Business Development Manager, onsite energy manager, or other Efficiency Nova Scotia staff on building better-than-code buildings, for example, the market trends, building certifications, operating costs, and tradespeople availability, among other things.

INSERT 0-10 SCALE WITH END POINTS: 0=NOT AT ALL IMPORTANT AND 10=EXTREMELY IMPORTANT

98. I am unsure

99. I prefer not to say



## D. Cross-Influence

D1. **[SINGLE RESPONSE]** Before participating in the Custom New Construction program for the **[INSERT PROJECT NAME]** project, had your organization already participated in Custom New Construction or in another Efficiency Nova Scotia program?

1. Yes, Custom New Construction
2. Yes, in another Efficiency Nova Scotia program
3. Yes, both
4. No
98. I am unsure
99. I prefer not to say

**[IF D1=4, 98 OR 99: SKIP TO D4]**

**[ASK D2 AND D3 IF D1= YES (CODE 1-3); SHOW INTRO ON SAME PAGE AS D2 AND D3]** To what extent do you agree or disagree with the following two statements:

D2. **[ASK IF D1= YES (CODE 1-3); SINGLE RESPONSE]** Because of your organization's previous participation in an Efficiency Nova Scotia program and what you learned from it, you/your organization asked a technical staff member or energy modeler to examine the energy efficiency options for your current building project.

INSERT 0-10 SCALE WITH END POINTS: 0=COMPLETELY DISAGREE AND 10=COMPLETELY AGREE

98. I am unsure
99. I prefer not to say

D3. **[ASK IF D1= YES (CODE 1-3); SINGLE RESPONSE]** Because of your organization's previous participation in an Efficiency Nova Scotia program and what you learned from it, you/your organization looked at the cost effectiveness of the energy efficiency measures in your new building by evaluating the different options available.

INSERT 0-10 SCALE WITH END POINTS: 1=COMPLETELY DISAGREE AND 10=COMPLETELY AGREE

98. Don't know
99. I prefer not to say

D4. **[SINGLE RESPONSE]** Before participating in the New Construction program, had you seen energy efficiency promotional materials distributed by Efficiency Nova Scotia through its website, advertisements, brochures, newsletters or presentations?

- 1. Yes
- 2. No
- 98. I am unsure
- 99. I prefer not to say

**[IF D4=2, 98 OR 99: GO TO END]**

**[ASK D5 TO D7 IF D4=YES; SHOW INTRO AND D5-D7 ON SAME PAGE]** To what extent do you agree or disagree with the following three statements:

D5. **[ASK IF D4=YES; SINGLE RESPONSE]** The energy efficiency promotional materials distributed by Efficiency Nova Scotia through its website, brochures, newsletters, or presentations were a major factor in your organization's decision to build a better-than-code building.

INSERT 0-10 SCALE WITH END POINTS: 0=COMPLETELY DISAGREE AND 10=COMPLETELY AGREE

- 98. I am unsure
- 99. I prefer not to say

D6. **[ASK IF D4=YES; SINGLE RESPONSE]** The energy efficiency promotional materials distributed by Efficiency Nova Scotia through its website, brochures, newsletters or presentations prompted you/your organization to ask a technical staff member or energy modeler to examine the energy efficiency options for your building project.

INSERT 0-10 SCALE WITH END POINTS: 0=COMPLETELY DISAGREE AND 10=COMPLETELY AGREE

- 98. I am unsure
- 99. I prefer not to say

D7. **[ASK IF D4=YES; SINGLE RESPONSE]** The energy efficiency promotional materials distributed by Efficiency Nova Scotia through its website, brochures, newsletters, or presentations prompted you/your organization to consider the cost effectiveness of the energy efficiency measures in your new building by evaluating the different options offered to your organization.

INSERT 0-10 SCALE WITH END POINTS: 0=COMPLETELY DISAGREE AND 10=COMPLETELY AGREE

- 98. I am unsure
- 99. I prefer not to say

**END: [PHONE: These are all the questions I have for you.] [ONLINE SURVEY: That's all the questions we have for you.] Thank you very much for your time and cooperation!**

## APPENDIX VIII

### New Construction Participant Interview Guide (Completed Projects)

#### GUIDE FOR INTERVIEWS WITH Participant Builders

**Table 3: Overview of Data Collection Activity**

| Descriptor                      | This Instrument                  |
|---------------------------------|----------------------------------|
| Instrument Type                 | Semi-directed in-depth interview |
| Estimated Time to Complete      | 15-20 Minutes                    |
| Target Audience                 | › Participant Builders           |
| Expected Number of Completions  | › Participant Builders (n = 12)  |
| Contact List Source             | Efficiency One                   |
| Fielding Firm                   | Econoler                         |
| Estimated Timeline for Fielding | November 2024                    |

**Table 4: Research Objectives and Questions**

| Research objective             | Research Questions                                                  | Section # |
|--------------------------------|---------------------------------------------------------------------|-----------|
| › Calculate net results        | › What are the free-ridership levels for New Construction projects? | › B,C     |
| › Program satisfaction         | › What is the satisfaction of participants in New Construction      | › E       |
| › Update program service logic | › What are the barriers to program participation?                   | › D,F,G   |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx]** / **[PROBE: xxxx]**

## Introduction

I am with \_\_\_\_\_ and we are performing an evaluation of the Custom New Construction program service offered by Efficiency Nova Scotia.

This interview should take about 15-20 minutes. Is this still a good time for you?

Through this interview, we hope to better understand your organization's decision-making process regarding the decision to build an energy efficient building. More specifically, we hope to better understand how you made the decision to use energy efficient materials or equipment that exceed building code requirements on efficiency levels. We will refer to this as your decision "to design a better-than-code building" throughout this interview.

Your responses will be kept confidential, and the results will be combined with those of other program participants. Your responses will not affect the incentive amount you will receive for this project.

### A. Identifying Key Decision-makers

A1. We hope to interview the person who played a key role in the decision to build a better-than-code building. Were you a key decision-maker?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

A2. **[IF A1=YES OR DK/REFUSE]** Please describe your role in the decision-making process for this project.

96. Specify:

A3. **[IF A1= YES]** Did others play a key role in the decision to build a better-than-code building? If so, can you provide the name, role, and contact information (either email or telephone) of one or two of the key decision-makers? **[IF NEEDED: WE WILL ONLY CONTACT THEM IF WE REQUIRE FURTHER INFORMATION ABOUT YOUR COMPANY'S DECISION TO BUILD A BETTER-THAN-CODE BUILDING]**

96. Specify:

**[IF A1= YES: GO TO SECTION B]**

A4. **[IF A1=NO]** Who were the people who played a key role in the decision to build a better-than-code building? Can you provide their names, roles, contact information of these decision-makers?

96. Specify:

**[IF A1= NO, DK or REFUSED: END]** These are all the questions I have for you. Thank you very much for your time and cooperation! **SCHEDULE INTERVIEW WITH KEY DECISION-MAKERS**

## B. Free-ridership

B1. Why did your organization decide to build a better-than-code building? **[DO NOT READ. MULTIPLE RESPONSE]**

1. Lower operation costs
2. Energy policy in my organization
3. Environmental reasons/energy efficiency
4. Competitors are doing it
5. Other, specify: \_\_\_\_\_
98. Don't know
99. Refused

B2. Had your organization finalized the design of the new building BEFORE knowing that you would receive an incentive from Efficiency Nova Scotia?

1. Yes
2. No
98. Don't know
99. Refused

B3. **[IF B2=YES]** When you decided to build a better-than-code building, how confident were you that you would receive an incentive from Efficiency Nova Scotia? **[READ]**

1. Very confident
2. Somewhat confident
3. Not very confident
4. Not at all confident
98. Don't know
99. Refused

- B4. I would like to understand the impact of the financial incentives offered by Efficiency Nova Scotia on the financial case for your new building. Which of the following best represents the role of the financial incentive? Did the financial incentives **[READ]**?
1. Reduce the cost of the additional energy efficiency measures included in the building to bring the project **within the pre-determined financial thresholds for approval. OR**
  2. Reduce the cost of the energy efficiency measures, significantly **strengthening the case for the overall project from a financial perspective. OR**
  3. Reduce the cost of the additional energy efficiency measures included in the building, **but even without financial support, you would have included the same measures** for other reasons. OR
  4. Did not have a significant impact on the decision.
  98. (Don't know)
  99. (Refused)
- B5. You received an incentive of **<MODELING INCENTIVE \$\$\$>** from Efficiency Nova Scotia for your energy model. Without this incentive, what is the likelihood that you would have hired an energy modeling consultant for your project?
1. Definitely would have
  2. Probably would have
  3. Probably would not have
  4. Definitely would not have
  98. Don't Know
  99. Refused
- B6. **[IF B5 ≠ 98 OR 99]** Did the energy modeling consultant help you assess different options available for building envelope and HVAC equipment?
1. Yes
  2. No
  98. Don't know
  99. Refused

- B7. You have received an incentive of **<IMPLEMENTATION INCENTIVE \$\$\$>** from Efficiency Nova Scotia specifically for the implementation of the energy efficiency measures. Without this incentive, which of the following scenarios would have been the most likely?
1. You would have designed the exact same building.
  2. You would have designed a less efficient building but still exceeded the minimum energy efficiency requirements prescribed in the building code.
  3. You would have designed a less efficient building that met the minimum energy efficiency requirements prescribed in the building code.
  98. (Don't know)
  99. (Refused)
- B8. **[IF C7 = 2]** Without the incentive provided by Efficiency Nova Scotia or the expertise provided by the energy modeler, what is the likelihood that you would have designed a building with **HVAC equipment as efficient as those you installed?**
1. Definitely would have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 100%]
  2. Probably would have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 75%]
  3. Probably would not have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 25%]
  4. Definitely would not have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 0%]
  98. Don't know
  99. Refused
- B9. **[IF C7 = 2]** Without the incentive from Efficiency Nova Scotia or the expertise provided by the energy modeler, what is the likelihood that you would have designed a building with **a building envelope as efficient as the one you designed, including insulation levels and glazing performance?**
1. Definitely would have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 100%]
  2. Probably would have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 75%]
  3. Probably would not have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 25%]
  4. Definitely would not have [DO NOT READ; FOR CALCULATION ONLY: SCORE = 0%]
  98. Don't know
  99. Refused

- B10. **[IF B7 = 2]** Without the incentive from Efficiency Nova Scotia or the expertise provided by the energy modeler, what is the likelihood that you would have designed a building with **as many efficiency measures as you included?**
1. Definitely would have **[DO NOT READ; FOR CALCULATION ONLY: SCORE = 100%]**
  2. Probably would have **[DO NOT READ; FOR CALCULATION ONLY: SCORE = 75%]**
  3. Probably would not have **[DO NOT READ; FOR CALCULATION ONLY: SCORE = 25%]**
  4. Definitely would not have **[DO NOT READ; FOR CALCULATION ONLY: SCORE = 0%]**
  98. Don't know
  99. Refused
- B11. **[IF B7 = 2 AND IF AVERAGE (B8,B9,B10) ≥ 75%]** You mentioned that, without an incentive from Efficiency Nova Scotia or the energy modeler, you would have designed a less efficient building than your current design. Can you explain how your building would have been different than what it is right now?
- B12. How important were the following factors in your decision to implement the energy efficiency measures in your new building?
- a. The New Construction program financial incentive for energy modeling.
  - b. The New Construction program financial incentive for implementation of energy efficiency measures.
  - c. The insights gained from the energy modeling regarding the energy savings associated with each potential measure.
  - d. The recommendations and technical assistance provided by the energy modeler, Business Development Manager, onsite energy manager, or other Efficiency Nova Scotia staff.
  - e. The non-technical information offered by the energy modeler, Business Development Manager, onsite energy manager, or other Efficiency Nova Scotia staff on building better-than-code buildings, for example, the market trends, building certifications, operating costs, and tradespeople availability, among other things.

For each sub-question:

1. Very important
2. Somewhat important
3. Not very important
4. Not at all important
98. Don't know
99. Refused





## C. Cross-Influence

- C1. Before participating in the Custom New Construction program for the building we discussed today, had you already taken part in Custom New Construction or another Efficiency Nova Scotia program?
1. Yes, Custom New Construction
  2. Yes, in another Efficiency Nova Scotia program
  3. Yes, both
  4. No **[SKIP TO C4]**
  98. Don't know **[SKIP TO C4]**
  99. Refused **[SKIP TO C4]**

**[ASK C2 AND C3 IF C1= YES (codes 1-3)]** Do you agree or disagree with the following statements?

- C2. **[ASK IF C1= YES (codes 1-3)]** Because of your previous participation in an Efficiency Nova Scotia program and what you learned from it, you asked a technical staff member or energy modeler to examine the energy efficiency options for your current building project.
1. Agree
  2. Disagree
  98. Don't know
  99. Refused
- C3. **[ASK IF C1= YES (codes 1-3)]** Because of your previous participation in an Efficiency Nova Scotia program and what you learned from it, you looked at the cost effectiveness of the energy efficiency measures in your new building by evaluating the different options available.
1. Agree
  2. Disagree
  98. Don't know
  99. Refused
- C4. Before participating in the New Construction program, had you seen energy efficiency promotional materials distributed by Efficiency Nova Scotia through its website, advertisements, brochures, newsletters or presentations?
1. Yes
  2. No **[SKIP TO D1]**
  98. Don't know **[SKIP TO D1]**
  99. Refused **[SKIP TO D1]**

**[ASK C5 TO C7 IF C4=YES]** Do you agree or disagree with each of the following statements?

- C5. **[ASK IF C4= YES]** The energy efficiency promotional materials distributed by Efficiency Nova Scotia through its website, brochures, newsletters, or presentations were a major factor in your decision to build a better-than-code building.
- 1. Agree
  - 2. Disagree
  - 98. Don't know
  - 99. Refused
- C6. **[ASK IF C4= YES]** The energy efficiency promotional materials through its website, brochures, newsletters, or presentations distributed by Efficiency Nova Scotia prompted you to ask a technical staff member or energy modeler to examine the energy efficiency options for your building project.
- 1. Agree
  - 2. Disagree
  - 98. Don't know
  - 99. Refused
- C7. **[ASK IF C4= YES]** The energy efficiency promotional materials through its website, brochures, newsletters, or presentations distributed by Efficiency Nova Scotia prompted you to consider the cost effectiveness of the energy efficiency measures in your new building by evaluating the different options offered to your organization.
- 1. Agree
  - 2. Disagree
  - 98. Don't know
  - 99. Refused

## D. Barriers and Motivations

D1. What were your primary concerns when you were considering building a high-efficiency building?  
**[DO NOT READ. MULTIPLE RESPONSE]**

1. (Cost of energy efficient technologies)
1. (Cost of energy modeling)
2. (Lower profits)
3. (Speed of construction)
4. (Lack of company expertise to design high-efficiency buildings)
5. (Performance of energy efficient technologies)
6. (Developer or investor satisfaction or retention)
7. (Building occupant satisfaction or comfort)
96. (Other [SPECIFY \_\_\_\_\_])
98. (Don't know)
99. (Refused)
97. (None/no concerns)

D2. Were there additional higher-efficiency technologies that you would have liked to have installed but you did not include in the project?

1. Yes
2. No
98. (Don't know)
99. (Refused)

D3. [ASK IF D2=1] What were these technologies? [RECORD VERBATIM RESPONSE]

D4. **[ASK IF D2=1]** Why did you decide not to include these technologies? **[RECORD VERBATIM RESPONSE]**

1. (Higher cost)
2. (Lower profits)
3. (Slower speed of construction)
4. (Unavailability of the technologies in the marketplace)
5. (Lack of contractor or market labor to install and/or maintain the technologies)
6. (Lack of company expertise with the technologies)
7. (Complexity of technology installation)
8. (Complexity of technology operations and maintenance)
9. (Performance of the technologies)
10. (Developer or investor satisfaction or retention)
11. (Building occupant satisfaction or comfort)
96. (Other [SPECIFY \_\_\_\_\_])
98. (Don't know)
99. (Refused)

## E. Program satisfaction

E1. On a scale from 1 to 10 (where 1 = not at all satisfied and 10 = very satisfied) ...

- a. how would you rate your satisfaction with each of the following aspects of the New Construction program?
- b. If less than 8, please explain the reason(s) for your score.

| Aspects of the program [READ AND RANDOMIZE]                                                                 | Score                                 | Reason |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------|--------|
| 1. The overall program                                                                                      | __ Response __98 DK __99 Ref __97 N/A |        |
| 2. The responsiveness of Efficiency Nova Scotia employees to your requests and enquiries in a timely manner | __ Response __98 DK __99 Ref __97 N/A |        |
| 3. The speed with which the application was approved                                                        | __ Response __98 DK __99 Ref __97 N/A |        |
| 4. The value of the program or service relative to the time and cost involved                               | __ Response __98 DK __99 Ref __97 N/A |        |
| 5. The ability to provide estimates of the savings or return on investment associated with the program      | __ Response __98 DK __99 Ref __97 N/A |        |
| 6. The technical expertise of Efficiency Nova Scotia employees related to the program                       | __ Response __98 DK __99 Ref __97 N/A |        |

E2. Has your company experienced any challenges with the program over the last year?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

E3. **[ASK IF E2=1]** Please describe the challenges you encountered **[OPEN RESPONSE]**

E4. Do you have any suggestions to improve the program? **[OPEN RESPONSE]**

Record: \_\_\_\_\_

☐ No suggestion at this time

I have a few more questions to ask you about GHG emissions and electrification. Would you have another 3-4 minutes?

## **F. GHG Emissions and Electrification (Builders)**

F1. Would you say that reducing GHG emissions is...**[READ]**

- 1. ...very important to your company?
- 2. ...important to your company?
- 3. ...of little importance to your company?, or
- 4. ...not at all important to your company?
- 98. Don't know
- 99. Refused

F2. **[ASK IF F1=1-2]** Has your desire to reduce GHG emissions in your buildings influenced your participation in the New Construction program?

- 1. Yes
- 2. No
- 98. Don't know
- 99. Refused

F3. **[ASK IF F2=1]** How has it influenced your participation? **[RECORD VERBATIM RESPONSE]**

F4. Would you say that electrification is...**[READ]**

1. ...very important to your company?
2. ...important to your company?
3. ...of little importance to your company?, or
4. ...not at all important to your company?
98. Don't know
99. Refused

F5. **[ASK IF F4=1-2]** Has your opinion regarding electrification influenced your participation in the New Construction program?

1. Yes
2. No
98. Don't know
99. Refused

F6. **[ASK IF F5=1]** How has it influenced your participation? **[RECORD VERBATIM RESPONSE]**

## **G. Building codes**

G1. In April 2025, Nova Scotia will adopt the National Energy Code of Canada for Buildings 2020 (NECB2020). Would you say that the adoption of NECB2020 increases, decreases, or has no impact on your likelihood to participate in the New Construction program in the future?

1. Increases
2. Decreases
3. Has no impact
98. Don't know
99. Refused

G2. **[IF G3=1-3]** Why do you say that? **[RECORD VERBATIM RESPONSE]**

## **END**

Those are all the questions I have for you today. Thank you for your time and the valuable feedback you have provided.

## APPENDIX IX

### New Construction Non-Participant Modeler Guide

#### GUIDE FOR INTERVIEWS WITH Non-Participant and new ENERGY Modelers

**Table 5: Overview of Data Collection Activity**

| Descriptor                       | This Instrument                           |
|----------------------------------|-------------------------------------------|
| Instrument Type                  | Semi-directed in-depth interview          |
| Estimated Time to Complete       | 15 Minutes                                |
| Target Audience                  | › New or Non-Participant Modelers         |
| › Expected Number of Completions | › Non-Participant or New Modelers (n = 3) |
| Contact List Source              | Efficiency One                            |
| Fielding Firm                    | Econoler                                  |
| Estimated Timeline for Fielding  | November 2024                             |

**Table 6: Research Objectives and Questions**

| Research objective                                                                            | Research Questions                                                                           | Section/Question # |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------|
| › Explore opportunities to expand program presence outside of electrically heated MURB market | › Are projects outside of Halifax area underrepresented in New Construction?                 | A3<br>E9           |
|                                                                                               | › What is the awareness level of the program among non-MURB builders and energy modellers?   | A2<br>Section E    |
|                                                                                               | › What are the motivations and barriers for non-MURB builders to participate in the program? | A2<br>Section B    |
|                                                                                               | › What actions could be taken by the program to target more non-MURB participants?           | E9                 |
| › Update program service logic                                                                | › What are the barriers to program participation?                                            | Section B          |

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Black text: instructions for interviewer **[NOTE: xxxx]** / **[PROBE: xxxx]**

## Introduction

Hello, may I speak with [Contact name]?

My name is [Interviewer name] and I'm calling from Narrative Research, a Halifax based market research firm on behalf of Efficiency Nova Scotia. We are conducting an evaluation of energy efficiency services provided by Efficiency Nova Scotia.

We would appreciate your help in answering questions about the commercial new construction market in Nova Scotia. The information you provide will be used to help Efficiency Nova Scotia improve their new construction program offerings.

**[IF NEEDED: EFFICIENCY NOVA SCOTIA'S NEW CONSTRUCTION PROGRAM PROVIDES SUPPORT FOR THE DESIGN AND CONSTRUCTION OF ENERGY EFFICIENT BUILDINGS LARGER THAN 15,000 SQUARE FEET. THE PROGRAM OFFERS AN INCENTIVE TOWARD ENERGY MODELLING FEES AS WELL AS AN IMPLEMENTATION INCENTIVE BASED ON THE ELECTRICITY SAVINGS OF THE NEW BUILDING RELATIVE TO THE BUILDING CODE. ]**

Today's call should take about 15 minutes. Is this a convenient time to talk? Please be advised that this call may be recorded for quality assurance.

1. (Yes) [CONTINUE]
2. (No, later) [RESCHEDULE]
3. (No, refused) [THANK AND TERMINATE]

## A. Energy Modeller Profile

A1. To begin, what is your title and your role with your company?

A2. We would like to understand a bit more about your company's energy modelling business in Nova Scotia. Roughly what percentage of your energy modelling business in Nova Scotia is for buildings in the the following sectors <READ EACH BUILDING TYPE WHERE A1=YES>? **[TOTAL MUST EQUAL 100%]**

| Building type                  | % |
|--------------------------------|---|
| Residential multiunit ("MURB") |   |
| Commercial                     |   |
| Institutional and Government   |   |
| Industrial                     |   |
| Other                          |   |

98. Don't know

99. Refused



A3. And roughly what percentage of your company's modelling business in Nova Scotia is for buildings inside the Halifax Regional Municipality versus outside the Halifax Regional Municipality?

Inside HRM \_\_\_\_% Outside HRM \_\_\_\_% **[TOTAL MUST EQUAL 100%]**

98. Don't know

99. Refused

A4. What percentage of your Nova Scotia modelling business is for buildings?

1. ...less than 15,000 square feet in size \_\_\_\_

2. ...greater than 15,000 square feet in size \_\_\_\_%

**[TOTAL MUST EQUAL 100%]**

98. Don't know

99. Refused

A5. And finally, what percentage of your Nova Scotia models are for buildings that are electrically-heated versus gas-heated?

1. ... electricity\_\_\_\_%

2. ... gas\_\_\_\_%

3. ... Other [SPECIFY\_\_\_\_\_])

**[TOTAL MUST EQUAL 100%]**

98. Don't know

99. Refused

## B. Barriers to Participation and Motivations

B1. In your experience, why are some builders NOT completing an **energy model** for their building? **[DO NOT READ. MULTIPLE RESPONSE]**

1. (Cost – energy efficiency upgrades are too expensive)
2. (Cost – energy modeling is too expensive)
3. (Cost – developers or investors are not willing to pay for energy efficiency upgrades)
4. (Time – builders think the additional time for modelling will cause project delays)
5. (Builder awareness – builders are not aware of energy efficient design or technologies)
6. (Builder expertise – builders lack expertise to design or build energy efficient buildings)
7. (Builders are not aware of the benefits of energy modelling)
8. (Developers or investors do not request or prioritize energy efficiency)
9. (Builder believes meeting minimum energy efficiency code requirements is sufficient)
10. (Risk – Builder believes incorporating energy efficiency into building design is too risky)
11. (Project size may be too small to justify the additional time and cost of modelling)
96. Other: [SPECIFY \_\_\_\_\_]
98. Don't know
99. Refused

B2. And what are the reasons your customers complete an **energy model**? **[DO NOT READ. MULTIPLE RESPONSES]**

1. (Cost reduction – modeling can help identify cost-effective materials and systems)
2. (Code compliance – meeting minimum building energy code/energy performance requirements)
3. (Increased energy performance – builders want to construct buildings that exceed minimum energy performance requirements)
4. (Green building certification – builders seek green building certifications such as LEED or BREEM)
5. (Financial incentives and rebates from government and utilities)
6. (Increase long term investment value through more energy efficient design)
7. (Higher marketing value – energy efficient buildings result in lower operating costs for tenants)
8. (Higher marketing value – sustainability is an important selling point)
96. Other: [SPECIFY \_\_\_\_\_]
98. Don't know
99. Refused

B3. In your experience, what are the reasons builders choose NOT to design higher energy efficient buildings that exceed code requirements? **[DO NOT READ. MULTIPLE RESPONSES]**

1. (Cost – builders believe energy efficiency upgrades are too expensive)
2. (Time – builders believe higher performing buildings take longer to build)
3. (Investors or developers do not prioritize energy efficiency)
4. (Uncertain market value – builders are unsure the market will recognize the value added of higher performing buildings)
5. (Builder awareness – builders are not aware of energy efficient design or technologies)
6. (Builder expertise – builders lack expertise to design or build energy efficient buildings)
7. (Builders believe meeting minimum energy efficiency code requirements is sufficient)
8. (Uncertain energy costs – builders believe energy prices are too uncertain to justify investments in energy efficiency)
9. (Risk – Builder believes incorporating energy efficiency into building design is too risky)
96. Other: [SPECIFY \_\_\_\_\_])
98. Don't know
99. Refused

B4. What are the reasons builders decide to design higher energy efficient buildings that exceed the building code? **[DO NOT READ. MULTIPLE RESPONSES]**

1. (Lower building operating costs)
2. (Increase property value )
3. (Protection against rising energy costs)
4. (Gaining a competitive advantage in the market)
5. (Meet tenant or investor expectations for energy efficiency)
6. (Satisfy market demand for sustainable or green buildings)
7. (Access financing or incentives for high performing buildings)
8. (Improve building occupant comfort or satisfaction)
9. (Increase building durability)
10. (Meet government mandates and/or climate goals)
96. Other: [SPECIFY \_\_\_\_\_])
98. Don't know
99. Refused

## C. GHG Emissions & Electrification

- C1. Have you had discussions with your builder clients about reducing GHG emissions or about electrification?
1. Yes, reducing GHG emissions
  2. Yes, electrification
  3. No
  98. Don't know
  99. Refused
- C2. **[IF C1 = 1 OR 2]** What issues or concerns, if any, are top of mind among them? **[RECORD VERBATIM]**
- C3. In your opinion, how do these issues impact your clients' choices related to the energy performance of their new buildings? **[PROBE: less/more interest in energy efficiency, fuel choice (electric vs. gas heating)]** **[RECORD VERBATIM]**

## D. NECB 2020

- D1. In April 2025, Nova Scotia will adopt the National Energy Code of Canada for Buildings 2020 (NECB2020). Have you had discussions with your builder clients about NECB2020?
1. Yes
  2. No
  98. Don't know
  99. Refused
- D2. **[IF D1 = 1]** What issues or concerns, if any, are top of mind among them? **[RECORD VERBATIM]**
- D3. In your opinion, how does NECB2020 impact your clients' choices related to the energy performance of their new buildings? **[PROBE: more energy modelling, less/more interest in energy efficiency, fuel choice (electric or gas heating)]** **[RECORD VERBATIM]**

## E. Program Awareness and Participation

- E1. Have you ever heard of the New Construction program from Efficiency Nova Scotia?
1. Yes
  2. No
  98. Don't know
  99. Refused

- E2. **[IF E1 = 1]** How familiar are you with the New Construction program? Are you **[READ RESPONSES]** familiar with the program?
1. Very
  2. Somewhat
  3. Not very; or
  4. Not at all
  98. Don't know
  99. Refused
- E3. **[IF E1=1]** How did you hear of the New Construction program? Anywhere else? **[DO NOT READ. MULTIPLE RESPONSE]**
1. (Another modeller)
  2. (Efficiency Nova Scotia website)
  3. (Online – general)
  4. (Social media)
  5. (Through another Efficiency One)
  6. (Via a friend, acquaintance, or family member)
  7. (Radio ads)
  8. (Newspaper)
  9. (Efficiency newsletter - online/email)
  10. (TV ad)
  11. (Brochure/handout)
  12. (Special event like a home show)
  96. (Other [SPECIFY \_\_\_\_\_])
  98. (Don't know)
  99. (Refused)
- E4. **[IF NON-PARTICIPANT MODELLER and E1 = 1]** Why have you not been involved in the program? **[DO NOT READ. MULTIPLE RESPONSE]**
1. (Does not understand how program works)
  2. (Energy modelling incentives are too low)
  3. (Customers do not want to participate in the program)
  4. (Company staff lacks time to participate in program)
  5. (Heard negative feedback about program from other modelers)
  6. (Had negative experiences with similar programs in the past)
  96. (Other [SPECIFY \_\_\_\_\_])
  98. (Don't know)
  99. (Refused)

- E5. **[IF E1 = 1 AND NON-PARTICIPANT MODELLER]** Do you ever discuss the New Construction program to the builders you work with?
1. Yes
  2. No
  98. Don't know
  99. Refused
- E6. **[IF E5 = 1 AND NON-PARTICIPANT MODELLER]** Who typically initiates the discussions about the New Construction program? Is it **[READ]**?
1. You/your business bringing up the topic with the client
  2. The client bringing up the topic with you
  3. The idea arising from a discussion between your business and the client
  4. Someone from Efficiency Nova Scotia (e.g. Business Development Manager) suggesting it to you and your client.
  96. (Other [SPECIFY \_\_\_\_\_])
  98. (Don't know)
  99. (Refused)
- E7. **[IF NEW MODELLER]** Who initiated the discussion about participating in the New Construction program? Was it **[READ]**?
1. You/your business bringing up the topic with the client
  2. The client bringing up the topic with you
  3. The idea arising from a discussion between your business and the client
  4. Someone from Efficiency Nova Scotia (e.g. Business Development Manager) suggesting it to you and your client.
  96. (Other [SPECIFY \_\_\_\_\_])
  98. (Don't know)
  99. (Refused)

**[READ IF E1 = 2 OR E2=2 TO 4: EFFICIENCY NOVA SCOTIA'S NEW CONSTRUCTION PROGRAM PROVIDES SUPPORT FOR THE DESIGN AND CONSTRUCTION OF ENERGY EFFICIENT BUILDINGS LARGER THAN 15,000 SQUARE FEET. THE PROGRAM OFFERS AN INCENTIVE TOWARD ENERGY MODELLING FEES AS WELL AS AN IMPLEMENTATION INCENTIVE BASED ON THE ELECTRICITY SAVINGS OF THE PERFORMANCE OF THE NEW BUILDING RELATIVE TO THE BUILDING CODE.]**

- E8. What could Efficiency Nova Scotia do to support the building energy modelling industry in Nova Scotia? **[RECORD VERBATIM RESPONSE]**
96. (Don't know)
  99. (Refused)

- E9. What could the New Construction program do to encourage more participation among builders? **[DO NOT READ. MULTIPLE RESPONSE]**
1. (Increase incentives for energy modelling)
  2. (Increase incentive for my customers – for implementation/performance)
  3. (Speed-up the incentive payment process)
  4. (Clarify eligibility guidelines)
  5. (Make eligibility guidelines more flexible)
  6. (Allow gas-heated buildings)
  7. (Provide more technical support)
  8. (Improve communications and outreach)
  9. (Nothing)
  96. (Other [SPECIFY \_\_\_\_\_])
  98. (Don't know)
  99. (Refused)
- E10. Is there anything additional that Efficiency Nova Scotia could do to encourage participation specifically from the non-MURB market? What about the market outside of Halifax Metropolitan Area? **[RECORD VERBATIM RESPONSE for each]**
- a. Answer for encouraging non-MURB market: \_\_\_\_\_
  - b. Answer for encouraging market outside of Halifax: \_\_\_\_\_
  98. (Don't know)
  99. (Refused)
- E11. **[IF NEW MODELLER]** What additional support could Efficiency One offer to make your job easier when supporting clients in the New Construction program? **[RECORD VERBATIM RESPONSE for each]**
98. (Don't know)
  99. (Refused)

**END**

Those are all the questions I have for you today. Thank you for your time and the valuable feedback you have provided.

## APPENDIX X

# New Construction Program Manager and Business Development Manager Interview Guide

## GUIDE FOR INTERVIEWS WITH Program staff and BDMs

**Table 7: Overview of Data Collection Activity**

| Descriptor                      | This Instrument                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------|
| Instrument Type                 | Semi-directed in-depth interview                                                                                 |
| Estimated Time to Complete      | 45 min for Program Manager, 45 min for BDM                                                                       |
| Target Audience                 | E1 program staff: <ul style="list-style-type: none"> <li>› Commercial NC PM</li> <li>› Commercial BDM</li> </ul> |
| Expected Number of Completions  | 2                                                                                                                |
| Contact List Source             | Efficiency One                                                                                                   |
| Fielding Firm                   | Econoler                                                                                                         |
| Estimated Timeline for Fielding | October 2024                                                                                                     |

**Table 8: Research Objectives and Questions**

| Research objective                                      | Research Questions                                                                           | Section/Question # |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------|
| › Explore opportunities to expand program participation | › How has program participation changed over time?                                           | › Section E        |
|                                                         | › Are projects outside of Halifax area underrepresented in New Construction?                 | › E1-E3            |
|                                                         | › What are the motivations and barriers for non-MURB builders to participate in the program? | › E4-E5            |
|                                                         | › What actions could be taken by the program to target more non-MURB participants?           |                    |
|                                                         | › What is E1's current relationship with modelers involved in the program?                   | › Section D        |
|                                                         | › How could the number of energy modelers involved be increased?                             |                    |
| › Update program service logic                          | › What are the barriers to program participation?                                            | › Section B        |
|                                                         | › Does the current program logic align with participant barriers?                            | › Section C        |

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Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx]** / **[PROBE: xxxx]**



## A. Respondent Involvement in the Program

- A1. [FOR BDM Interviews] To begin, please tell me about your role as a **< Business development Manager>** as it relates to Custom New Construction program services?

## B. Motivation and Barriers

- B1. In your experience, what prevents customers from building high-efficiency buildings in the absence of support from E1?
- B2. How do you describe the value or benefits of the Custom New Construction Program to potential participants?
- B3. What are the most common motivations for participants to participate in the program?
- B4. In your opinion, what is the primary barrier to participating in the program? Any others? Do you think that varies depending on the building/participant type or regionally?

## C. Program logic model

- C1. [PROGRAM MANAGER ONLY] Can you walk through the program logic model, starting with what you see as the main market barriers to efficient new buildings and how the program addresses those barriers?.

## D. Market actors

- D1. How do you work with energy modellers/consultants for New Construction? **[Probe: Are they a source of projects?]**
- D2. How would you describe E1's current relationship with energy modellers?
- D3. Do you have any suggestions for improving the program's relationship with energy modellers?
- D4. In the past projects in the New Construction program were primarily modelled by one energy modeller. Do you think that is an issue for participation in the program? Why do you say that?
- D5. What, if anything, have you done to increase the number of modellers participating in the program?

## E. Market and program evolution

- E1. How has the new construction market evolved in Nova Scotia the last few years, both inside and outside of the Halifax Municipal Region?
- E2. In your opinion, is the program under-represented in areas outside of Halifax? Why do you say that?
- E3. What could be done to attract more participation outside of the Halifax Metropolitan Area?

- 
- E4. In your opinion, is the program under-represented in non-MURBs? Why do you say that?
  - E5. What could be done to attract more participation outside of the MURB market?
  - E6. Can you describe, overall, how the program has evolved during the last few years?
  - E7. Have your customers discussed decarbonization or electrification with you? If yes, what are their concerns?
  - E8. In your opinion, how do participant's decarbonization or electrification objectives impact participation in New Construction? [PROBE: more interest, different measures]?
  - E9. Have your customers discussed NECB2020 with you? If yes, what are their concerns? Any impact on participation in New Construction?

## **F. Challenges and Opportunities**

- F1. Overall, what is the main strength of the New Construction program?
- F2. What is the main challenge of the New Construction program?
- F3. What feedback have you heard from participants about the New Construction program?
- F4. Are there any other challenges with the program or delivery that we haven't discussed?
- F5. Are there any changes to the program you are interested in for the future?
- F6. Do you have any other suggestions for program improvements?
- F7. What should the program stop doing?
- F8. What should the program start doing?

## **G. Program evaluation**

- G1. [Program manager only] We will look at Commercial new construction program eligibility criteria in other jurisdictions to inform the process evaluation. Are there specific jurisdictions you recommend we consider?

Those are all the questions I have for you today. Would you like to add anything else regarding the New Construction program?

# APPENDIX XI

## New Construction Energy Model Review Protocol

### Project Review Protocol



Custom New Construction  
Efficiency Nova Scotia  
Simulation Model Review Protocol

#### 1. General Information

Review Date: \_\_\_\_\_ Contact Name: \_\_\_\_\_  
Project ID: \_\_\_\_\_ Contact Title: \_\_\_\_\_  
Project Type: \_\_\_\_\_ Contact Phone: \_\_\_\_\_  
Project Status: \_\_\_\_\_ Email: \_\_\_\_\_  
Project Name: \_\_\_\_\_  
Address: \_\_\_\_\_

#### Project Energy Efficiency Measure(s)

Information Sent by E1 Sufficient to Review the Project? \_\_\_\_\_ (Y/N)

Call or Virtual Visit Needed \_\_\_\_\_ (Call/Visit)

List of people participating to the virtual visit/call: \_\_\_\_\_  
\_\_\_\_\_

#### 2. Facility Operation Schedules

*These data should be asked prior the virtual visit by email or phone to the final beneficiary of the building or found in documentation sent by E1*

People/ Document giving information \_\_\_\_\_  
\_\_\_\_\_

**Facility Description:** \_\_\_\_\_ Outline a quick description of the facility and its primary operation/purpose.

NOTE: PC Users "Alt+Enter" for new line in cell. MAC Users "CMD+Option+Enter".



**Facility Annual Schedule:**

*Gather info for each occupancy schedule reported by the site contact as occupancy could vary for each section of the facility. Use additional lines if necessary. Ensure info is for a typical year (non-COVID).*

|  |
|--|
|  |
|--|

**HVAC System Operation Schedule:**

*Gather info for each HVAC system.*

|  |
|--|
|  |
|--|

**3. Virtual Visit, Call or Document Review Summary**

|  |
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#### 4. Adjustments to Energy Model per Measure

The reviewer must verify the model following guidance defined in the tab "Modelling Review Checklist".

| Description from project documentation |  |
|----------------------------------------|--|
| Virtual visit, call or document        |  |
| As modeled by participant              |  |
| Changes to model by Econoler           |  |

| Description from project documentation |  |
|----------------------------------------|--|
| Virtual visit, call or document        |  |
| As modeled by participant              |  |
| Changes to model by Econoler           |  |

| Description from project documentation |  |
|----------------------------------------|--|
| Virtual visit                          |  |
| As modeled by participant              |  |
| Changes to model by Econoler           |  |

| Description from project documentation |  |
|----------------------------------------|--|
| Virtual visit, call or document        |  |
| As modeled by participant              |  |
| Changes to model by Econoler           |  |

| Description from project documentation |  |
|----------------------------------------|--|
| Virtual visit                          |  |
| As modeled by participant              |  |
| Changes to model by Econoler           |  |

## 5. Simulation Outputs

Name of the simulation file

|          | EOne | Evaluator |
|----------|------|-----------|
| Basecase |      |           |
| Proposed |      |           |

### Energy Consumption (kWh)

|                  | EOne     |          | Evaluator |          |
|------------------|----------|----------|-----------|----------|
|                  | Basecase | Proposed | Basecase  | Proposed |
| LIGHTS           |          |          |           |          |
| TASK LIGHTS      |          |          |           |          |
| MISC EQUIP       |          |          |           |          |
| SPACE HEATING    |          |          |           |          |
| SPACE COOLING    |          |          |           |          |
| HEAT REJECT      |          |          |           |          |
| PUMPS & AUX      |          |          |           |          |
| VENT FANS        |          |          |           |          |
| REFRIG DISPLAY   |          |          |           |          |
| HT PUMP SUPPLEM  |          |          |           |          |
| DOMESTIC HOT WTR |          |          |           |          |
| EXT USAGE        |          |          |           |          |
| <b>Total</b>     | <b>0</b> | <b>0</b> | <b>0</b>  | <b>0</b> |

### Peak Demand - Average for Jan, Feb and Dec

|  | EOne       |            | Evaluator  |            |
|--|------------|------------|------------|------------|
|  | Basecase   | Proposed   | Basecase   | Proposed   |
|  |            |            |            |            |
|  |            |            |            |            |
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|  |            |            |            |            |
|  |            |            |            |            |
|  | <b>0.0</b> | <b>0.0</b> | <b>0.0</b> | <b>0.0</b> |

## 6. Energy and Demand Savings Adjustments

|                                     |      |        |
|-------------------------------------|------|--------|
| Energy Savings from Tracking Sheet: |      | kWh/yr |
| Demand Savings from Tracking Sheet: |      | kW     |
| Diversity Factor Used by ENSC:      | 100% |        |

|                                 |  |
|---------------------------------|--|
| Project Estimated Finish Month: |  |
| Notes on Project Status:        |  |

### Adjustment from the Evaluator

|                                    |            |
|------------------------------------|------------|
| Adjusted Energy Savings:           | <b>0</b>   |
| Adjusted Demand Savings:           | <b>0.0</b> |
| Adjusted Demand Savings with PCF:  | <b>1.0</b> |
| Diversity Factor Used by Econoler: |            |

Adjustments made to energy savings?  (Y/N)

Adjustments made to demand savings?  (Y/N)

Adjustments made to PCF?  (Y/N)

|                                        |         |
|----------------------------------------|---------|
| Percent of Tracked Energy Savings      | #DIV/0! |
| Percent of Tracked Peak Demand Savings | #DIV/0! |
| Client Rate Code                       |         |

|                       |  |
|-----------------------|--|
| Line Loss Factor Used |  |
|-----------------------|--|

## 7. Summarize Adjustments to Energy, Demand & Diversity Factor



# Modelling Review Checklist

## Reminder of Evaluation Goals and Key Principles

While developing the checklist, the Evaluator kept in mind the key evaluation goals and the five guiding principles presented in the 2020-2022 Overall Strategic Evaluation Plan.

Notably for New Construction, Principle 4 states that:

For some complex program services (e.g. Custom New Construction), the Evaluator thoroughly reviews measures that contribute the most savings to a project but does not comprehensively review the entire model or measurement and verification (M&V) procedures. Thus, the evaluation review should not be interpreted as vetting all modelling or M&V practices.

## Simulation Model Review Checklist

The checklist consists of the six main items below. This checklist should be considered as general guidelines. Simulation model reviews are treated on a case by case basis and other items may be considered depending on the building type, complexity of the HVAC systems, energy efficiency measures installed etc.

### 1 Results General Overview

- Check savings (in %) for each end use and identify where the major savings lie. Crosscheck with the energy efficiency measure list to validate if the savings claimed make sense.
- Verify GJ/m<sup>2</sup> and check benchmarking data to verify if energy intensity is normal based on the type of building. Pay attention to differences in buildings that can explain discrepancies (e.g. two apartment buildings with the same area will not have a comparable GJ/m<sup>2</sup> if only one of them has an underground parking).

### 2 Envelope Review

- Check envelope resistance value (wall/fenestration/roof/etc.) and validate with shop drawings and construction details. Make sure that effective R/RSI – U/USI values are used in the simulation.
- Pay particular attention to curtain walls. Although the nominal insulation value may be high (up to R15-20), the effective value rarely exceeds R8 because of the effect of the frame.
- Verify fenestration-to-wall ratio (%) in the proposed model. If the ratio is above baseline allowance, validate that the reference model ratio has been reduced to maximum allowance.
- Validate that the values used for the reference are in accordance with the specifications of the code used.

### 3 Parametrization and Zoning

- For buildings with a repetitive storey pattern, if the “Copy” function is used, the modeller often forgets to check the “Over conditioned space” option, which may create an “exterior floor”.
- Verify the zoning to make sure it is appropriate.

### 4 Loads and Schedules

- Validate occupancy and plug-load values according to NECB.
- Validate lighting loads by spot-checking installed lighting power in random rooms vs. electrical plans and shop drawings.
- Validate domestic hot water (DHW) loads according to the guideline developed by EfficiencyOne for DHW consumption values.
- Validate that the schedules used are typical for the type of building modelled.



## 5 HVAC Systems

This section can be very complex, depending on the building modelled, so the following should be considered as general guidelines.

Please refer to E1 White Paper - Baseline HVAC System in MURBs for MURBS

- Validate that all HVAC inputs concord with shop drawings.
- In the case of a dedicated outside air system, pay attention to how it has been modelled.
- Validate that the systems selected are in accordance with the specification of the code used (type of system, efficiency, sizing) for the reference building.
- Carefully read the operating sequence and verify that the HVAC systems operate accordingly.
- Take special care to validate the modelling of energy efficiency measures.
- Make sure that the air flow (cfm) of installed systems match the cfm modelled (reference and proposed) for fresh air.
- Be on the lookout if known bugs/miscalculations in the modelling software are present due to the system types used within the model. If present, see if the energy modeller can address them.

## 6 External Calculations

- Review external calculations, if any.



## APPENDIX XII

### New Construction Algorithm for Free-Ridership Calculation

**Table 1: Participant Interview Questionnaire and Free-ridership Algorithm**

| Question |                                                                                                                                                                                                  | Answer                                                                                                                                                                                                                                          | Score                                                                                                                                                                                                                        |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |                                                                                                                                                                                                  |                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                              |
| A1       | We hope to interview the key decision-makers that played a key role in the decision to build a better-than-code building. Were you a key decision-maker?                                         | 1) Yes                                                                                                                                                                                                                                          | EMPTY                                                                                                                                                                                                                        |
|          |                                                                                                                                                                                                  | 2) No                                                                                                                                                                                                                                           |                                                                                                                                                                                                                              |
|          |                                                                                                                                                                                                  | 98) DK/Refuse                                                                                                                                                                                                                                   |                                                                                                                                                                                                                              |
| A2       | [IF A1=YES] Please describe your role in the decision-making process.                                                                                                                            | Answer: _____                                                                                                                                                                                                                                   | Contextual information to help identify if respondent is a key decision-maker                                                                                                                                                |
| A3       | [IF A1=YES] Were there other key decision-makers that played a role in the decision to build a better-than-code building? If so, can you provide their names, roles, and contact information?    | Answer: _____                                                                                                                                                                                                                                   | Contextual information to help identify other key decision-makers to interview.<br>If participant is unable to identify other key decision-makers, the Evaluator will ask E1 if they are aware of other key decision-makers. |
| A4       | [IF A1=NO, DK or REFUSED] Who were the key decision-makers that played a key role in the decision to build a better-than-code building? Can you provide their names, roles, contact information? | Answer: _____<br>[IF A4= NO, DK or REFUSED: END]<br>These are all the questions I have for you. Thank you very much for your time and cooperation!                                                                                              | Contextual information to help identify other key decision-makers to interview                                                                                                                                               |
|          |                                                                                                                                                                                                  |                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                              |
| B1       | Can you explain why your organization decided to build a better-than-code building?<br>[DO NOT READ]                                                                                             | Answer: _____ Pre-coded answers<br>[DO NOT READ]:<br>1) Lower operation costs<br>2) Energy policy in my organization<br>3) Environmental reasons/energy efficiency<br>4) Competitors are doing it<br>96) Other, specify: _____<br>98) DK/Refuse | Contextual information to help explain free-ridership results.                                                                                                                                                               |
| B2       | Had your organization finalized the design of the new building BEFORE knowing that you would receive an incentive from Efficiency Nova Scotia?                                                   | 1) Yes                                                                                                                                                                                                                                          | Use B3                                                                                                                                                                                                                       |
|          |                                                                                                                                                                                                  | 2) No                                                                                                                                                                                                                                           | 0%                                                                                                                                                                                                                           |
|          |                                                                                                                                                                                                  | 98) DK/Refuse                                                                                                                                                                                                                                   |                                                                                                                                                                                                                              |
| B3       | [ASK IF B2=1] When you decided to build a better-than-code building, how confident were you that you would receive an incentive from Efficiency Nova Scotia? [READ]                              | 1) Very confident                                                                                                                                                                                                                               | 0%                                                                                                                                                                                                                           |
|          |                                                                                                                                                                                                  | 2) Somewhat confident                                                                                                                                                                                                                           | 25%                                                                                                                                                                                                                          |
|          |                                                                                                                                                                                                  | 3) Not very confident                                                                                                                                                                                                                           | 75%                                                                                                                                                                                                                          |
|          |                                                                                                                                                                                                  | 4) Not at all confident                                                                                                                                                                                                                         | 100%                                                                                                                                                                                                                         |
|          |                                                                                                                                                                                                  | 98) DK/Refuse                                                                                                                                                                                                                                   | 50%                                                                                                                                                                                                                          |

| Question |                                                                                                                                                                                                                                                      | Answer                                                                                                                                                                                   | Score                                                   |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
|          |                                                                                                                                                                                                                                                      | Planning Score (PS)                                                                                                                                                                      | B2<br>adjusted by B3                                    |
|          |                                                                                                                                                                                                                                                      |                                                                                                                                                                                          |                                                         |
| B4       | I would like to understand the impact of the financial incentives offered by Efficiency Nova Scotia on the financial business case for your new building project. Which of the following best represents the role of the financial incentive? [READ] | Reduced the cost of the additional energy efficiency measures included in the building to bring the project within the project's pre-determined financial thresholds for approval.       | 0%                                                      |
|          |                                                                                                                                                                                                                                                      | Reduced the cost of the energy efficiency measures, significantly strengthening the case for the overall project from a financial perspective.                                           | 25%                                                     |
|          |                                                                                                                                                                                                                                                      | Reduced the cost of the additional energy efficiency measures included in the building, but even without financial support, you would have included the same measures for other reasons. | IF B6 => 75% OR EMPTY<br>= 100%<br>IF B6 < 75%<br>= 50% |
|          |                                                                                                                                                                                                                                                      | Did not have a significant impact on the decision.                                                                                                                                       | IF B6 => 75% OR EMPTY<br>= 100%<br>IF B6 < 75%<br>= 50% |
|          |                                                                                                                                                                                                                                                      | 98) DK/Refuse                                                                                                                                                                            | EMPTY                                                   |
| B5       | You received an incentive of <\$\$\$> from Efficiency Nova Scotia for your energy model. Without the Efficiency Nova Scotia incentive, what is the likelihood that you would have hired an energy modeling consultant for your project?              | 1) Definitely would have                                                                                                                                                                 | 100%                                                    |
|          |                                                                                                                                                                                                                                                      | 2) Probably would have                                                                                                                                                                   | 75%                                                     |
|          |                                                                                                                                                                                                                                                      | 3) Probably would not have                                                                                                                                                               | 25%                                                     |
|          |                                                                                                                                                                                                                                                      | 4) Definitely would not have                                                                                                                                                             | 0%                                                      |
|          |                                                                                                                                                                                                                                                      | 98) DK/Refuse                                                                                                                                                                            | EMPTY                                                   |
| B6       | [ASK IF B5 ≠ 98] Did the energy modeling consultant help you assess different options available for building envelope and HVAC equipment?                                                                                                            | 1) Yes                                                                                                                                                                                   | B5 Score                                                |
|          |                                                                                                                                                                                                                                                      | 2) No                                                                                                                                                                                    | EMPTY                                                   |
|          |                                                                                                                                                                                                                                                      | 98) DK/Refuse                                                                                                                                                                            | EMPTY                                                   |
|          |                                                                                                                                                                                                                                                      | Cost Score (CS)                                                                                                                                                                          | B4<br>adjusted by B5 & B6                               |
|          |                                                                                                                                                                                                                                                      |                                                                                                                                                                                          |                                                         |
| B7       | You [received/will also be receiving] an incentive based on energy savings once your building is complete. Without the implementation incentive from Efficiency Nova Scotia, which of the following scenarios would have been the most likely?       | 1) Would have designed the exact same better-than-code building.                                                                                                                         | 100%                                                    |
|          |                                                                                                                                                                                                                                                      | 2) Would have designed a less efficient building but would have still exceeded the minimum energy efficiency requirements prescribed in the building code.                               | AVERAGE (B8, B9, B10)                                   |
|          |                                                                                                                                                                                                                                                      | 3) Would have designed a less efficient building that met the minimum energy efficiency requirements prescribed in the building code.                                                    | 0%                                                      |
|          |                                                                                                                                                                                                                                                      | 98) DK/Refuse                                                                                                                                                                            | EMPTY                                                   |

| Question                                                                                                                                                 |                                                                                                                                                                                                                                                                               | Answer                       | Score                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B8                                                                                                                                                       | [ASK IF B7=2]<br>Without Efficiency Nova Scotia or the energy modeler, what is the likelihood that you would have designed a building with HVAC equipment as efficient as you did?                                                                                            | 1) Definitely would have     | 100%                                                                                                                                                         |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 2) Probably would have       | 75%                                                                                                                                                          |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 3) Probably would not have   | 25%                                                                                                                                                          |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 4) Definitely would not have | 0%                                                                                                                                                           |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 98) DK/Refuse                | EMPTY                                                                                                                                                        |
| B9                                                                                                                                                       | [ASK IF B7=2]<br>Without Efficiency Nova Scotia or the expertise provided by the energy modeler, what is the likelihood that you would have designed a building with a <b>building envelope as efficient as you did, including insulation levels and glazing performance?</b> | 1) Definitely would have     | 100%                                                                                                                                                         |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 2) Probably would have       | 75%                                                                                                                                                          |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 3) Probably would not have   | 25%                                                                                                                                                          |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 4) Definitely would not have | 0%                                                                                                                                                           |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 98) DK/Refuse                | EMPTY                                                                                                                                                        |
| B10                                                                                                                                                      | [ASK IF B7=2]<br>Without Efficiency Nova Scotia or the expertise provided by the energy modeler, what is the likelihood that you would have designed a building with <b>as many efficiency measures as you included?</b>                                                      | 1) Definitely would have     | 100%                                                                                                                                                         |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 2) Probably would have       | 75%                                                                                                                                                          |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 3) Probably would not have   | 25%                                                                                                                                                          |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 4) Definitely would not have | 0%                                                                                                                                                           |
|                                                                                                                                                          |                                                                                                                                                                                                                                                                               | 98) DK/Refuse                | EMPTY                                                                                                                                                        |
| B11                                                                                                                                                      | [ASK IF B7=2 AND IF AVERAGE (B8, B9, B10) ≥ 75%]<br>You explained that, without an incentive from Efficiency Nova Scotia or the energy modeler, you would have designed a less efficient building. Can you explain how your building would have been different?               | Answer: _____                | <b>Inconsistency Test</b><br><b>Analyze verbatim. If building would have been different in the absence of the program:</b><br><b>AVERAGE (B8, B9, B10)/2</b> |
| <b>Efficiency and Quantity Score (EQS)</b>                                                                                                               |                                                                                                                                                                                                                                                                               |                              | <b>B7</b><br>adjusted by B8, B9, B10 & validated with B11                                                                                                    |
| <b>INTENTION Score (IS): AVERAGE (B2, B4, B7)</b><br>(B2: Adjusted with B3; B4: Adjusted by B5-B6; B7: Adjusted with B8, B9, B10 and validated with B11) |                                                                                                                                                                                                                                                                               |                              |                                                                                                                                                              |

| Question |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Answer                                                                                                                                 | Score                                                    |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                        |                                                          |
| B12      | How important were the following factors in your decision to implement the planned energy efficiency measures in your new building through the New Construction program?                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | For each sub-question:                                                                                                                 | For each sub-question: Score                             |
|          | <p>a. The program financial incentive for energy modeling.</p> <p>b. The program financial incentive for implementation of energy efficiency measures.</p> <p>c. The insights gained from the energy modeling regarding the energy savings associated with each potential measure.</p> <p>d. The recommendations and technical assistance provided by the energy modeler, Business Development Manager, onsite energy manager, or other Efficiency Nova Scotia staff.</p> <p>e. The non-technical information offered by the energy modeler, Business Development Manager, onsite energy manager, or other Efficiency Nova Scotia staff on building better-than-code buildings, for example, the market trends, building certifications, operating costs, and tradespeople availability.</p> | <p>1) Very important</p> <p>2) Somewhat important</p> <p>3) Not very important</p> <p>4) Not at all important</p> <p>98) DK/Refuse</p> | <p>0%</p> <p>25%</p> <p>75%</p> <p>100%</p> <p>EMPTY</p> |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>INFLUENCE Score (IS): MINIMUM (B12a, B12b, B12c, B12d, B12e)</b>                                                                    |                                                          |
|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Free-Ridership (FR): (INTENTION + INFLUENCE)/2</b>                                                                                  |                                                          |

## APPENDIX XIII

### New Construction Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 Custom Corrected Tracked Savings**

| Program Component Result                | Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|-----------------------------------------|---------------|------|-------------------------|------|---------------------|
|                                         | Value         | Unit | Value                   | Unit |                     |
| Gross Energy Savings – at the Generator | 20.855        | GWh  | 20.900                  | GWh  | 0.22%               |
| Gross Demand Savings – at the Generator | 3.984         | MW   | 3.992                   | MW   | 0.19%               |
| Net Energy Savings – at the Generator   | 14.390        | GWh  | 14.421                  | GWh  | 0.22%               |
| Net Demand Savings – at the Generator   | 2.749         | MW   | 2.754                   | MW   | 0.19%               |

There were no substantial differences between the tracked and corrected tracked energy and demand savings. The minor changes were due to adjustments made to line loss factors.

## APPENDIX XIV

### Custom 2024 Recommendations

This appendix summarizes all the recommendations made by the Evaluator as part of the Custom evaluation.

| Section           | Recommendations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | 2024 New Construction Recommendation #1: Review the demand savings script used for projects modelled in eQuest to ensure accurate results and favour an approach that can be applied consistently across a variety of modelling software.                                                                                                                                                                                                                                                                                                            |
| Executive Summary | 2024 New Construction Recommendation #2: Amend section 7.10 of the New Construction program guide to require M&V for large industrial New Construction projects.                                                                                                                                                                                                                                                                                                                                                                                     |
| Executive Summary | New Construction Recommendation #3: Investigate the impact of increasing modelling incentives (the share of modelling costs covered as well as the incentive cap) on the service.                                                                                                                                                                                                                                                                                                                                                                    |
| Executive Summary | New Construction Recommendation #4: Endeavour to recruit new energy modellers through targeted outreach; modellers put a premium on networking opportunities with builders.                                                                                                                                                                                                                                                                                                                                                                          |
| Executive Summary | New Construction Recommendation #5: Consider collaborating with educational institutions and professional associations for energy modelling to build a stronger pipeline of qualified and engaged energy modellers across Nova Scotia.                                                                                                                                                                                                                                                                                                               |
| Executive Summary | New Construction Recommendation #6: The program should increase targeted outreach and educational activities for builders and energy modellers related to the code shift and its impacts, particularly those involving technologies (including electrification), costs, and energy efficiency improvements. By providing practical guidance on meeting new requirements and exceeding them with the program's support, the program can position itself as a valuable resource while increasing program awareness and encouraging more participation. |
| Executive Summary | New Construction Recommendation #7: Review the program guidelines and update to align with NECB 2020, which will be adopted in April 2025.                                                                                                                                                                                                                                                                                                                                                                                                           |
| Executive Summary | New Construction Recommendation #8: Investigate aligning implementation incentives with NECB 2020 Tiers. Such alignment would need to consider the phased-in adoption of NECB 2020 Tiers 1–3 over 2025-29.                                                                                                                                                                                                                                                                                                                                           |
| Executive Summary | New Construction Recommendation #9: E1 should update the Custom New Construction logic model to document and address current barriers and update the theory of change to include all activities being carried out to address these barriers.                                                                                                                                                                                                                                                                                                         |

## APPENDIX XV

### SEM Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by EfficiencyOne (E1)
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net electrical energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 SEM Corrected Tracked Savings**

| Program Component Result                   | Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|--------------------------------------------|---------------|------|-------------------------|------|---------------------|
|                                            | Value         | Unit | Value                   | Unit |                     |
| Gross Energy Savings at the Generator      | 4.474         | GWh  | 4.480                   | GWh  | 0.12%               |
| Gross Peak Demand Savings at the Generator | 0.536         | MW   | 0.537                   | MW   | 0.18%               |
| Net Energy Savings at the Generator        | 4.474         | GWh  | 4.480                   | GWh  | 0.12%               |
| Net Peak Demand Savings at the Generator   | 0.536         | MW   | 0.537                   | MW   | 0.18%               |

The minor changes in electrical energy and peak demand savings were due to adjustments made to line loss factors.

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Phone interviews or site visits were conducted after a review of EfficiencyOne digital project files. As part of the project file review, the Evaluator noted questions to be answered by participants during the interview or the site visit, and the protocol was also used to consign their answers.






|                                      |                          |       |                          |                |  |
|--------------------------------------|--------------------------|-------|--------------------------|----------------|--|
| Interview/Site Visit Date:           |                          | Team: |                          | Contact Name:  |  |
| Project ID:                          |                          |       |                          | Contact Title: |  |
| NSPI Rate Code:                      |                          |       |                          | Phone:         |  |
| Company Name:                        |                          |       |                          | Email:         |  |
| Address:                             |                          |       |                          |                |  |
|                                      |                          |       |                          |                |  |
| List of people met during the visit: |                          |       |                          |                |  |
|                                      |                          |       |                          |                |  |
| Person(s) Responsible for SEM:       |                          |       |                          |                |  |
|                                      |                          |       |                          |                |  |
| Type of building:                    | Commercial/institutional |       | Industrial/manufacturing |                |  |
|                                      | Municipal                |       | Other (specify)          |                |  |

|                                                                                |  |
|--------------------------------------------------------------------------------|--|
| Number of years in program (1st, 2nd, et.c)                                    |  |
| What was the savings quantification approach last year (bottom-up or top-down) |  |
| Last year measure list                                                         |  |
| Last year savings                                                              |  |



#### 4. Impact Evaluation & Savings Adjustments

|                                    |  |
|------------------------------------|--|
| Reporting period                   |  |
| Overall M&V approach and reasoning |  |

Which measures were implemented and do they generate incremental energy and demand savings?

| Measure | Implementation date | Expected to generate incremental savings for this year? | Time period when generating savings | PCF |
|---------|---------------------|---------------------------------------------------------|-------------------------------------|-----|
|         |                     |                                                         |                                     |     |
|         |                     |                                                         |                                     |     |
|         |                     |                                                         |                                     |     |
|         |                     |                                                         |                                     |     |
|         |                     |                                                         |                                     |     |

#### Bottom-up Approach

| Measure 1                                                        | Notes |
|------------------------------------------------------------------|-------|
| Measure Description                                              |       |
| Validation of the measure (is it installed and operational?)     |       |
| Savings calculation approach - What is it and is it appropriate? |       |
| What is the baseline and is it appropriate?                      |       |
| Are savings annualized for a standard year?                      |       |
| Are IE considered?                                               |       |
| EUL                                                              |       |

|                         |        | Tracked | Evaluated | % of Tracked savings |  |  |  |
|-------------------------|--------|---------|-----------|----------------------|--|--|--|
| Electricity Savings     | kWh/yr |         |           |                      |  |  |  |
| Peak Demand Savings     | kW     |         |           |                      |  |  |  |
| Peak Coincidence Factor | -      |         |           |                      |  |  |  |

| Top-down Approach                                                                                  |                | Short answer  | NOTES |
|----------------------------------------------------------------------------------------------------|----------------|---------------|-------|
| <b>Periods and boundaries</b>                                                                      |                |               |       |
| Project Measurement Boundary (full facility meter, subsystem?)                                     |                |               |       |
| Reporting Period (Days and dates)                                                                  |                |               |       |
| Baseline Period (Days and dates)                                                                   |                |               |       |
| Summary of Non-Routine Baseline Adjustments in Current Model                                       |                |               |       |
| <b>Regression Equation Analysis</b>                                                                |                |               |       |
| Regression Equation Used                                                                           |                |               |       |
| Coefficient of Determination (R2)                                                                  |                |               |       |
| Is R2 IPMVP Compliant (0.75 or greater)?                                                           |                |               |       |
| Coefficient of Variation (CV)                                                                      |                |               |       |
| Is the CV below 10%                                                                                |                |               |       |
| Is the p-value for independent variables below 10%?                                                |                |               |       |
| Is the equation adequate (form and independent variables?)                                         |                |               |       |
| <b>Are the baseline and reporting period appropriate?</b>                                          |                |               |       |
| When did the change occur?                                                                         |                |               |       |
| Is the baseline period adequate?                                                                   |                |               |       |
| Does the reporting period need to be extrapolated?                                                 |                |               |       |
| Do any adjustments need to be made for COVID impacts?                                              |                |               |       |
| <b>Does the model account for changes in energy consumption due to factors other than the ECM?</b> |                |               |       |
| Are there changes other than the ECM between the baseline and                                      |                |               |       |
| Does the ECM cause other impacts outside of the measurement                                        |                |               |       |
| <b>Savings Adjustments</b>                                                                         |                |               |       |
| <b>Documented Savings Calculations</b>                                                             | Tracking Sheet | Annual report |       |
| Energy Savings (kWh)                                                                               |                |               |       |
| Peak Demand Savings (kW)                                                                           |                |               |       |
| PCF                                                                                                |                |               |       |
| <b>Evaluator's Savings Calculations</b>                                                            | Value          | Notes         |       |
| Energy Savings (kWh)                                                                               |                |               |       |
| Peak Demand Savings (kW)                                                                           |                |               |       |
| PCF                                                                                                |                |               |       |
| <b>Summary of Adjustments</b>                                                                      |                |               |       |
| Energy Adjustment Ratio (%)                                                                        | #DIV/0!        |               |       |
| Peak Demand Adjustment Ratio (%)                                                                   | #DIV/0!        |               |       |

| Summary of Evaluator's Findings and Adjustment      |  |  |  |
|-----------------------------------------------------|--|--|--|
| (TO BE COPIED IN THE SUMMARY FILE SHARED WITH EONE) |  |  |  |
|                                                     |  |  |  |

## APPENDIX XVII

### SEM Detailed Project Review Adjustments

**Table 1: 2024 SEM Electrical Energy Savings Adjustments**

| Project      | Tracked Savings (kWh) | Evaluated Savings (kWh) | Adjustment Ratio | Explanation for Adjustment                                                                                                                                                                                                                                                                                                                    |
|--------------|-----------------------|-------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | 1,186,033             | 1,186,033               | 1.000            | None.                                                                                                                                                                                                                                                                                                                                         |
| 2            | 298,525               | 298,525                 | 1.000            | None.                                                                                                                                                                                                                                                                                                                                         |
| 3            | 277,960               | 276,378                 | 0.994            | Electrical energy savings were adjusted from 277,960 to 276,378 kWh to correct for two minor calculation errors.                                                                                                                                                                                                                              |
| 4            | 111,321               | 111,321                 | 1.000            | None.                                                                                                                                                                                                                                                                                                                                         |
| 5            | 76,574                | 76,487                  | 0.999            | The electrical energy savings were adjusted based on a calculation error made in the energy savings calculation for energy conservation measure (ECM) 69. This adjustment increased the daily electrical energy savings for ECM 69 from 296 kWh/day to 317 kWh/day, which were then subtracted from the site-level electrical energy savings. |
| 6            | 1,775,743             | 1,775,743               | 1.000            | None.                                                                                                                                                                                                                                                                                                                                         |
| 7            | 542,829               | 542,829                 | 1.000            | None.                                                                                                                                                                                                                                                                                                                                         |
| <b>Total</b> | <b>4,268,985</b>      | <b>4,267,316</b>        | <b>1.000</b>     |                                                                                                                                                                                                                                                                                                                                               |

**Table 2: 2024 SEM Peak Demand Savings Adjustments**

| Project      | Tracked Savings (MW) | Evaluated Savings (MW) | Adjustment Ratio | Explanation for Adjustment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------|----------------------|------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | 0.1354               | 0.1354                 | 1.000            | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 2            | 0.0344               | 0.0344                 | 1.000            | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3            | 0.0544               | 0.0530                 | 0.994            | Peak demand savings were adjusted from 54.4 kW to 53.0 kW due to minor spreadsheet errors and to account for the annual winter maintenance outage.                                                                                                                                                                                                                                                                                                                                                                                              |
| 4            | 0                    | -0.0012                | -                | Peak demand savings were updated. The change reflects an increase in peak demand resulting from scrap materials being processed during weekdays as opposed to the baseline condition when scrap was processed on weekends.                                                                                                                                                                                                                                                                                                                      |
| 5            | 0.0087               | 0.0262                 | 3.007            | Peak demand savings were increased based on a review of hourly interval data. When calculating 8.7 kW as the peak demand savings, the electrical energy savings were averaged across 8,760 hours/year. The Evaluator reviewed the actual electrical energy savings achieved between 5 p.m. and 7 p.m. on non-holiday weekdays between December 1 and February 28 and adjusted the peak demand savings accordingly.                                                                                                                              |
| 6            | 0.2027               | 0.2027                 | 1.000            | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 7            | 0.0766               | 0.0627                 | 0.819            | Updates to the peak demand savings were made to ECM 85 and ECM 95 to better reflect that the interval data used in both measures to calculate the peak demand savings does not fully align with the non-holiday weekday or December to February timeframe. Therefore, a conservative approach to estimating these savings assumed the use of a peak coincident factor (PCF) of 1. For ECM 85, this resulted in peak demand savings increasing from 6.9 kW to 7.5 kW while, for ECM 95, the peak demand savings changed from 46.6 kW to 32.1 kW. |
| <b>Total</b> | <b>0.5122</b>        | <b>0.5132</b>          | <b>1.002</b>     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



## APPENDIX XVIII

### SEM 2024 Recommendations

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The Evaluator made no recommendations as part of the 2024 SEM evaluation.



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**ECONOLER**



EfficiencyOne

# DIRECT INSTALLATION PROGRAM

Final Report

2024 DSM EVALUATION

March 25, 2025



**ECONOLUX**



## ABBREVIATIONS

---

|                 |                                           |
|-----------------|-------------------------------------------|
| <b>BER</b>      | Business Energy Rebates                   |
| <b>BNI</b>      | Business, non-profit and institutional    |
| <b>CDI</b>      | Commercial Direct Install                 |
| <b>DC</b>       | direct current                            |
| <b>DIY</b>      | Do-it-yourself                            |
| <b>DSM</b>      | Demand-side management                    |
| <b>E1</b>       | EfficiencyOne                             |
| <b>EER</b>      | energy efficiency ratio                   |
| <b>ENS</b>      | Efficiency Nova Scotia                    |
| <b>EUL</b>      | Effective useful life                     |
| <b>GHG</b>      | Greenhouse gas                            |
| <b>HSPF</b>     | Heating seasonal performance factor       |
| <b>HVAC</b>     | Heating, ventilation and air conditioning |
| <b>LED</b>      | Light emitting diode                      |
| <b>MA</b>       | Measure Assessment                        |
| <b>NS Power</b> | Nova Scotia Power                         |
| <b>NSUARB</b>   | Nova Scotia Utility and Review Board      |
| <b>NTGR</b>     | Net-to-gross ratio                        |
| <b>PCF</b>      | peak coincidence factor                   |
| <b>SBES</b>     | Small Business Energy Solutions           |
| <b>SEER</b>     | Seasonal energy efficiency ratio          |

## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Available Demand Response Capacity</b> | The capacity which is available to NSP to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure the available DR capacity. Available DR capacity is evaluated on a per-participant basis, based on the average demand reduction observed for each event that the participant was scheduled to participate in. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                 |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or load reduction in response to events called by the electric utility (Nova Scotia Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.                                                                                                                                                                                                                                                |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                           |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Equipment life</b>                     | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |





|                                         |                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global-warming potential is estimated over a timescale of 100 years.                                                                |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                         |
| <b>First-year savings</b>               | The first full year of energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                         |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program regardless of why they participated.                                                                                                                                    |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                      |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems in a building (such as heating and cooling) due to the installation of an energy-efficient measure.                                                                                                                                                               |
| <b>In-service rate</b>                  | The proportion of incentivized products that are installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as LED lamps.                                                   |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.             |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                              |
| <b>Line loss factor</b>                 | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                      |
| <b>Margin of error</b>                  | The amount of random sampling error.                                                                                                                                                                                                                                                                                 |
| <b>Market effects</b>                   | The impact of a program on the market (in terms of product availability, practices, and prices) that extends beyond changing program participant behaviours. This includes spillover among non-participants.                                                                                                         |

|                                 |                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Net savings</b>              | Energy or peak demand savings that can be reliably attributed to a program. This includes effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                           |
| <b>Net-to-gross ratio</b>       | The ratio of net energy savings to gross energy savings.                                                                                                                                                                                                                                                                                     |
| <b>Non-sampling error</b>       | Errors arising during all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                 |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when Nova Scotia Power's 10-minute reserve is low.                |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                            |
| <b>Random sampling error</b>    | An error in measurement because measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                        |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                           |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                   |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                           |
| <b>Spillover</b>                | Savings attributable to participants who continue to implement the energy efficiency measure introduced by a program after participating in it once, without participating in the program a second time.                                                                                                                                     |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, except the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one-tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                      |



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# EXECUTIVE SUMMARY

This report presents the 2024 Demand-Side Management (DSM) results of the Direct Installation program administered by EfficiencyOne (E1). This program is comprised of the Small Business Energy Solutions (SBES) program component. SBES offers incentives and resources to encourage Nova Scotia's small businesses to make energy efficiency upgrades to their facilities.

## Evaluation Approach

The purpose of the 2024 evaluation was to calculate gross and net results of the program components, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided greenhouse gas (GHG) emissions. Table 1 summarizes the types of evaluations conducted and the corresponding methodology.

**Table 1: Summary of 2024 Direct Installation Program Evaluation**

| Program Component               | Evaluation Type |         |        | Methodology                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-----------------|---------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | Impact          | Process | Market |                                                                                                                                                                                                                                                                                                                                   |
| Small Business Energy Solutions | Condensed       | -       | -      | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Unitary savings review and Measure Assessment (MA) update</li><li>› Use of 2023 adjustment ratios and NTGR values</li><li>› Non-participant survey</li><li>› Calculations using evaluation results</li><li>› GHG emission reduction calculations</li></ul> |

## Program Performance

Table 2 presents the participation levels, net-to-gross ratios (NTGRs), evaluated gross and net savings at the generator, annual GHG emission reductions, as well as effective useful life (EUL) values for the Direct Installation program.

**Table 2: Overall 2024 Direct Installation Participation and Evaluated Savings<sup>1</sup>**

|                                                                                                                      | Participation Level |               | Gross Savings |                  | NTGR* | Net Savings |                  |
|----------------------------------------------------------------------------------------------------------------------|---------------------|---------------|---------------|------------------|-------|-------------|------------------|
|                                                                                                                      | Value               | Unit          | Value         | Unit             | Value | Value       | Unit             |
| Energy Savings                                                                                                       | 61,673 <sup>2</sup> | Units rebated | 13.459        | GWh              | 0.81  | 10.854      | GWh              |
| Lifetime Energy Savings                                                                                              |                     |               | 220.510       | GWh              | 0.81  | 177.557     | GWh              |
| Peak Demand Savings                                                                                                  |                     |               | 2.679         | MW               | 0.80  | 2.155       | MW               |
| Annual GHG Emission Reductions                                                                                       |                     |               | 6,356         | Tonnes of CO2 eq | 0.81  | 5,125       | Tonnes of CO2 eq |
| EUL                                                                                                                  |                     |               | 16.4          | Years            |       | 16.4        | Years            |
| * The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for SBES. |                     |               |               |                  |       |             |                  |

<sup>1</sup> The results presented in this table include savings for SBES and the CDI pilot.

<sup>2</sup> 741 of the 61,664 units rebated were CDI Pilot projects.

Direct Installation aimed to achieve 10.592 GWh of net electrical energy savings and 2.558 MW of net peak demand savings at the generator in 2024. The program slightly exceeded the planned net electrical energy savings target, but did not meet the planned net peak demand savings target.

## SBES Findings and Recommendations

This subsection presents the key findings from the SBES evaluation.

**2024 SBES-Finding:** SBES surpassed its net electrical energy savings by 2% and fell short of its net peak demand savings target by 16%.

**2024 SBES-Finding:** The evaluated net electrical energy savings and peak demand savings determined by the Evaluator were higher than the net savings tracked by E1.

**2024 SBES-Finding:** Participation in SBES, in terms of units rebated, increased by 53% in 2024 compared to 2023 levels. The DIY path remained the most popular, accounting for 98% of all units rebated. The units rebated through the CDI Pilot decreased by 48% in 2024 compared to 2023 levels.

**2024 SBES-Finding:** Based on the results from a survey of 30 businesses, non-participant spillover was found to be nil.

## Program Tracked and Evaluated Savings

Table 3 below compares E1 tracked energy and peak demand savings compared to evaluated savings at the generator. It also includes the realization rate, which is the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings. The NTGRs are also presented and correspond to the rounded averages obtained by dividing net savings by gross savings, which explains why the NTGR values are different from those presented in other sections.

**Table 3: Comparison of 2024 SBES Tracked and Evaluated Savings at the Generator<sup>3</sup>**

|                       | Gross Savings |      | NTGR | Net Savings |      | Realization Rate |
|-----------------------|---------------|------|------|-------------|------|------------------|
|                       | Value         | Unit |      | Value       | Unit |                  |
| Energy Savings        |               |      |      |             |      |                  |
| Tracked Savings by E1 | 12.936        | GWh  | 0.81 | 10.426      | GWh  | 104%             |
| Evaluation Results    | 13.459        | GWh  | 0.81 | 10.854      | GWh  |                  |
| Peak Demand Savings   |               |      |      |             |      |                  |
| Tracked Savings by E1 | 2.521         | MW   | 0.81 | 2.033       | MW   | 106%             |
| Evaluation Results    | 2.679         | MW   | 0.80 | 2.155       | MW   |                  |

<sup>3</sup> The results presented in this table include savings for SBES and the CDI Pilot.

## INTRODUCTION

EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight of its DSM activities is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electricity DSM activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs, three business, non-profit, and institutional (BNI) programs, and one demand response (DR) program that are marketed to Nova Scotians through the ENS franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2024 DSM program portfolio.

This evaluation report relates to the Direct Installation program, which is comprised of a single component: Small Business Energy Solutions (SBES). Table 4 below lists the Direct Installation program component and the type of evaluation conducted in 2024. A condensed impact evaluation involves using some or all of the previous year's impact evaluation parameters, such as unitary savings values, adjustment ratios, installation rates, and net-to-gross ratios (NTGRs) to provide evaluated results.

**Table 4: Type of Evaluation Conducted for SBES, 2024**

| Program             | Program Component | 2024    |        |           |
|---------------------|-------------------|---------|--------|-----------|
|                     |                   | Process | Market | Impact    |
| Direct Installation | SBES              | -       | -      | Condensed |

For each program, the Evaluator prepared a DSM evaluation report presenting key findings, electrical first-year and lifetime energy savings, peak demand savings, and avoided greenhouse gas (GHG) emissions.<sup>4</sup>

<sup>4</sup> Unless specified otherwise, energy savings refer to first-year energy savings rather than lifetime energy savings throughout this report.



# 1 SBES Overview

This section describes the Small Business Energy Solutions (SBES) program component, follows up on past evaluation recommendations, and provides an overview of participation history.

## 1.1 SBES Description

SBES offers incentives and resources to Nova Scotia small businesses to encourage them to make energy efficient upgrades in their facilities. To be eligible, businesses must annually consume less than 600,000 kWh<sup>5</sup> in electricity. Businesses with electricity consumption higher than this limit are directed toward the E1 Custom or Business Energy Rebates program components. SBES offers on-bill financing for eligible businesses provided they are NS Power customers and their accounts are in good standing.

SBES offers two paths for participation: Audit and Do-it-yourself (DIY). The Audit path provides a no-cost energy audit conducted by a Small Business Energy Auditor. The Audit path is intended for participants who request assistance in identifying potential energy-saving measures for implementation. The DIY path does not include an energy audit and is intended for participants who have identified one or more energy-saving measures that they wish to implement. Participants have 180 days<sup>6</sup> following preapproval to complete their projects.

SBES applicants have the choice of two program applications that partially serve to determine whether their project will follow the Audit or DIY path:

- › Opportunity Worksheet: Participants who do not know which measures to implement or are interested in receiving a no-cost energy audit use the Opportunity Worksheet to apply. E1 uses the information from the Opportunity Worksheet and the business' electricity consumption history provided by NS Power to determine whether the applicant is eligible for SBES and if an audit would help identify additional potential energy-saving upgrades.
  - › Participants who are approved for a no-cost audit proceed via the Audit path.
  - › Participants who are not approved for a no-cost audit may choose to have an audit conducted at their own expense and proceed via the DIY path.
  - › Participants who are not approved for a no-cost audit and who choose not to conduct an audit at their own expense may proceed via the DIY path.
- › Before You Buy Commercial Product Rebate Application: Participants who know which measures they plan to implement and are not interested in receiving a no-cost audit complete the Before You Buy Commercial Product Rebate Application. Once approved by E1, these participants proceed via the DIY path.

Figure 1 and Figure 2 below illustrate the key steps of the participation process for the Audit and DIY paths respectively.

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<sup>5</sup> The maximum consumption criterion was updated from 350,000 kWh to 600,000 kWh in 2024

<sup>6</sup> The maximum period allowed for project completion was updated from 120 days to 180 days in 2024.



**Figure 1: 2024 Audit Path Participation Process**

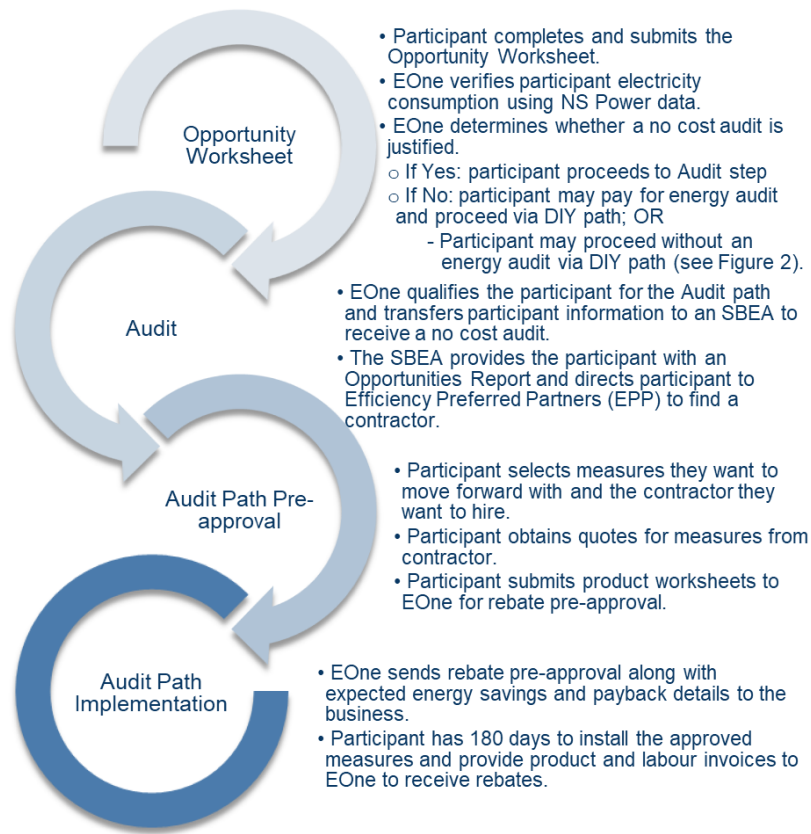
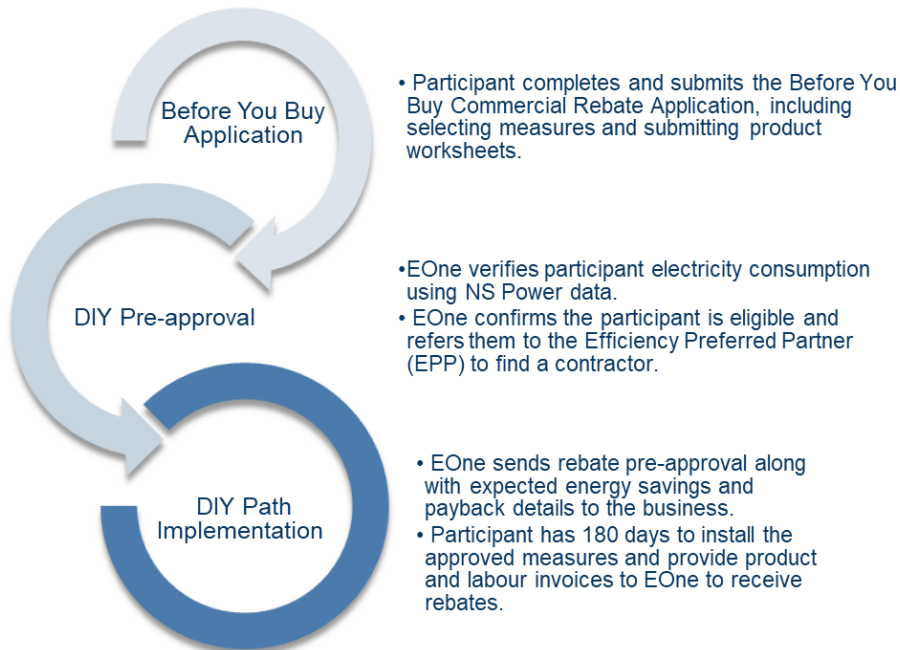


**Figure 2: 2024 DIY Path Participation Process**



Rebates vary according to factors related to specific technologies, including incremental costs, adoption rates, and the strategic importance of a given technology to SBES and the E1 portfolio.

In 2021, E1 launched the Commercial Direct Install (CDI) pilot. The pilot provides small businesses with free-of-charge direct installations of energy efficient products. E1 indicated that CDI was still in the pilot stage in 2024.

SBES was aimed at achieving net electrical energy savings of 10.592 GWh and net peak demand savings of 2.558 MW at the generator in 2024.

## 1.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated SBES in previous years and issued improvement recommendations. Table 5 below provides a summary of the implementation status of past recommendations that were carried forward. The Evaluator notes that all remaining recommendations are in progress.

**Table 5: Implementation Status of Past Recommendations for SBES**

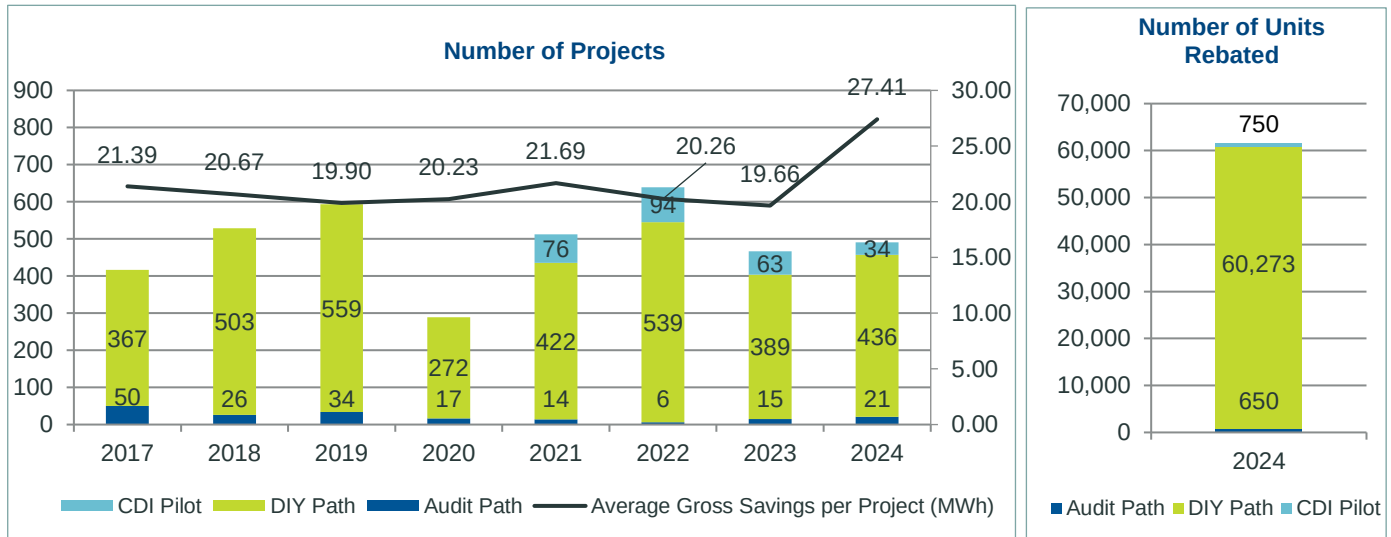
| #            | Past Recommendations                                                                                                                                                                                                            | Status      | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2023-SBES-R1 | Consider improvements to the Customer Information System, notably by reviewing how missing entries are treated and extracting more information from the Customer Information System to allow validating automated calculations. | In progress | In 2024, E1 staff explored methods to improve missing entries and validate automated calculations within the Customer Information System (CIS). E1 staff are investigating how to implement proposed improvements in the CIS.                                                                                                                                                                                                                        |
| 2023-SBES-R2 | Consider implementing communication strategies for participants who are approaching their project expiration date.                                                                                                              | Complete    | E1 implemented communication strategies by increasing project pre-approval expiry from 120 to 180 days and by launching a customer automated email journey. Two email reminders are sent to customers. The first email is sent 90 days after preapproval to encourage customers to complete their projects. The second email is sent 150 days after preapproval to encourage customers to reach out to E1 for assistance to complete their projects. |

## 1.3 Participation History

In 2024, SBES rebated a total of 61,673 units: 650 through the Audit path, 60,273 through the DIY path, and 750 through the CDI Pilot. Participation in SBES,<sup>7</sup> in terms of units rebated, increased by 53% compared to 2023 levels. This increase was mainly due to the DIY path that represented 98% of total units rebated and in which participation increased by 57% compared to 2023 levels. The CDI Pilot units rebated decreased by 48% in 2024 compared to 2023 levels.

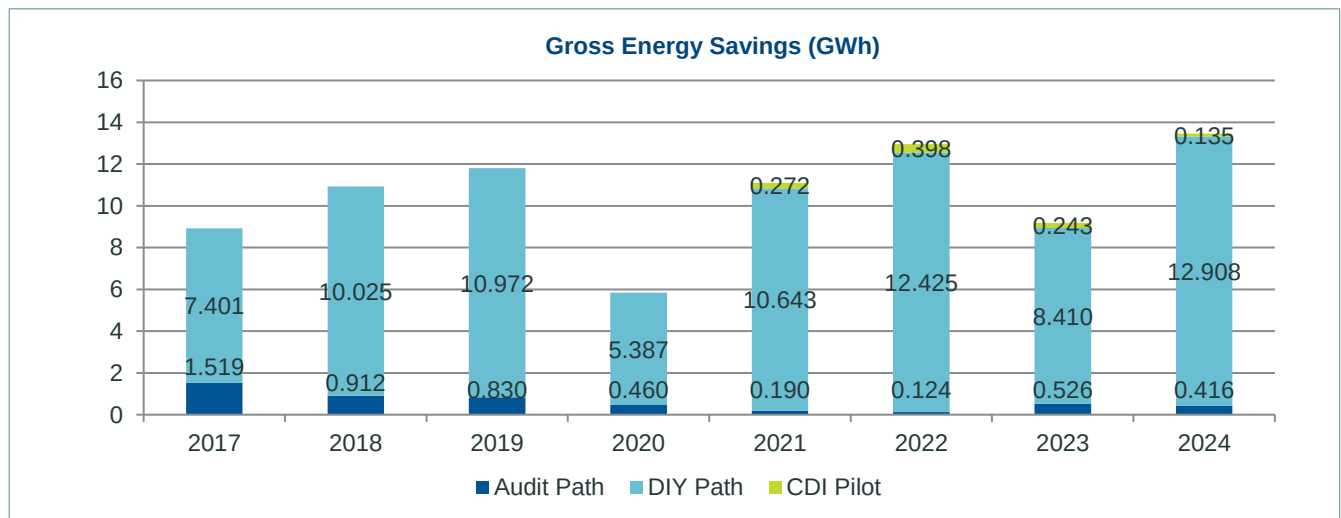
<sup>7</sup> As of 2024, the SBES participation metric used was the number of rebated units. However, prior to 2024, SBES participation was reported in terms of projects completed, so this metric is also included in Figure 3 to provide historical context.

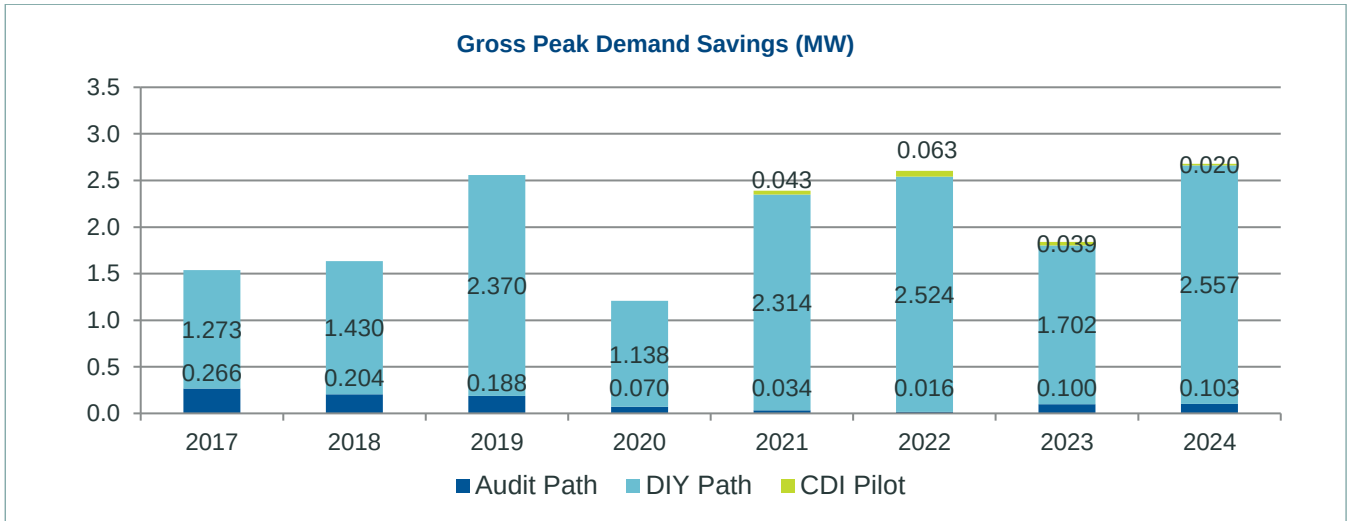
**Figure 3: Overview of SBES Participation, 2017-2024**



The increased participation is reflected in gross energy and peak demand savings, as illustrated in Figure 4 below. Gross energy and peak demand savings increased respectively by 47% and 46% in 2024 compared to 2023.

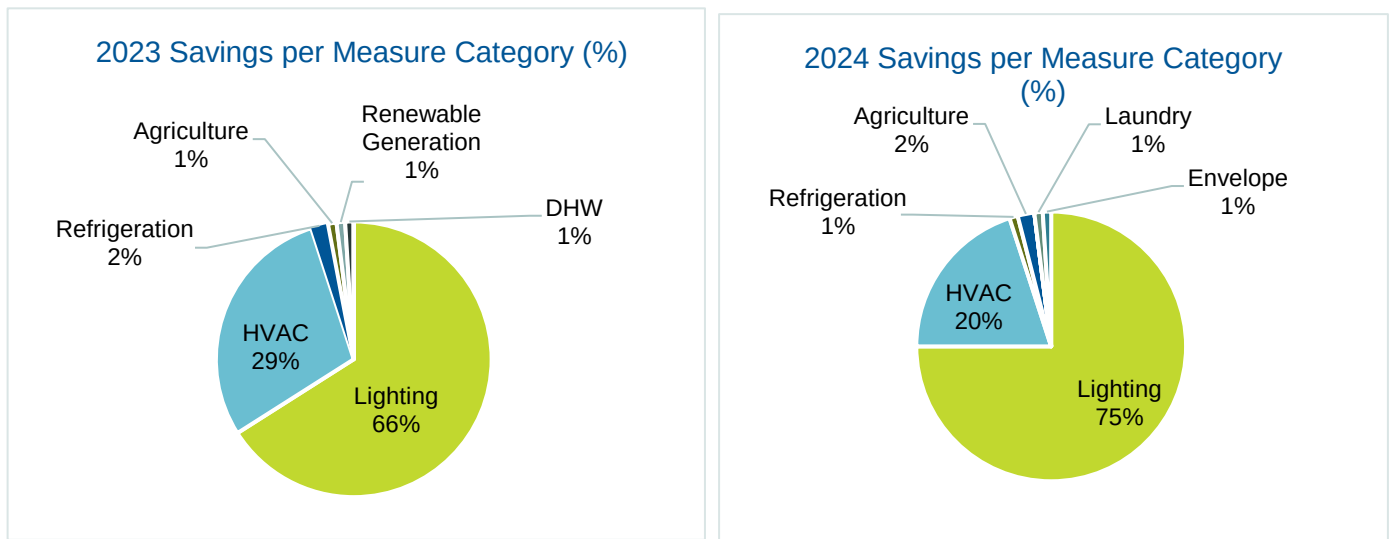
**Figure 4: Evolution of SBES Gross Savings, 2017-2024**





As presented in Figure 5 below, lighting represented a slightly larger proportion of total program energy savings in 2024 as compared with 2023, while HVAC represented a smaller share.

**Figure 5: 2023-2024 Energy Savings per Measure Category**



## 2 SBES Evaluation Approach

The 2024 SBES evaluation consisted of a condensed impact evaluation, which also covered the Commercial Direct Install (CDI) pilot. The main objectives of the 2024 SBES evaluation were as follows:

- › Calculate gross and net SBES results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions
- › Calculate spillover levels using non-participant surveys

The Evaluator identified key research questions aimed at achieving the above objectives. Table 6 outlines the evaluation objectives and maps them to the Evaluator's research questions, methods, and sample sizes (n). Each method is described further below.

**Table 6: 2024 SBES Evaluation Approach**

| Evaluation Objectives                | Research Questions                                                                                                                                                                                                                                                                                                      | Methodology                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate gross results              | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› What are the formulas and savings parameters for the top 10 SBES measures?</li><li>› What are the evaluated first-year and lifetime gross electrical energy and peak demand savings?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Unitary savings review</li><li>› Use of adjustment ratio from 2023 evaluation, with corrections to account for modifications to the 2024-2025 Demand-side Management Measure Assessment<sup>8</sup> (DSM MA) equations and values</li><li>› Calculations using evaluation results</li></ul> |
| Calculate net results                | <ul style="list-style-type: none"><li>› What is the spillover for non-participants?</li><li>› What are the evaluated first-year and lifetime net electrical energy and peak demand savings?</li><li>› What are the net GHG emission reductions in CO2 eq?</li></ul>                                                     | <ul style="list-style-type: none"><li>› Non-participant survey</li><li>› Use of 2023 net-to-gross ratio (NTGR) results</li><li>› Calculations using evaluation results</li><li>› GHG emission reduction calculations</li></ul>                                                                                                                                     |
| Collect non-participant perspectives | <ul style="list-style-type: none"><li>› What is the level of awareness about SBES among non-participating small businesses in Nova Scotia?</li><li>› What are the key sources of awareness?</li><li>› What are the motivations and barriers for small businesses when completing energy efficiency projects?</li></ul>  | <ul style="list-style-type: none"><li>› Non-participant survey</li></ul>                                                                                                                                                                                                                                                                                           |

### Tracking Sheet Audit

Prior to performing the savings calculation review, the Evaluator performed an audit of the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The detailed protocol used for the tracking sheet audit and the results obtained are presented in Appendix III.

<sup>8</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the evaluations conducted during the last two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.



## Unitary Savings Review

As part of the 2024-2025 DSM MA activities, and based on the results of both a literature review and a tracking sheet data review, the Evaluator reviewed the equations, parameters, and assumptions used to establish savings values for ten SBES. The 2024-2025 DSM MA was then updated accordingly.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the first-year and lifetime gross energy and peak demand savings as per the calculation methodology presented in Section 4.2.

## Non-participant Survey

Narrative Research completed telephone surveys<sup>9</sup> with a sample of 30 SBES non-participants to identify any non-participant spillover that should be attributed to SBES and to collect non-participant perspectives. The sample of non-participants consisted of 30 businesses randomly selected among the pool of Nova Scotia businesses satisfying the following criteria:

- › Business customers with an annual electricity consumption under 600,000 kWh; and
- › Businesses that have never participated in either SBES or Business Energy Rebates (BER).

The average length of the telephone interviews was nine minutes and 55 seconds. Surveys were conducted between November 1 and 11, 2024. Drawing a random sample of 30 participants from a population of 1,200 yields a margin of error of 14.9% at a 90% confidence level, which applies to results for non-participant perspectives (a distinct margin of error is established for spillover results).

The non-participant survey questionnaire, profile of non-participants, and data tables for all responses received are included in Appendix I.

## GHG Emission Reduction Calculation

To obtain net avoided GHG emissions in CO<sub>2</sub> eq for SBES, the Evaluator multiplied the net energy savings by the latest Nova Scotia-specific factor for GHG emissions generated by electricity production. This factor was established using Nova Scotia Power (NS Power) data.

## Note on Margins of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>10</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>11</sup>

As part of the 2024 SBES evaluation, no data-collection activities warranted the calculation of margins of error. The margins of error are listed alongside free-ridership results that were obtained as part of the 2023 evaluation in the applicable sections herein. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Program Evaluation Executive Summary.

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<sup>9</sup> Findings associated with questions where there were 20 responses or less are reported as counts and not percentages.

<sup>10</sup> Precision refers to how reproducible a set of measurements is. However, it does not consider how close the measured values are to the true values; this would refer to accuracy.

<sup>11</sup> As part of this evaluation, the confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.

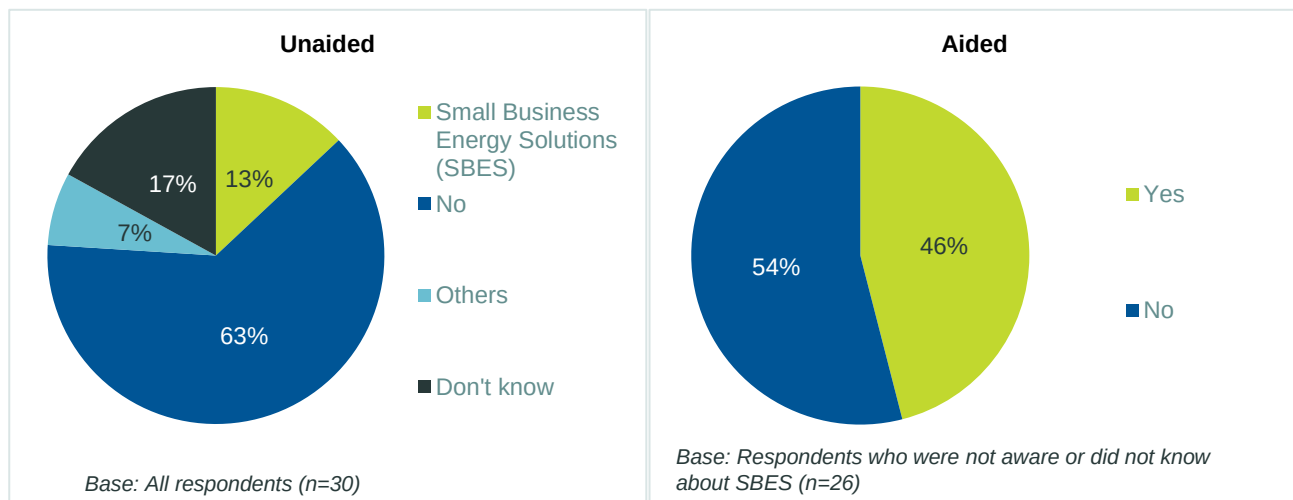
### 3 SBES Non-participant Perspectives

This section presents the results of the perspectives collected as part of the SBES non-participant survey. First, program awareness and sources are presented, followed by participation barriers and respondent energy efficiency project history.

#### 3.1 Program Awareness and Sources

When asked without prompting, close to two-thirds (63%) of non-participants said they were not aware of any rebate programs that E1 offers to small businesses for energy efficiency upgrades. Non-participants who were unaware or did not know of any E1 program offered to small businesses (n=26) were read a brief description of SBES and then asked if they had heard of the program component. Just over half (54%) said they were still unaware of the component even after hearing the description, while just under half (46%) said they were aware of the component after hearing the description. Overall, 53% of non-participants were aware of SBES, whether before the survey (unaided) or after hearing a description (aided).

**Figure 6: 2024 Non-participant SBES Awareness**



The most common sources of awareness among those who knew about SBES (whether unaided or aided) included receiving an information brochure (4), hearing about the program from a contractor (4), and receiving an email or electronic newsletter (3). Fewer non-participants became aware of SBES through social media (2), TV/radio ads (2), and the E1 website (2).

#### 3.2 Program Participation and Barriers

Among non-participants who had heard of SBES, five had applied to participate in the past, while 11 had not. Among those who had participated in SBES, three completed their participation and received their rebates, while the remaining two did not.

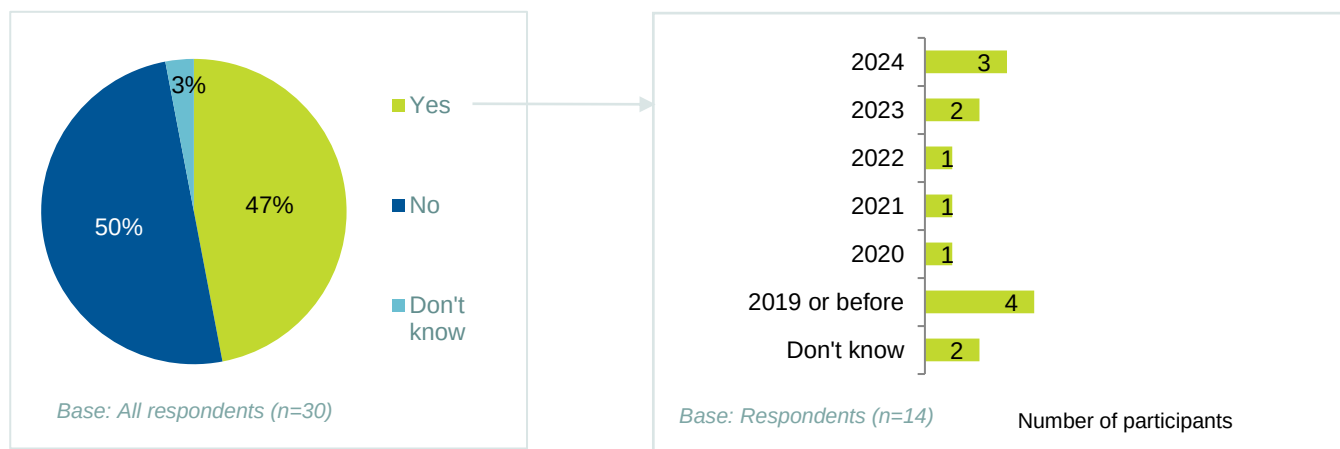
Among non-participants who either did not apply to participate or did not complete the participation process (n=13), a variety of reasons is cited for not doing so. Already upgraded lighting or lighting that was installed before SBES was launched, lack of awareness about the existence of the program component, and lack of interest in making upgrades to a leased space were most commonly cited.

### 3.3 Past Energy Efficiency Projects Among Small Businesses

#### 3.3.1 Energy Efficiency Project – History

Non-participants are almost equally divided into those who had implemented energy efficiency projects without financial assistance from E1 (47%)<sup>12</sup> and those who had not (50%). Of those who had implemented energy efficiency projects with no financial assistance from E1 (n=14), three had done so in 2024, two in 2023, and one each in 2022, 2021, and 2020. As illustrated in Figure 7 below, four non-participants had implemented energy efficiency projects with no financial assistance from E1 prior to 2020, while two did not recall when they did so.

**Figure 7: Energy Efficiency Projects Implemented Without E1 Financial Assistance**



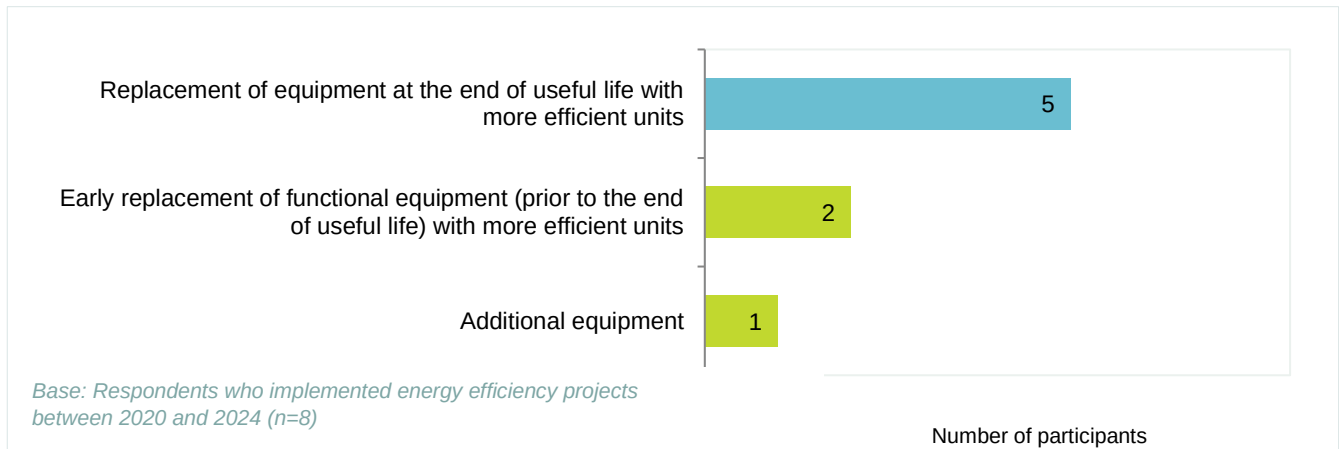
#### 3.3.2 Energy Efficiency Project – Motivations

Among the eight non-participants who had implemented energy efficiency projects between 2020 and 2024, five said their reason for installing energy efficiency upgrades was to replace equipment that was at the end of its useful life with more efficient equipment, two said they replaced functional equipment with more efficient units (prior to the equipment reaching its end of useful life), and one indicated that they added new equipment to supplement the existing equipment.

<sup>12</sup> Within the past five years.



**Figure 8: Reasons for Installing Energy Efficiency Upgrades**





## 4 SBES Impact Evaluation

The objectives of the 2024 SBES impact evaluation were to determine gross and net electrical energy and peak demand savings.

### 4.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The results obtained from the tracking sheet audit are presented in Appendix III. The tracked savings results presented in this report therefore refer to the corrected tracked savings validated by the Evaluator.

### 4.2 Gross Savings

Gross savings correspond to the change in energy consumption resulting from actions taken by participants regardless of their reasons for participating.<sup>13</sup> For each SBES Audit or DIY project, E1 calculates gross savings using the standard equations defined in the CIRx Screening Tool<sup>14</sup> or the custom calculations performed by energy auditors or E1 SBES staff. For the CDI pilot, savings are based on unitary savings algorithms.

#### 4.2.1 Unitary Energy and Peak Demand Savings

Savings for SBES Audit and DIY projects are established through calculations using data specific to each project. The 2024-2025 DSM MA provides a detailed description of inputs, references, and unitary savings calculations for all measure categories. As part of the unitary savings review performed in 2024, the Evaluator validated these parameters for the top 10 SBES measures. Below is a summary of the changes made to the unitary savings inputs or calculations for SBES measures. All other parameters remained unchanged.

- › For air-source heat pumps less than 65,000 Btu/h (excluding air-to-water), the baseline seasonal energy efficiency ratio (SEER) value was changed from 13 to 14.
- › For efficient refrigeration compressors, the algorithm was simplified, and the low-temperature full-load hours parameter was changed from 5,858 to 4,139 hours.
- › For brushless direct current (DC) motors, the baseline output power was changed from 132 to 42 watts and a load factor of 90% was introduced.
- › For dairy scroll compressors, the baseline energy efficiency ratio (EER) value as well as the milk weight and change in milk temperature parameters were updated.
- › For LED lamps (CDI only), the peak coincidence factor (PCF) was changed from 59% to 54%.

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<sup>13</sup> Definition adapted from: National Renewable Energy Laboratory, The Uniform Methods Project Chapter 23: Estimating Net Savings: Common Practices, September 2014, p. 3. [http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings\\_0.pdf](http://energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf) (last accessed November 25, 2016).

<sup>14</sup>The CIRx Screening Tool is a tool provided by E1 and that presents the savings calculation methodologies, assumptions, and calculation parameters for measures implemented under SBES.

## 4.2.2 Installation Rates

Installation rates are accounted for in the adjustment ratios for SBES Audit and DIY projects, as documented in the 2024-2025 DSM MA update.

The CDI pilot adjustment ratios do not encompass installation rates. For the pilot, the Evaluator assumed an installation rate of 100% since no activities aimed at establishing installation rates were conducted during the 2024 evaluation.

## 4.2.3 Interactive Effects

Interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling. For the SBES Audit and DIY paths, these are taken into account through the gross savings standard equation in the E1 CIRx Screening Tool. Since 2016, building-specific interactive effects factors have been used for both energy and peak demand savings. As part of the 2023 SBES evaluation, the Evaluator ensured that E1 used the correct interactive effects factors for reviewed projects based on site visit observations. Where applicable, the Evaluator adjusted the interactive effects factor based on the CIRx Screening Tool value that most accurately corresponded to the situation observed on site. The interactive effects adjustments are included in the adjustment ratios established in 2023,<sup>15</sup> and this assumption remains valid in 2024.

For the CDI pilot, the Evaluator established average interactive effects factors to be applied to each measure in the 2024-2025 DSM MA; these have not been changed since 2022.

## 4.2.4 Effective Useful Life

As part of the 2024-2025 DSM MA activities, the Evaluator reviewed the EUL values used in the calculation of electrical energy savings that are expected to persist over time. The EUL values established in previous evaluations remained valid for the 2024 evaluation with the exception of the EUL values for air-source heat pumps, photovoltaic systems, and lighting measures for which the baseline changes over the life of the measures. These EUL values were revised as part of the 2024-2025 DSM MA update. The gross weighted average EUL value is equal to 16.4 years.

**Table 7: 2024 SBES Equivalent EUL and Gross Lifetime Unitary Savings Values**

| Product                                                               | Tracked Equivalent EUL [years] | Evaluated Equivalent EUL [years] | Evaluated Gross Lifetime Unitary Savings [kWh] |
|-----------------------------------------------------------------------|--------------------------------|----------------------------------|------------------------------------------------|
| LED Lamps                                                             | 2.0                            | 1.0                              | 211                                            |
| LED Nightlights                                                       | 22.8                           | 1.0                              | 29.3                                           |
| Air-source Heat Pumps Less Than 65,000 Btu/h (excluding air-to-water) | 18.0                           | 18.0                             | 406,871                                        |
| Air-source Heat Pumps Greater Than or Equal to 65,000 Btu/hr          | 15.0                           | 20.0                             | 871,651                                        |
| Photovoltaic Systems                                                  | 22.4                           | 30.0                             | 281,697                                        |

<sup>15</sup> The adjustment ratios for each path and each measure category are documented in the 2024-2025 DSM MA.

## 4.2.5 Evaluated Gross Savings

To obtain evaluated gross savings, the Evaluator applied the adjustment ratios<sup>16</sup> established as part of the 2023 SBES impact evaluation to 2024 tracked savings. Table 8, Table 9, and Table 10 below present the evaluated total gross savings at the meter and at the generator for both SBES paths and the CDI pilot respectively. The savings at the generator were calculated by applying the appropriate line loss factor for each participant based on their rate code. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>17</sup>

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<sup>16</sup> The adjustment ratios for each path and each measure category are documented in the 2024-2025 DSM MA.

<sup>17</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1. For municipal utility participants, the line loss factor of the most similar NS Power rate code was assumed.

**Table 8: Evaluated 2024 SBES Gross Energy and Peak Demand Savings – Audit Path**

| Category of Measure                                                | Commercial Kitchen | DHW          | HVAC           | Lighting     | Laundry      | Refrigeration | Envelope     | Total for All Categories |
|--------------------------------------------------------------------|--------------------|--------------|----------------|--------------|--------------|---------------|--------------|--------------------------|
| <b>Energy Savings</b>                                              |                    |              |                |              |              |               |              |                          |
| Gross Energy Savings Without Adjustment Ratio – at the Meter (GWh) | 0.005              | 0.005        | 0.199          | 0.086        | 0.003        | 0.005         | 0.082        | 0.385                    |
| Adjustment Ratio on Energy Savings                                 | 1.000              | 1.000        | 0.980          | 1.070        | 1.000        | 1.000         | 1.000        | -                        |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                   | <b>0.005</b>       | <b>0.005</b> | <b>0.195</b>   | <b>0.092</b> | <b>0.003</b> | <b>0.005</b>  | <b>0.082</b> | <b>0.388</b>             |
| Line Loss Factor                                                   | 1.0901             | 1.0901       | 1.0726         | 1.0635       | 1.0835       | 1.0631        | 1.0901       | -                        |
| <b>Gross Energy Savings – at the Generator (GWh)</b>               | <b>0.006</b>       | <b>0.005</b> | <b>0.20919</b> | <b>0.098</b> | <b>0.003</b> | <b>0.005</b>  | <b>0.090</b> | <b>0.416</b>             |
| Effective Useful Life (years)                                      | 12.0               | 15.0         | 17.2           | 19.0         | 11.9         | 15.0          | 25.0         | -                        |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>      | <b>0.066</b>       | <b>0.082</b> | <b>3.604</b>   | <b>1.861</b> | <b>0.038</b> | <b>0.077</b>  | <b>2.243</b> | <b>7.970</b>             |
| <b>Peak Demand Savings</b>                                         |                    |              |                |              |              |               |              |                          |
| Gross Peak Demand Savings (MW)                                     | 0.001              | 0.000        | 0.064          | 0.020        | 0.001        | 0.001         | 0.009        | 0.095                    |
| Adjustment Ratio on Peak Demand Savings                            | 1.000              | 1.000        | 1.009          | 0.917        | 1.000        | 1.000         | 1.000        | -                        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>               | <b>0.001</b>       | <b>0.000</b> | <b>0.064</b>   | <b>0.019</b> | <b>0.001</b> | <b>0.001</b>  | <b>0.009</b> | <b>0.094</b>             |
| Line Loss Factor                                                   | 1.1003             | 1.1003       | 1.0895         | 1.0705       | 1.0908       | 1.0700        | 1.1003       | -                        |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>           | <b>0.001</b>       | <b>0.000</b> | <b>0.071</b>   | <b>0.020</b> | <b>0.001</b> | <b>0.001</b>  | <b>0.009</b> | <b>0.103</b>             |

**Table 9: Evaluated 2024 SBES Gross Energy and Peak Demand Savings – DIY Path**

| Category of Measure                                                | Agriculture  | HVAC          | Lighting       | Laundry      | Motors       | Refrigeration | Renewable Generation | Envelope     | Total for all Categories |
|--------------------------------------------------------------------|--------------|---------------|----------------|--------------|--------------|---------------|----------------------|--------------|--------------------------|
| <b>Energy Savings</b>                                              |              |               |                |              |              |               |                      |              |                          |
| Gross Energy Savings Without Adjustment Ratio – at the Meter (GWh) | 0.243        | 2.195         | 8.786          | 0.080        | 0.002        | 0.162         | 0.009                | 0.006        | 11.483                   |
| Adjustment Ratio on Energy Savings                                 | 1.107        | 0.980         | 1.070          | 1.000        | 1.000        | 0.987         | 0.930                | 1.000        | -                        |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                   | <b>0.269</b> | <b>2.151</b>  | <b>9.401</b>   | <b>0.080</b> | <b>0.002</b> | <b>0.160</b>  | <b>0.009</b>         | <b>0.006</b> | <b>12.077</b>            |
| Line Loss Factor                                                   | 1.0842       | 1.0797        | 1.0659         | 1.0631       | 1.0947       | 1.0640        | 1.1722               | 1.0947       | -                        |
| <b>Gross Energy Savings – at the Generator (GWh)</b>               | <b>0.292</b> | <b>2.322</b>  | <b>10.020</b>  | <b>0.085</b> | <b>0.003</b> | <b>0.170</b>  | <b>0.010</b>         | <b>0.006</b> | <b>12.908</b>            |
| Effective Useful Life (years)                                      | <b>14.9</b>  | <b>18.3</b>   | <b>16.1</b>    | <b>11.8</b>  | <b>15.0</b>  | <b>14.1</b>   | <b>20.0</b>          | <b>25.0</b>  | -                        |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>      | <b>4.353</b> | <b>42.579</b> | <b>161.383</b> | <b>1.004</b> | <b>0.040</b> | <b>2.391</b>  | <b>0.205</b>         | <b>0.151</b> | <b>212.105</b>           |
| <b>Peak Demand Savings</b>                                         |              |               |                |              |              |               |                      |              |                          |
| Gross Peak Demand Savings (MW)                                     | 0.055        | 0.742         | 1.610          | 0.012        | 0.000        | 0.036         | 0.000                | 0.000        | 2.455                    |
| Adjustment Ratio on Peak Demand Savings                            | 1.077        | 1.009         | 0.932          | 1.000        | 1.000        | 0.993         | -                    | 1.000        | -                        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>               | <b>0.059</b> | <b>0.749</b>  | <b>1.501</b>   | <b>0.012</b> | <b>0.000</b> | <b>0.035</b>  | <b>0.000</b>         | <b>0.000</b> | <b>2.356</b>             |
| Line Loss Factor                                                   | 1.1413       | 1.1008        | 1.0759         | 1.0700       | 1.1466       | 1.0701        | 1.1003               | 1.1466       | -                        |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>           | <b>0.067</b> | <b>0.824</b>  | <b>1.615</b>   | <b>0.013</b> | <b>0.000</b> | <b>0.038</b>  | <b>0.000</b>         | <b>0.000</b> | <b>2.557</b>             |

**Table 10: Evaluated 2024 SBES Gross Energy and Peak Demand Savings – CDI Pilot**

| Measure Category                                                                                                                                                                                                                   | Lighting     | Water Heating | Total for All Categories |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|--------------------------|
| <b>Energy Savings</b>                                                                                                                                                                                                              |              |               |                          |
| Gross Energy Savings without Interactive Effects – at the Meter (GWh)                                                                                                                                                              | 0.117        | 0.031         | 0.148                    |
| Adjustment Ratio on Energy Savings                                                                                                                                                                                                 | 0.973        | 1.00          | -                        |
| Interactive Effects*                                                                                                                                                                                                               | -17.9%       | -0.9%         | -                        |
| <b>Gross Energy Savings – at the Meter (GWh)</b>                                                                                                                                                                                   | <b>0.093</b> | <b>0.031</b>  | <b>0.124</b>             |
| Line Loss Factor                                                                                                                                                                                                                   | 1.0954       | 1.0728        | -                        |
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                               | <b>0.102</b> | <b>0.033</b>  | <b>0.135</b>             |
| Effective Useful Life (years)                                                                                                                                                                                                      | 1.0          | 9.9           | -                        |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b>                                                                                                                                                                      | <b>0.102</b> | <b>0.332</b>  | <b>0.434</b>             |
| <b>Peak Demand Savings</b>                                                                                                                                                                                                         |              |               |                          |
| Gross Peak Demand Savings Without Interactive Effects – at the Meter (MW)                                                                                                                                                          | 0.018        | 0.006         | 0.024                    |
| Adjustment Ratio on Peak Demand Savings                                                                                                                                                                                            | 0.973        | 1.00          | -                        |
| Interactive Effects                                                                                                                                                                                                                | -31.8%       | -1.6%         | -                        |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>                                                                                                                                                                               | <b>0.012</b> | <b>0.006</b>  | <b>0.018</b>             |
| Line Loss Factor                                                                                                                                                                                                                   | 1.0967       | 1.0912        | -                        |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>                                                                                                                                                                           | <b>0.013</b> | <b>0.006</b>  | <b>0.020</b>             |
| * Interactive effects for water heating measures are for information purposes only. The interactive effects vary based on the participant's space heating system. The values presented herein are the average interactive effects. |              |               |                          |

Table 11 summarizes the gross energy and peak demand savings for each path, the CDI Pilot, and SBES as a whole.

**Table 11: Evaluated 2024 SBES Gross Energy and Peak Demand Savings – All Paths**

| Program Path                                                  | Audit        | DIY            | CDI Pilot    | Total          |
|---------------------------------------------------------------|--------------|----------------|--------------|----------------|
| <b>Energy Savings</b>                                         |              |                |              |                |
| <b>Gross Energy Savings – at the Meter (GWh)</b>              | <b>0.388</b> | <b>12.077</b>  | <b>0.124</b> | <b>12.589</b>  |
| Line Loss Factor                                              | 1.0746       | 1.0688         | 1.0897       | -              |
| <b>Gross Energy Savings – at the Generator (GWh)</b>          | <b>0.416</b> | <b>12.908</b>  | <b>0.135</b> | <b>13.459</b>  |
| Effective Useful Life (years)                                 | 19.1         | 16.4           | 3.2          | -              |
| <b>Gross Lifetime Energy Savings – at the Generator (GWh)</b> | <b>7.970</b> | <b>212.105</b> | <b>0.434</b> | <b>220.510</b> |
| <b>Peak Demand Savings</b>                                    |              |                |              |                |
| <b>Gross Peak Demand Savings – at the Meter (MW)</b>          | <b>0.094</b> | <b>2.356</b>   | <b>0.018</b> | <b>2.467</b>   |
| Line Loss Factor                                              | 1.0915       | 1.0853         | 1.0949       | -              |
| <b>Gross Peak Demand Savings – at the Generator (MW)</b>      | <b>0.103</b> | <b>2.557</b>   | <b>0.020</b> | <b>2.679</b>   |

Figure 9 and Figure 10 below compare tracked gross savings to evaluated gross savings for electrical energy and peak demand savings respectively. Evaluated gross electrical energy savings and peak demand savings were approximately 4% and 6% above tracked values respectively, primarily due to corrected adjustment ratios and line loss factors

**Figure 9: 2024 SBES Tracked and Evaluated Gross Energy Savings at the Generator**

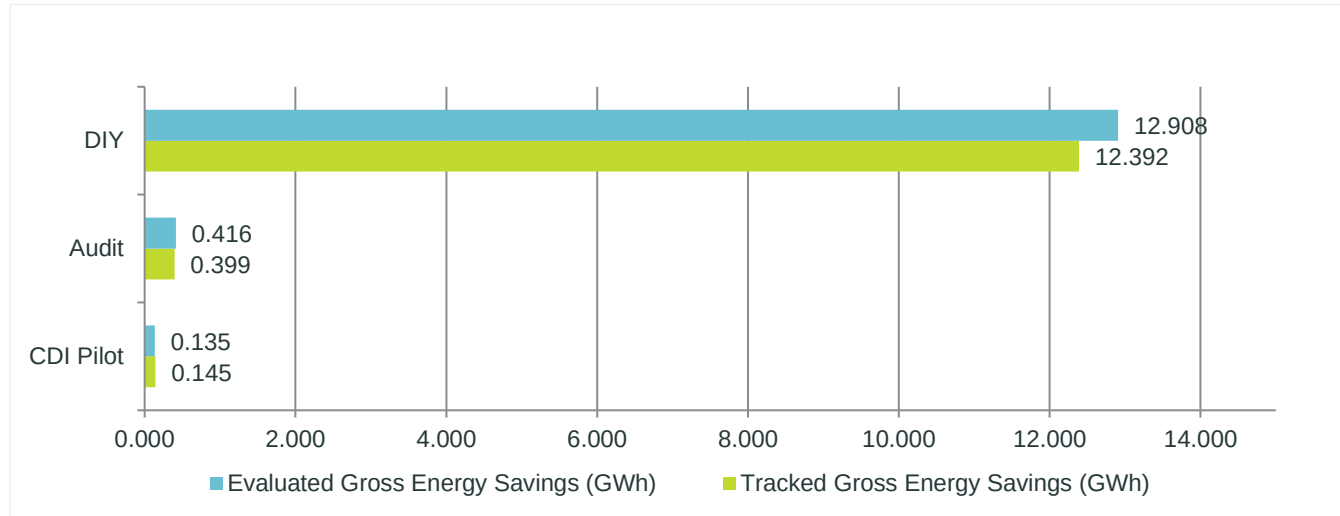
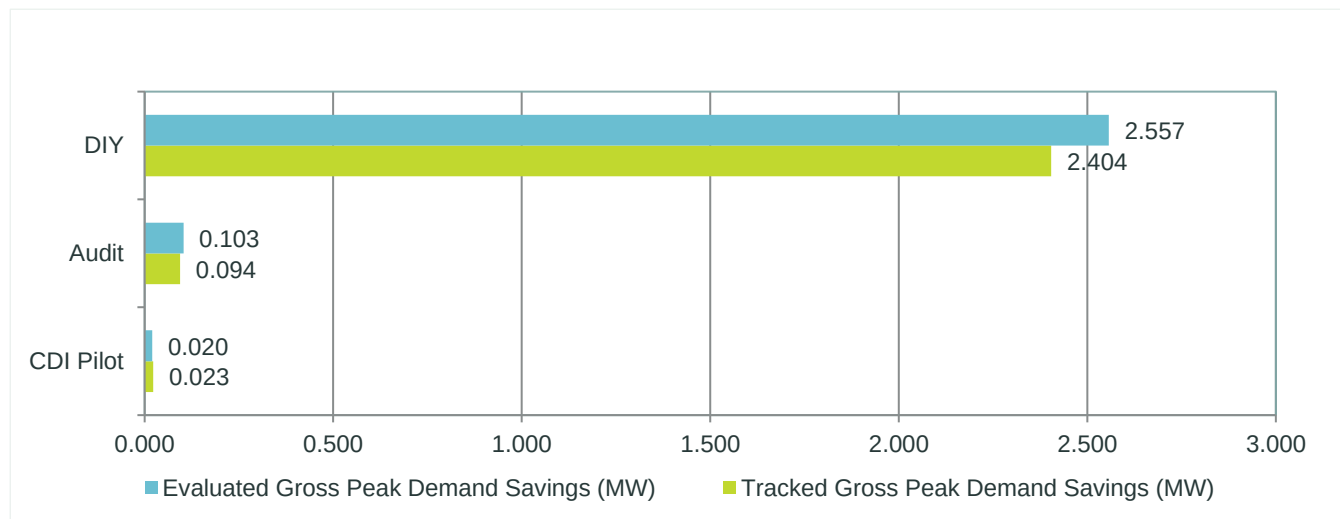


**Figure 10: 2024 SBES Tracked and Evaluated Gross Peak Demand Savings at the Generator**



As presented in Table 12 below, GHG emission reductions were calculated by applying the Nova Scotia-specific factor<sup>18</sup> for GHG emissions generated by electricity production to SBES gross savings.

<sup>18</sup> At the time of writing, 2024 data were not yet available. The Nova Scotia-specific factor was obtained from Nova Scotia Power's 2023 total system emissions data (4,931,152 CO<sub>2</sub> eq tonnes), and total electricity generation (10,442 GWh) was drawn from the following two sources: Nova Scotia Power, Total System Emissions, <https://www.nspower.ca/clean-energy/air-emissions-reporting> (last accessed September 27, 2024) and Emera Inc., Emera Inc. 2023 Annual Report, p. 31, available at [https://s25.q4cdn.com/978989322/files/doc\\_financials/2023/ar/Emera\\_2023\\_AR\\_FINAL.pdf](https://s25.q4cdn.com/978989322/files/doc_financials/2023/ar/Emera_2023_AR_FINAL.pdf) (last accessed September 27, 2024).



**Table 12: Evaluated 2024 SBES GHG Gross Emission Reductions**

|                                                                                             |  | Total         |
|---------------------------------------------------------------------------------------------|--|---------------|
| <b>Gross Energy Savings – at the Generator (GWh)</b>                                        |  | <b>13,459</b> |
| Nova Scotia-specific GHG Emissions Factor for Electricity Production (tonnes of CO2 eq/GWh) |  | 472.2         |
| <b>Gross Annual GHG Emission Reductions (tonnes of CO2 eq)</b>                              |  | <b>6,356</b>  |

## 4.3 Net Savings

The Evaluator determined the net energy and peak demand savings, i.e. the electrical energy and peak demand savings that can be reliably attributed to the program component, by estimating the NTGR. More precisely, the Evaluator established the NTGR by accounting for free-ridership and spillover effects that positively or negatively affect the energy savings generated by the program component.

### 4.3.1 Free-Ridership

For SBES, free-ridership occurs when participants would have implemented energy efficiency upgrades in the absence of the program component. The free-ridership levels for DIY and Audit projects were assessed during the 2023 evaluation using a self-report approach that involved asking participants a set of questions during a telephone survey. Since no data collection aimed at updating the free-ridership levels was conducted in 2024, the Evaluator used the 2023 free-ridership levels. For the CDI pilot, no activity was conducted to establish a free-ridership level in 2023; thus, the Evaluator assumed no free-ridership.

Table 13 outlines the free-ridership level used for the 2024 SBES evaluation.

**Table 13: 2024 SBES Free-ridership Levels**

| Project Path                  | Average Free-ridership Level | Margin of Error |
|-------------------------------|------------------------------|-----------------|
| DIY (based on 2023 results)   | 20%                          | 5.2%            |
| Audit (based on 2019 results) | 12%                          | 6.5%            |
| CDI Pilot                     | -                            | N/A             |

### 4.3.2 Participant Spillover

For SBES, spillover occurs when participants implement eligible energy efficiency measures due to the influence of having previously participated in the program component without receiving any kind of additional support. As there was no data collection to update participant spillover levels in 2024, the Evaluator used the 2023 spillover levels, which were found to be nil.

### 4.3.3 Non-Participant Spillover

Using the approach described in Section 2, the Evaluator assessed non-participant spillover from a sample of 30 commercial customers. Respondents were asked if they had implemented energy efficiency projects or installed more efficient equipment in the last five years without receiving financial assistance from E1, and whether E1 had some influence on their decision to implement the measures. Respondents were asked about several influencing factors, including previous participation in other E1 programs, information or communications published by E1, and information provided by E1 representatives or members of the “Efficiency Nova Scotia Preferred Partner Network”. Respondents who had implemented energy efficiency measures were asked to estimate electric energy savings associated with these measures, either in terms of annual electricity bill savings or in annual electric energy savings (in kWh or % of annual consumption). The non-participant survey questionnaire, profile of non-participants, and data tables for all responses received are included in Appendix I and II.

Of the 30 respondents, 14 indicated that they had implemented energy efficiency measures without receiving financial assistance from E1. Six of those 14 respondents either indicated that they had implemented the measures before 2020 or that they did not know when measures were implemented and were therefore not asked the remainder of the survey questions. Of the eight respondents who said they implemented measures in 2020 or later, five implemented lighting measures, two installed heat pumps and one installed more efficient electronic equipment. Also, of those eight respondents, six responded “not at all influential” when asked whether the factors related to E1’s actions had influenced their decision to implement energy efficiency measures, while one responded “not very influential” and one responded “somewhat influential”. The measure implemented by that last respondent was the installation of six LED luminaires, which equates to negligible savings.

As a result of the non-participant survey findings, the Evaluator found the non-participant spillover level to be nil.

### 4.3.4 Net-to-gross Ratio Calculation

The NTGR results from the comprehensive impact evaluation performed in 2023 were used for the 2024 evaluation.

The NTGR for SBES was calculated using the following equation.

$$NTGR = (1 - \% \text{ Free-ridership} + \% \text{ Participant Spillover})$$

The NTGR results from the comprehensive impact evaluation performed in 2023, shown in Table 14 below, were used for the 2024 evaluation.

**Table 14: 2024 SBES NTGRs**

| Project Path | Free-ridership | Participant Spillover | NTGR |
|--------------|----------------|-----------------------|------|
| DIY          | 20%            | 0%                    | 0.80 |
| Audit        | 12%            | 0%                    | 0.88 |
| CDI Pilot    | -              | -                     | 1.00 |

### 4.3.5 Evaluated Net Savings

Net savings are defined as the energy use reductions that are specifically attributable to SBES. Program component net impacts were estimated by applying the above NTGRs to the revised gross savings by using the following equation:

$$\text{Net Savings} = \text{Revised Gross Savings} \times \text{NTGR}$$

This equation was used to calculate both electrical energy savings and peak demand savings.

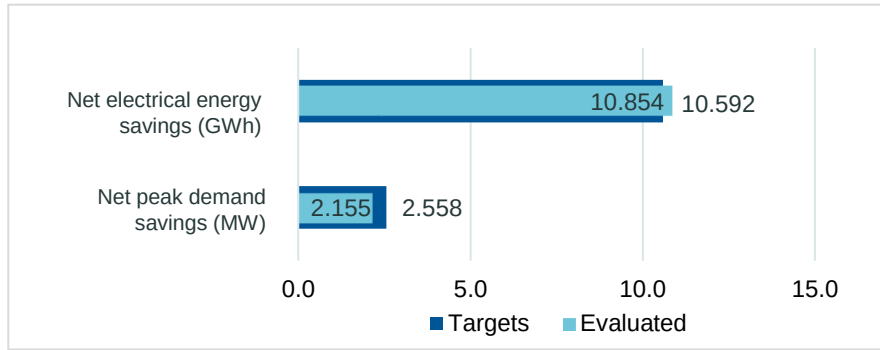
The detailed results are listed in Table 15. The net energy savings resulted in 5,125 tonnes of CO<sub>2</sub> eq in net annual GHG emission reductions.

**Table 15: Evaluated 2024 SBES Net Energy and Peak Demand Savings**

| Measure Category                                            | Audit        | DIY            | CDI Pilot    | Total          |
|-------------------------------------------------------------|--------------|----------------|--------------|----------------|
| <b>Energy Savings</b>                                       |              |                |              |                |
| Gross Energy Savings – at the Meter (GWh)                   | 0.388        | 12.077         | 0.124        | 12.589         |
| NTGR                                                        | 0.88         | 0.80           | 1.00         | -              |
| <b>Net Energy Savings – at the Meter (GWh)</b>              | <b>0.341</b> | <b>9.686</b>   | <b>0.124</b> | <b>10.151</b>  |
| Line Loss Factor                                            | 1.0746       | 1.0687         | 1.0897       | -              |
| <b>Net Energy Savings – at the Generator (GWh)</b>          | <b>0.366</b> | <b>10.352</b>  | <b>0.135</b> | <b>10.854</b>  |
| Effective Useful Life (years)                               | 19.1         | 16.4           | 3.2          | -              |
| <b>Net Lifetime Energy Savings – at the Generator (GWh)</b> | <b>7.014</b> | <b>170.108</b> | <b>0.434</b> | <b>177.557</b> |
| <b>Peak Demand Savings</b>                                  |              |                |              |                |
| Gross Peak Demand Savings – at the Meter (MW)               | 0.094        | 2.356          | 0.018        | 2.467          |
| NTGR                                                        | 0.88         | 0.80           | 1.00         | -              |
| <b>Net Peak Demand Savings – at the Meter (MW)</b>          | <b>0.083</b> | <b>1.885</b>   | <b>0.018</b> | <b>1.985</b>   |
| Line Loss Factor                                            | 1.0915       | 1.0853         | 1.0949       | -              |
| <b>Net Peak Demand Savings – at the Generator (MW)</b>      | <b>0.090</b> | <b>2.045</b>   | <b>0.020</b> | <b>2.155</b>   |

As outlined in Figure 11 below, SBES surpassed its target of 10.592 GWh in net electrical energy savings by 2% and fell short of its target of 2.558 MW in net peak demand savings by 16%.

**Figure 11: 2024 SBES Targets and Evaluated Results**



## 4.4 Realization Rate

Table 16 below compares the tracked energy and peak demand savings values established through this evaluation to those calculated in the 2024 tracking sheet. It also includes the realization rate, representing the ratio of evaluated net savings to tracked net savings, for both energy savings and peak demand savings.

**Table 16: Comparison of 2024 SBES Tracked and Evaluated Savings at the Generator<sup>19</sup>**

|                                                                                                                     | Gross Savings |      | NTGR* | Net Savings |      | Realization Rate |
|---------------------------------------------------------------------------------------------------------------------|---------------|------|-------|-------------|------|------------------|
|                                                                                                                     | Value         | Unit |       | Value       | Unit |                  |
| Energy Savings                                                                                                      |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                               | 12.936        | GWh  | 0.81  | 10.426      | GWh  | 104%             |
| Evaluation Results                                                                                                  | 13.459        | GWh  | 0.81  | 10.854      | GWh  |                  |
| Peak Demand Savings                                                                                                 |               |      |       |             |      |                  |
| Tracked Savings by E1                                                                                               | 2.521         | MW   | 0.81  | 2.033       | MW   | 106%             |
| Evaluation Results                                                                                                  | 2.679         | MW   | 0.80  | 2.155       | MW   |                  |
| * The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for SBES |               |      |       |             |      |                  |

The evaluated net electrical energy and peak demand savings were respectively 4% and 6% higher than the values tracked by E1. The differences are mainly due to corrected adjustment ratios and line loss factors.

<sup>19</sup> The results presented in Table 17 include savings for SBES and the CDI pilot.



## 5 SBES Key Findings and Recommendations

The main objectives of the 2024 SBES evaluation were as follows:

- › Calculate gross and net SBES results, namely electrical first-year and lifetime energy savings, peak demand savings, as well as avoided GHG emissions
- › Calculate spillover levels using non-participant surveys

This section provides the Evaluator's key findings and recommendations in relation to the above objectives.

**2024 SBES-Finding: SBES met its net electrical energy savings target, but did not meet its net electrical peak demand savings target.**

In 2024, SBES achieved 10.854 GWh in net electrical energy savings, thus surpassing its target by 2%. SBES achieved 2.155 MW in net peak demand savings, thus falling short of its target by 16%.

**2024 SBES-Finding: The evaluated net electrical energy savings and peak demand savings determined by the Evaluator were higher than the net savings tracked by E1.**

Energy and peak demand savings were calculated using the parameters E1 provided. Some parameters were updated based on the 2024-2025 DSM MA. Also, some other parameters like EUL, line loss factor and adjustment ratios were updated, which resulted in different energy savings. Thus, the evaluated net electrical energy savings was 4% higher than the one tracked by E1. Similarly, the net peak demand savings was 6% higher than the value tracked by E1.

**2024 SBES-Finding: Participation in SBES increased in 2024 compared to 2023 levels.**

A total of 61,673 units were rebated through SBES in 2024, including 650 units through the Audit Path, 60,273 units through the DIY Path, and 750 units through the CDI Pilot. Overall, units rebated through SBES in 2024 increased by 53% compared to 2023. The DIY Path continued to be the most popular, representing 98% of all units rebated. The CDI Pilot units rebated decreased by 48% in 2024 compared to 2023 levels.

**2024 SBES-Finding: Based on results of a survey conducted on 30 businesses, non-participant spillover was found to be nil.**

Eight survey respondents indicated that they had implemented energy efficiency measures in the last five years without receiving financial assistance from E1, but only one indicated that E1's actions were at least "somewhat influential" in their decision to implement measures, and that respondent generated negligible savings.

## CONCLUSION

Table 17 below summarizes the participation level, net-to-gross ratios (NTGRs), evaluated gross and net savings at the generator, annual GHG emission reductions, as well effective useful life (EUL) values for Direct Installation.

**Table 17: Overall 2024 Direct Installation Participation and Evaluated Savings<sup>20</sup>**

|                                                                                                                      | Participation Level |               | Gross Savings |                  | NTGR* | Net Savings |                  |
|----------------------------------------------------------------------------------------------------------------------|---------------------|---------------|---------------|------------------|-------|-------------|------------------|
|                                                                                                                      | Value               | Unit          | Value         | Unit             | Value | Value       | Unit             |
| SBES                                                                                                                 |                     |               |               |                  |       |             |                  |
| Energy Savings                                                                                                       | 61,673**            | Units rebated | 13.459        | GWh              | 0.81  | 10.854      | GWh              |
| Lifetime Energy Savings                                                                                              |                     |               | 220.510       | GWh              | 0.81  | 177.557     | GWh              |
| Peak Demand Savings                                                                                                  |                     |               | 2.679         | MW               | 0.80  | 2.155       | MW               |
| Annual GHG Emission Reductions                                                                                       |                     |               | 6,356         | Tonnes of CO2 eq | 0.81  | 5,125       | Tonnes of CO2 eq |
| EUL                                                                                                                  |                     |               | 16.4          | Years            |       | 16.4        | Years            |
| * The average NTGR values presented in this table correspond to the ratios of net savings to gross savings for SBES. |                     |               |               |                  |       |             |                  |
| ** 750 of the 61,673 units rebated were CDI Pilot units.                                                             |                     |               |               |                  |       |             |                  |

As Figure 12 and Figure 13 below illustrate, Direct Installation surpassed its planned net electrical energy savings target of 10.592 GWh by 2% and fell short of its net peak demand savings target of 2.558 MW by 16%.

**Figure 12: 2024 Direct Installation Targeted and Evaluated Net Energy Savings**

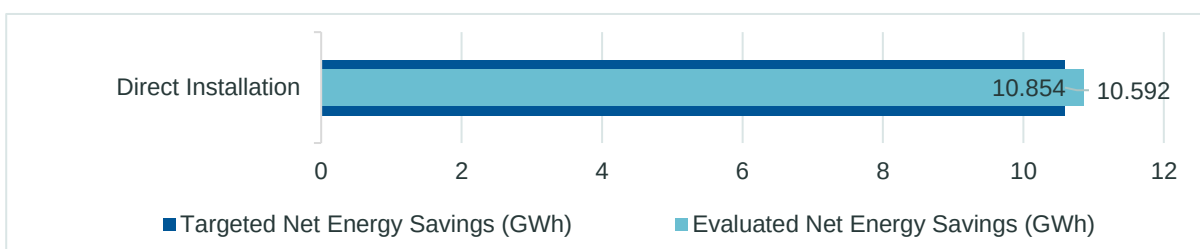
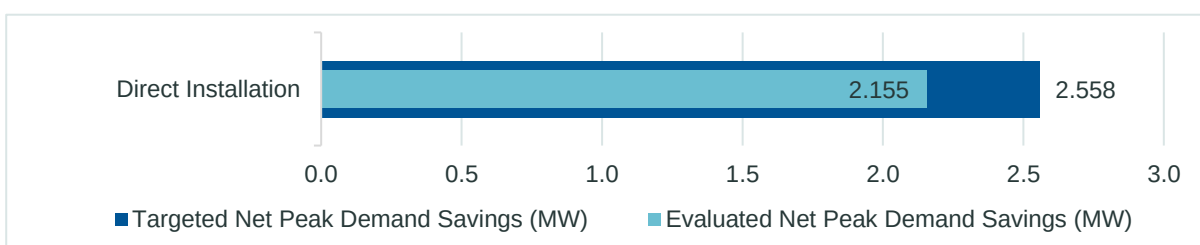


**Figure 13: 2024 Direct Installation Targeted and Evaluated Net Peak Demand Savings**



<sup>20</sup> The results presented in this table include savings for the SBES program component and the CDI Pilot.



## LIST OF APPENDICES

The following are presented in the Direct Installation Program – Appendices document.

### **Small Business Energy Solutions**

Appendix I SBES: Non-Participant Survey Questionnaire

Appendix II SBES: Non-Participant Survey Results

Appendix III SBES: 2024 Tracking Sheet Audit

Appendix IV SBES: 2024 Recommendations



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EfficiencyOne

# DIRECT INSTALLATION PROGRAM

Final Appendix Report

2024 DSM EVALUATION

March 12, 2025



**ECONOLUX**



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# APPENDIX I

## SBES Non-Participant Survey Questionnaire

### SMALL BUSINESS ENERGY SOLUTIONS SURVEY WITH NON- PARTICIPANTS

Table 1: Overview of Data Collection Activity

| Descriptor                      | This Instrument                 |
|---------------------------------|---------------------------------|
| Instrument Type                 | Telephone Survey                |
| Estimated Time to Complete      | 10 min                          |
| Target Audience                 | Small Businesses in Nova Scotia |
| Expected Number of Completions  | 30                              |
| Contact List Source             | EfficiencyOne                   |
| Fielding Firm                   | Narrative Research              |
| Estimated Timeline for Fielding | October 2024                    |

Table 2: Research Objectives and Associated Questions

| Research Objectives                 | Questions |
|-------------------------------------|-----------|
| Introduction & Screener             |           |
| Awareness, Participation & Barriers | 1-6       |
| Non-Participant Spillover           | 7-17      |
| Firmographics                       | 18-22     |

To be adapted by Econoler **[Blue text]**

Import variables from database < **LIKE THIS** >

Skip pattern or programming instructions **[LIKE THIS]**

Black text: instructions for interviewer **[NOTE: xxxx ] / [PROBE: xxxx ]**



## Introduction & Screener

Hello, my name is \_\_\_\_\_ and I am calling from Narrative Research, a Halifax-based survey research company. We are performing an evaluation of energy efficiency services and programs provided by Efficiency Nova Scotia. We are interested in gathering general feedback on energy efficiency practices in small businesses in Nova Scotia. We would appreciate your help in answering questions related to your business and energy efficiency in Nova Scotia. The information you provide will be used to help Efficiency Nova Scotia improving its energy efficiency programming offered to small businesses in the province. Is this a good time for you?

**[IF NEEDED:** The survey will take about 10 minutes.]

- a. Yes
- b. No

**[IF NO, ASK “CAN WE SCHEDULE A MORE CONVENIENT TIME FOR YOU TO CONDUCT THIS SURVEY?” & RESCHEDULE.]**

Can you confirm, are you the owner or primary decision-maker **[“at a small business operating in Nova Scotia” OR PIPE IN “of <BUSINESS NAME>” (if in contacts database)]?**

- a. Yes
- b. No
- 99. (Refused) **[THANK & TERMINATE]**

**[IF NO, ASK “CAN YOU SHARE THE CONTACT INFORMATION FOR THE OWNER OR PRIMARY DECISION MAKER?” & RECORD CONTACT INFO.]**

Please indicate your business’ annual electrical energy consumption. Please choose from the from the following options: **[READ OPTIONS]**

- a. Less than 350,000 kWh annually, that is approximately \$3600/month
- b. BETWEEN 350,000 kWh annually (Approx. \$3600/month) and 600,000 kWh annually (Approx. \$6000/month)
- c. Over 600,000kWh (that is, approximately \$6000/month OR LESS in electricity bill costs) ...?
- 99. (Refused)

**[IF C/99 – THANK & TERMINATE]**

## A. Awareness, Participation & Barriers

[NOTE FOR INTERVIEWER: THERE IS A PROGRAM SIMILAR TO THE SMALL BUSINESS PROGRAM WE ARE COLLECTING FEEDBACK ON THROUGH THIS QUESTIONNAIRE. WHILE WE WILL BE FOCUSING ON SBES, “SMALL BUSINESS ENERGY SOLUTIONS” – THERE IS ANOTHER PROGRAM CALLED BER, “BUSINESS ENERGY REBATES” OFFERED BY EFFICIENCY NOVA SCOTIA THAT RESPONDENTS MAY REFER TO. THIS PROGRAM OFFERS MAIL-IN OR IN-STORE REBATES ON EFFICIENT PRODUCTS FOR ALL BUSINESS TYPES (AND SIZES). PRE-APPROVAL OF THE PRODUCT UPGRADES ARE NOT REQUIRED AS THEY ARE IN SBES. REBATE AMOUNTS VARY BY EFFICIENT PRODUCT BUT DO NOT TYPICALLY COVER UP TO 80% OF PROJECT COSTS AS IS THE CASE WITH SBES.]

- A1. [UNAIDED – DO NOT READ DESCRIPTION] Are you aware of any rebate programs that Efficiency Nova Scotia offers to small businesses for energy efficiency related equipment upgrades? If yes, please describe.

|           |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |    |            |
|-----------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|------------|
| a) SBES   | Small Business Energy Solutions | The program offers eligible small businesses in Nova Scotia access to energy assessments, energy efficiency contractors, rebates and financing for the installation of energy efficient upgrades. [Retrofits only.] Rebates are available in the following categories: agriculture, compressed air, space and water heating, kitchen equipment, laundry appliances, lighting, pumps (pools and general), refrigeration, variable frequency drives. | Yes | No | Don't Know |
| b) Other? |                                 | RECORD NAME & DESCRIPTION [TEXT BOX]                                                                                                                                                                                                                                                                                                                                                                                                               |     |    |            |

- A2. [ASK ONLY IF NO/DON'T KNOW/OTHER IN A1] [AIDED] I am going to read you a brief description of a rebate program offered by Efficiency Nova Scotia to small businesses in the province. Please indicate if you've heard of this program after hearing the description.

|         |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |     |    |            |
|---------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|------------|
| a) SBES | Small Business Energy Solutions | The program offers eligible small businesses in Nova Scotia access to energy assessments, energy efficiency contractors, rebates and financing for the installation of energy efficient upgrades. [Retrofits only.] Rebates are available in the following categories: agriculture, compressed air, space and water heating, kitchen equipment, laundry appliances, lighting, pumps (pools and general), refrigeration, variable frequency drives. Rebates cover up to 80% of project costs for upgrades. Projects require pre-approval before small businesses proceed with an upgrade. | Yes | No | Don't Know |
|---------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|------------|

**A3. [ASK ONLY IF A1 or A2 = YES]** How did you learn about Efficiency Nova Scotia's Small Business Energy Solutions Program? **[DO NOT READ. MULTIPLE RESPONSE.]**

- a. From a contractor
- b. From an equipment vendor
- c. From an energy auditor, recommissioning provider or energy consultant
- d. From an Efficiency Nova Scotia account representative
- e. At an event/trade show
- f. Received an email or electronic newsletter
- g. Received an informational brochure
- h. From Efficiency Nova Scotia's website
- i. From a neighbouring small business
- j. TV/radio ad
- k. Friends or colleagues
- l. Through experience with the program
- m. Through participation in another Efficiency Nova Scotia energy efficiency program for businesses (SPECIFY THE PROGRAM: \_\_\_\_\_)
- n. Through participation in another Efficiency Nova Scotia energy efficiency program for homes (SPECIFY THE PROGRAM: \_\_\_\_\_)
- 96. Other, please specify: **[OPEN-ENDED RESPONSE]**
- 98. (Don't know)

**A4. [ASK ONLY IF A1 or A2 = YES]** Have you applied to participate in the Small Business Energy Solutions Program in the past? **[DO NOT READ. ACCEPT ONE RESPONSE]**

- a. Yes
- b. No
- 98. (Don't know)
- 99. (Refused)

**A5. [ASK ONLY IF A4 = YES]** Did you complete your participation in the Small Business Energy Solutions and receive your rebate(s)? **[DO NOT READ. ACCEPT ONE RESPONSE]**

- a. Yes
- b. No
- 98. (Don't Know)
- 99. (Refused)

**A6. [ASK ONLY IF A4 = NO OR A5 = NO] What was the main reason why your business did not [IF A4 = NO “apply to participate” OR IF A5 = NO “complete your participation”] in the Small Business Energy Solutions program? [DO NOT READ AT FIRST. ACCEPT ONE RESPONSE. PROMPT BY READING LIST IF NECESSARY. RANDOMIZE.]**

- a. The time to recoup the investment/payback period / the time it takes to re-coup the equipment investment via energy savings on bills
- b. Financial challenges, even after rebate, such as lack of funds
- c. The offer of 0% on-bill financing through Nova Scotia Power was not attractive for my business
- d. I was unable to proceed as I was not eligible for the 0% on-bill financing through Nova Scotia Power
- e. The potential wait-time to receive the rebate
- f. The potential wait-time to receive pre-approval for an upgrade project
- g. Time constraints or competing priorities for your business
- h. Concern that rebates will not be available when project is completed
- i. Concern that energy efficiency upgrades won't work as well as advertised
- j. Need for information or technical support to get a project idea off the ground
- k. Availability of qualified contractors to complete upgrade or renovation projects
- l. Availability of the desired upgrade equipment to install for your business
- m. Do not know which energy efficiency upgrades to prioritize for my business
- n. Reducing energy costs is not a priority for my business at this time
- o. Unsure about which energy efficiency upgrades my business can complete versus which are the landlord's responsibility
- p. Cannot obtain permission from my landlord to complete upgrades
- q. Not interested in making upgrades in a leased space
- 96. Other, please specify: **[OPEN-ENDED RESPONSE]**
- 98. (Don't know)
- 99. (Refused)

## **B. Non-Participant Spillover**

**B1.** Have you implemented energy efficiency projects or installed more efficient equipment aimed at generating electricity savings in your establishment in the last five years without receiving financial assistance from Efficiency Nova Scotia?

- a. Yes
- b. No **[SKIP TO FIRMOGRAPHICS]**
- 98. Don't know **[SKIP TO FIRMOGRAPHICS]**



**B2.**     **[IF B1 = YES]** In which year?

- a.     2024
- b.     2023
- c.     2022
- d.     2021
- e.     2020
- f.     2019 or before **[SKIP TO FIRMOGRAPHICS]**
- 98.    Don't know **[SKIP TO FIRMOGRAPHICS]**



**B3. Which energy efficiency upgrades did you install? [PUT CODES IN ALPHABETICAL ORDER. DO NOT READ. MULTIPLE RESPONSES]**

- a. Lighting
- b. Thermal envelope: Insulation (wall, floor, or roof)
- c. Thermal envelope: Doors/windows
- d. Heating system (in general)
- e. Geothermal
- f. Radiant floor
- g. Heat recovery ventilation (HRV) system
- h. Air-conditioning system
- i. Domestic hot water heating system
- j. Solar water heater
- k. Solar space heating system
- l. Efficiency refrigeration system
- m. Efficient compressor/compressed air system
- n. Heat recovery system
- o. Variable frequency drive (VFD)
- p. Electronic control HVAC system
- q. Efficient motor
- r. Efficient fans
- s. Efficient pump
- t. Efficient pool pump
- u. Kitchen equipment/appliances
- v. Mechanical system
- w. Piping/aqueduct
- x. Heat pump
- y. Laundry appliances
- z. Agricultural equipment
- aa. IT/server equipment
- 96. (Other, please specify \_\_\_\_\_)
- 98. (Don't know) **[SKIP TO FIRMOGRAPHICS]**

**B4. [IF B3 = A) Lighting]** What type of lighting did you install? Please indicate how many of each category. **[READ AS NEEDED, MULTIPLE RESPONSES – COLLECT QUANTITY IN NUMERIC BOX]**

- a. Interior lighting – T5/T8 fluorescents
- b. Interior lighting – LED luminaires
- c. Interior lighting – LED exit signs
- d. Interior lighting – Occupancy sensor
- e. Various interior lighting
- f. Exterior lighting – Photovoltaic cell
- g. Exterior lighting – LED luminaires
- h. Exterior lighting – High-pressure sodium (HPS) lamps
- i. Various exterior lighting
- 96. (Other, please specify \_\_\_\_\_)
- 98. (Don't know)

**B5. [IF B3 = NOT A) Lighting]** Please describe the upgrade that you implemented **[PROBE FOR: type/size/model/efficiency level/quantity of equipment/appliance OR quantity/size/area/type (R-value) of insulation]** **[INSERT TEXT BOX with DON'T KNOW option.]**

**B6.** When you installed the energy efficiency upgrades you mentioned just now, what was the estimated electricity energy savings associated with the project(s) you completed? Please frame your answer around annual savings. **[NOT REQUIRED. HELPFUL IF THEY CAN RESPOND.]**

This estimation can be in dollars, kWh, or percentage of electricity consumption.

Write the amount in dollars per year: \$ \_\_\_\_\_

Write the savings in kWh per year: \_\_\_\_\_

Write the % of annual electricity consumption: \_\_\_\_\_%

98. (Don't Know)

**B7.** Which of the following situations best describes why you installed the energy efficiency upgrades you outlined just now? **[ACCEPT ONLY ONE ANSWER. ONLY READ IF NECESSARY.]**

- a. Early replacement of functional equipment (in other words, prior to the end of useful life) with more efficient units
- b. Replacement of equipment at the end of useful life with more efficient units
- c. Urgent or mandatory replacements of equipment
- d. Adding equipment to improve the efficiency of existing units (for example controls)
- 96. (Other, please specify: \_\_\_\_\_)
- 98. (Don't know)

**B8.** Did you receive some form of financial assistance for these energy efficiency upgrades to your business?

- a. Yes
- b. No
- 98. (Don't Know)

**B9.** [IF B8 = Y] Who provided the financial assistance? [DO NOT READ – MULTIPLE RESPONSES POSSIBLE]

- a. Government of Canada
- b. Natural Resources Canada/Canada Greener Homes Program
- c. The Government of Nova Scotia
- 96. (Other, please specify: \_\_\_\_\_)
- 98. (Don't know)

**B10.** Thinking about when you decided to install energy efficiency upgrades in your business, please indicate how influential the following factors were using a response of **very, somewhat, not very or not at all...** [READ, ROTATE]

- a. Information you received from Efficiency Nova Scotia programs targeting business clients... in your decision?
- b. Information you read on the Efficiency Nova Scotia website... in your decision?
- c. Information you received through Efficiency Nova Scotia communications, promotional materials or publicity... in your decision?
- d. Past participation in a different energy efficiency program offered by Efficiency Nova Scotia (not for small businesses) ... in your decision?
- e. Information and advice from an Efficiency Nova Scotia representative... in your decision?
- f. Recommendations from a member of the Efficiency Nova Scotia Preferred Partner Network (supplier, contractor, etc.) ... in your decision?

[READ CHOICES & RECORD ONE RESPONSE OPTION BELOW FOR A-F]

- 1. Very influential
- 2. Somewhat influential
- 3. Not very influential
- 4. Not at all influential
- 98. (Don't know) [DO NOT READ]

## C. Firmographics

These final questions are asked for statistical purposes only. Results will be reported in aggregate and your responses will remain confidential.

**C1.** What is the main source of energy used for space heating in your establishment/main location?

- a. Electricity
- b. Natural gas
- c. Oil
- d. Propane
- 96. (Other, please specify \_\_\_\_\_)
- 98. (Don't know)

**C2.** And what is the main source of energy used to heat water?

- a. Electricity
- b. Natural gas
- c. Oil
- d. Propane
- 96. (Other, please specify \_\_\_\_\_)
- 98. (Don't know)

**C3. What is the main activity of your business? [DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]**

- a. Educational services
- b. Food sales (i.e. grocery, health food store, bulk food store, greengrocer, etc.)
- c. Food service (restaurant, bar, café, etc.)
- d. Health care
- e. Dental care
- f. Veterinary
- g. Lodging
- h. Retail
- i. Office
- j. Public assembly
- k. Public order and safety
- l. Religious worship
- m. Service
- n. Warehouse and storage
- o. Construction
- p. Manufacturing
- q. Social assistance
- r. Farming
- s. Property management
- 96. (Other: please explain \_\_\_\_\_)
- 98. (Don't know)
- 99. (Refused)

**C4.** Approximately how many full-time equivalent workers are employed with your company (at all locations as a total)? **[DO NOT READ, CODE APPROPRIATE CATEGORY] [IF ASKED: FULL-TIME EQUIVALENT WORKERS REFERS TO THOSE WORKING 35 HOURS OR MORE PER WEEK.]**

- a. Fewer than 5
- b. 5 to 9
- c. 10 to 19
- d. 20 or more
- 98. (Don't know)
- 99. (Refused)

**C5.** Do you own or rent your business location(s)?

- a. Own
- b. Rent
- c. Multiple locations – mix of ownership and renting
- 96. (Other: please explain \_\_\_\_\_)
- 98. (Don't know)
- 99. (Refused)

**C6.** How many locations does your business have in Nova Scotia? **[RECORD A NUMBER 1-99; 998 = DON'T KNOW, 999 = REFUSED]**

**[END: Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!]**

## APPENDIX II

### SBES Non-Participant Survey Results

The participant survey results are presented in the following tables. Please note that Business Activities are noted as such in the following tables: **Lodging = L, Retail = R, Service = S, Warehouse = W, Manufacturing = M, Auto/Car Repairs/Dealership = A, Other = O.**

**TABLE A1: [UNAIDED]**

|                        | OVERALL<br>% | FULL-TIME<br>WORKERS |           |          | OWN OR<br>RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|------------------------|--------------|----------------------|-----------|----------|----------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                        |              | >5                   | 5-19      | 20+      | O              | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b> | <b>30</b>    | <b>15</b>            | <b>10</b> | <b>5</b> | <b>17</b>      | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| No                     | 63           | 67                   | 70        | 40       | 65             | 67        | 100                     | 67       | 50       | 50       | 75       | 40       | 60        |
| Don't know             | 17           | 20                   | 20        | 0        | 29             | 0         | 0                       | 33       | 50       | 0        | 0        | 20       | 20        |
| SBES                   | 13           | 13                   | 10        | 20       | 6              | 25        | 0                       | 0        | 0        | 0        | 25       | 20       | 20        |
| Other                  | 7            | 0                    | 0         | 40       | 0              | 8         | 0                       | 0        | 0        | 50       | 0        | 20       | 0         |

**TABLE A2: [AIDED]**

[ASK IF A1='No' OR 'Don't know'] I am going to read you a brief description of a rebate program offered by Efficiency Nova Scotia to small businesses in the province. Please indicate if you've heard of this program after hearing the description.

|                        | OVERALL<br>% | FULL-TIME<br>WORKERS |          |          | OWN OR<br>RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------|--------------|----------------------|----------|----------|----------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                        |              | >5                   | 5-19     | 20+      | O              | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b> | <b>26</b>    | <b>13</b>            | <b>9</b> | <b>4</b> | <b>16</b>      | <b>9</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>3</b> | <b>4</b> | <b>8</b> |
| Yes                    | 46           | 54                   | 44       | 25       | 56             | 22       | 25                      | 33       | 50       | 0        | 100      | 50       | 50       |
| No                     | 54           | 46                   | 56       | 75       | 44             | 78       | 75                      | 67       | 50       | 100      | 0        | 50       | 50       |

TABLE A1/A2: [AIDED/UNAIDED]

Are you aware of any rebate programs that Efficiency Nova Scotia offers to small businesses for energy efficiency related equipment upgrades?

|                        | OVERALL % | FULL-TIME WORKERS |           |          | OWN OR RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|------------------------|-----------|-------------------|-----------|----------|-------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                        |           | >5                | 5-19      | 20+      | O           | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b> | <b>30</b> | <b>15</b>         | <b>10</b> | <b>5</b> | <b>17</b>   | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| SBES                   | 53        | 60                | 50        | 40       | 59          | 42        | 25                      | 33       | 50       | 0        | 100      | 60       | 60        |
| No                     | 43        | 40                | 50        | 40       | 41          | 50        | 75                      | 67       | 50       | 50       | 0        | 40       | 40        |
| Other                  | 3         | 0                 | 0         | 20       | 0           | 8         | 0                       | 0        | 0        | 50       | 0        | 0        | 0         |

TABLE A3:

[ASK IF A1 OR A2='Yes (SBES)'] How did you learn about Efficiency Nova Scotia's Small Business Energy Solutions Program?

|                                                       | OVERALL # | FULL-TIME WORKERS |          |          | OWN OR RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|-------------------------------------------------------|-----------|-------------------|----------|----------|-------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                                                       |           | >5                | 5-19     | 20+      | O           | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b>                                | <b>16</b> | <b>9</b>          | <b>5</b> | <b>2</b> | <b>10</b>   | <b>5</b> | <b>1</b>                | <b>1</b> | <b>1</b> | <b>0</b> | <b>4</b> | <b>3</b> | <b>6</b> |
| Received an informational brochure                    | 4         | 3                 | 1        | 0        | 3           | 1        | 0                       | 0        | 0        | 0        | 0        | 1        | 3        |
| From a contractor                                     | 4         | 2                 | 0        | 2        | 1           | 2        | 0                       | 0        | 0        | 0        | 1        | 2        | 1        |
| Received an email or electronic newsletter            | 3         | 1                 | 2        | 0        | 3           | 0        | 0                       | 1        | 0        | 0        | 0        | 0        | 2        |
| Other                                                 | 2         | 0                 | 2        | 0        | 1           | 1        | 0                       | 0        | 0        | 0        | 1        | 0        | 1        |
| On social media                                       | 2         | 2                 | 0        | 0        | 2           | 0        | 0                       | 0        | 1        | 0        | 0        | 0        | 1        |
| TV/radio ad                                           | 2         | 1                 | 1        | 0        | 1           | 1        | 0                       | 0        | 0        | 0        | 1        | 0        | 1        |
| From Efficiency Nova Scotia's website                 | 2         | 2                 | 0        | 0        | 2           | 0        | 1                       | 0        | 0        | 0        | 0        | 0        | 1        |
| Through experience with the program                   | 1         | 0                 | 1        | 0        | 1           | 0        | 0                       | 0        | 0        | 0        | 1        | 0        | 0        |
| From an Efficiency Nova Scotia account representative | 1         | 0                 | 1        | 0        | 1           | 0        | 0                       | 0        | 0        | 0        | 1        | 0        | 0        |
| From an equipment vendor                              | 1         | 0                 | 1        | 0        | 1           | 0        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |



**TABLE A4:**

**[ASK IF A1 OR A2='Yes (SBES)'] Have you applied to participate in the Small Business Energy Solutions Program in the past?**

|                        | OVERALL<br># | FULL-TIME<br>WORKERS |          |          | OWN OR<br>RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------|--------------|----------------------|----------|----------|----------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                        |              | >5                   | 5-19     | 20+      | O              | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b> | <b>16</b>    | <b>9</b>             | <b>5</b> | <b>2</b> | <b>10</b>      | <b>5</b> | <b>1</b>                | <b>1</b> | <b>1</b> | <b>0</b> | <b>4</b> | <b>3</b> | <b>6</b> |
| Yes                    | 5            | 2                    | 2        | 1        | 4              | 0        | 1                       | 1        | 0        | 0        | 0        | 1        | 2        |
| No                     | 11           | 7                    | 3        | 1        | 6              | 5        | 0                       | 0        | 1        | 0        | 4        | 2        | 4        |

**TABLE A5:**

**[ASK IF A4 = 'Yes'] Did you complete your participation in the Small Business Energy Solutions and receive your rebate(s)?**

|                        | OVERALL<br># | FULL-TIME<br>WORKERS |          |          | OWN OR<br>RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------|--------------|----------------------|----------|----------|----------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                        |              | >5                   | 5-19     | 20+      | O              | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b> | <b>5</b>     | <b>2</b>             | <b>2</b> | <b>1</b> | <b>4</b>       | <b>0</b> | <b>1</b>                | <b>1</b> | <b>0</b> | <b>0</b> | <b>0</b> | <b>1</b> | <b>2</b> |
| Yes                    | 3            | 1                    | 2        | 0        | 3              | 0        | 0                       | 1        | 0        | 0        | 0        | 0        | 2        |
| No                     | 2            | 1                    | 0        | 1        | 1              | 0        | 1                       | 0        | 0        | 0        | 0        | 1        | 0        |

TABLE A6:

[ASK IF A4 OR A5 = 'No'] What was the main reason why your business did not [If A4 = No “apply to participate” OR If A5 = No “complete your participation”] in the Small Business Energy Solutions program?

|                                                                                                                             | OVERALL<br># | FULL-TIME<br>WORKERS |          |          | OWN OR<br>RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|--------------|----------------------|----------|----------|----------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                                                                                                                             |              | >5                   | 5-19     | 20+      | O              | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b>                                                                                                      | <b>13</b>    | <b>8</b>             | <b>3</b> | <b>2</b> | <b>7</b>       | <b>5</b> | <b>1</b>                | <b>0</b> | <b>1</b> | <b>0</b> | <b>4</b> | <b>3</b> | <b>4</b> |
| Lighting was already upgraded/was installed before the program was around                                                   | 2            | 2                    | 0        | 0        | 2              | 0        | 0                       | 0        | 0        | 0        | 0        | 1        | 1        |
| Did not know about the program/Not aware the program existed                                                                | 2            | 0                    | 1        | 1        | 0              | 2        | 0                       | 0        | 0        | 0        | 1        | 1        | 0        |
| Not interested in making upgrades in a leased space                                                                         | 2            | 2                    | 0        | 0        | 0              | 2        | 0                       | 0        | 0        | 0        | 2        | 0        | 0        |
| Other                                                                                                                       | 1            | 1                    | 0        | 0        | 1              | 0        | 0                       | 0        | 1        | 0        | 0        | 0        | 0        |
| Availability of the desired upgrade equipment to install for your business                                                  | 1            | 1                    | 0        | 0        | 1              | 0        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |
| Time constraints or competing priorities for your business                                                                  | 1            | 0                    | 1        | 0        | 1              | 0        | 0                       | 0        | 0        | 0        | 1        | 0        | 0        |
| The potential wait-time to receive the rebate                                                                               | 1            | 1                    | 0        | 0        | 0              | 1        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |
| I was unable to proceed as I was not eligible for the 0% on-bill financing through Nova Scotia Power                        | 1            | 0                    | 1        | 0        | 1              | 0        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |
| Financial challenges, even after rebate, such as lack of funds                                                              | 1            | 1                    | 0        | 0        | 1              | 0        | 1                       | 0        | 0        | 0        | 0        | 0        | 0        |
| The time to recoup the investment/payback period / the time it takes to re-coup the equipment investment via energy savings | 1            | 0                    | 0        | 1        | 0              | 0        | 0                       | 0        | 0        | 0        | 0        | 1        | 0        |

TABLE B7:

Have you implemented energy efficiency projects or installed more efficient equipment aimed at generating electricity savings in your establishment in the last five years without receiving financial assistance from Efficiency Nova Scotia?

|                        | OVERALL % | FULL-TIME WORKERS |           |          | OWN OR RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|------------------------|-----------|-------------------|-----------|----------|-------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                        |           | >5                | 5-19      | 20+      | O           | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b> | <b>30</b> | <b>15</b>         | <b>10</b> | <b>5</b> | <b>17</b>   | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| Yes                    | 47        | 47                | 60        | 20       | 53          | 42        | 75                      | 33       | 50       | 50       | 50       | 40       | 40        |
| No                     | 50        | 53                | 40        | 60       | 47          | 50        | 25                      | 67       | 50       | 0        | 50       | 60       | 60        |
| Don't know             | 3         | 0                 | 0         | 20       | 0           | 8         | 0                       | 0        | 0        | 50       | 0        | 0        | 0         |

TABLE B8:

[ASK IF B7='Yes'] In which year?

|                        | OVERALL # | FULL-TIME WORKERS |          |          | OWN OR RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------|-----------|-------------------|----------|----------|-------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                        |           | >5                | 5-19     | 20+      | O           | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b> | <b>14</b> | <b>7</b>          | <b>6</b> | <b>1</b> | <b>9</b>    | <b>5</b> | <b>3</b>                | <b>1</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>2</b> | <b>4</b> |
| 2024                   | 3         | 0                 | 2        | 1        | 1           | 2        | 0                       | 0        | 1        | 0        | 0        | 0        | 2        |
| 2023                   | 2         | 1                 | 1        | 0        | 1           | 1        | 0                       | 0        | 0        | 1        | 0        | 1        | 0        |
| 2022                   | 1         | 0                 | 1        | 0        | 1           | 0        | 0                       | 0        | 0        | 0        | 1        | 0        | 0        |
| 2021                   | 1         | 1                 | 0        | 0        | 0           | 1        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |
| 2020                   | 1         | 0                 | 1        | 0        | 1           | 0        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |
| 2019 or before         | 4         | 3                 | 1        | 0        | 3           | 1        | 1                       | 1        | 0        | 0        | 1        | 1        | 0        |
| Don't know             | 2         | 2                 | 0        | 0        | 2           | 0        | 2                       | 0        | 0        | 0        | 0        | 0        | 0        |

TABLE B9:

[ASK IF B8='2020 THRU 2024'] Which energy efficiency upgrades did you install?

|                        | OVERALL # | FULL-TIME WORKERS |          |          | OWN OR RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------|-----------|-------------------|----------|----------|-------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                        |           | >5                | 5-19     | 20+      | O           | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b> | <b>8</b>  | <b>2</b>          | <b>5</b> | <b>1</b> | <b>4</b>    | <b>4</b> | <b>0</b>                | <b>0</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>4</b> |
| Lighting               | 5         | 2                 | 3        | 0        | 3           | 2        | 0                       | 0        | 1        | 0        | 1        | 1        | 2        |
| (Other)                | 3         | 0                 | 2        | 1        | 2           | 1        | 0                       | 0        | 0        | 0        | 1        | 0        | 2        |
| Heat pump              | 3         | 1                 | 2        | 0        | 1           | 2        | 0                       | 0        | 0        | 1        | 0        | 0        | 2        |

TABLE B10:

[ASK IF B9 = 'Lighting'] What type of lighting did you install?

|                                                      | OVERALL # | FULL-TIME WORKERS |          |          | OWN OR RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------------------------------------|-----------|-------------------|----------|----------|-------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                                                      |           | >5                | 5-19     | 20+      | O           | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b>                               | <b>5</b>  | <b>2</b>          | <b>3</b> | <b>0</b> | <b>3</b>    | <b>2</b> | <b>0</b>                | <b>0</b> | <b>1</b> | <b>0</b> | <b>1</b> | <b>1</b> | <b>2</b> |
| Interior lighting – LED luminaires                   | 3         | 1                 | 2        | 0        | 2           | 1        | 0                       | 0        | 1        | 0        | 0        | 1        | 1        |
| (Other)                                              | 2         | 0                 | 2        | 0        | 1           | 1        | 0                       | 0        | 1        | 0        | 1        | 0        | 0        |
| Exterior lighting – LED luminaires                   | 2         | 0                 | 2        | 0        | 1           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 1        |
| Interior lighting – LED exit signs                   | 2         | 0                 | 2        | 0        | 1           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 1        |
| (Don't know)                                         | 1         | 1                 | 0        | 0        | 0           | 1        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |
| Various exterior lighting                            | 1         | 0                 | 1        | 0        | 0           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 0        |
| Exterior lighting – High-pressure sodium (HPS) lamps | 1         | 0                 | 1        | 0        | 0           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 0        |
| Exterior lighting – Photovoltaic cell                | 1         | 0                 | 1        | 0        | 0           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 0        |
| Various interior lighting                            | 1         | 0                 | 1        | 0        | 0           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 0        |
| Interior lighting – Occupancy sensor                 | 1         | 0                 | 1        | 0        | 0           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 0        |
| Interior lighting – T5/T8 fluorescents               | 1         | 0                 | 1        | 0        | 0           | 1        | 0                       | 0        | 1        | 0        | 0        | 0        | 0        |

TABLE B11:

[DO NOT ASK IF B9 = 'Lighting'] Please describe the upgrade that you implemented. [PROBE FOR: type/size/model/efficiency level/quantity of equipment/appliance OR quantity/size/area/type (R-value) of insulation].

|                        | OVERALL # | FULL-TIME WORKERS |          |          | OWN OR RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------|-----------|-------------------|----------|----------|-------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                        |           | >5                | 5-19     | 20+      | O           | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b> | <b>3</b>  | <b>0</b>          | <b>2</b> | <b>1</b> | <b>1</b>    | <b>2</b> | <b>0</b>                | <b>0</b> | <b>0</b> | <b>1</b> | <b>0</b> | <b>0</b> | <b>2</b> |
| Other                  | 3         | 0                 | 2        | 1        | 1           | 2        | 0                       | 0        | 0        | 1        | 0        | 0        | 2        |

TABLE B12A:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] When you installed the energy efficiency upgrades you mentioned just now, what was the estimated electricity energy savings associated with the project(s) you completed: Write the amount in dollars per year: \$

|                        | OVERALL #      | FULL-TIME WORKERS |                |                 | OWN OR RENT    |                   | BUSINESS' MAIN ACTIVITY |          |          |                   |          |          |                   |
|------------------------|----------------|-------------------|----------------|-----------------|----------------|-------------------|-------------------------|----------|----------|-------------------|----------|----------|-------------------|
|                        |                | >5                | 5-19           | 20+             | O              | R                 | L                       | R        | S        | W                 | M        | A        | O                 |
| <b>SAMPLE SIZE (#)</b> | <b>8</b>       | <b>2</b>          | <b>5</b>       | <b>1</b>        | <b>4</b>       | <b>4</b>          | <b>0</b>                | <b>0</b> | <b>1</b> | <b>1</b>          | <b>1</b> | <b>1</b> | <b>4</b>          |
| None                   | 1              | 1                 | 0              | 0               | 0              | 1                 | 0                       | 0        | 0        | 0                 | 0        | 0        | 1                 |
| \$2400                 | 1              | 0                 | 1              | 0               | 0              | 1                 | 0                       | 0        | 0        | 1                 | 0        | 0        | 0                 |
| \$5000                 | 1              | 0                 | 1              | 0               | 1              | 0                 | 0                       | 0        | 0        | 0                 | 0        | 0        | 1                 |
| \$20,000               | 1              | 0                 | 0              | 1               | 0              | 1                 | 0                       | 0        | 0        | 0                 | 0        | 0        | 1                 |
| Don't know             | 4              | 1                 | 3              | 0               | 3              | 1                 | 0                       | 0        | 1        | 0                 | 1        | 1        | 1                 |
| <b>MEAN</b>            | <b>\$6,850</b> | <b>\$0</b>        | <b>\$3,700</b> | <b>\$20,000</b> | <b>\$5,000</b> | <b>\$7,466.67</b> |                         |          |          | <b>\$2,400.00</b> |          |          | <b>\$8,333.33</b> |

TABLE B12B:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] When you installed the energy efficiency upgrades you mentioned just now, what was the estimated electricity energy savings associated with the project(s) you completed?

Write the savings in kWh per year:

|                        | OVERALL #  | FULL-TIME WORKERS |            |            | OWN OR RENT |            | BUSINESS' MAIN ACTIVITY |          |          |            |          |          |            |
|------------------------|------------|-------------------|------------|------------|-------------|------------|-------------------------|----------|----------|------------|----------|----------|------------|
|                        |            | >5                | 5-19       | 20+        | O           | R          | L                       | R        | S        | W          | M        | A        | O          |
| <b>SAMPLE SIZE (#)</b> | <b>6</b>   | <b>1</b>          | <b>4</b>   | <b>1</b>   | <b>3</b>    | <b>3</b>   | <b>0</b>                | <b>0</b> | <b>1</b> | <b>1</b>   | <b>1</b> | <b>1</b> | <b>2</b>   |
| None                   | 2          | 0                 | 1          | 1          | 0           | 2          | 0                       | 0        | 0        | 1          | 0        | 0        | 1          |
| Don't know             | 4          | 1                 | 3          | 0          | 3           | 1          | 0                       | 0        | 1        | 0          | 1        | 1        | 1          |
| <b>MEAN</b>            | <b>0.0</b> |                   | <b>0.0</b> | <b>0.0</b> |             | <b>0.0</b> |                         |          |          | <b>0.0</b> |          |          | <b>0.0</b> |

Note: Question is optional. Mean calculated excludes responses of 'Don't know'.

TABLE B12C:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] When you installed the energy efficiency upgrades you mentioned just now, what was the estimated electricity energy savings associated with the project(s) you completed?

Write the % of annual electricity consumption:

|                        | OVERALL<br># | FULL-TIME<br>WORKERS |             |             | OWN OR<br>RENT |             | BUSINESS' MAIN ACTIVITY |          |          |             |          |          |             |
|------------------------|--------------|----------------------|-------------|-------------|----------------|-------------|-------------------------|----------|----------|-------------|----------|----------|-------------|
|                        |              | >5                   | 5-19        | 20+         | O              | R           | L                       | R        | S        | W           | M        | A        | O           |
| <b>SAMPLE SIZE (#)</b> | <b>8</b>     | <b>2</b>             | <b>5</b>    | <b>1</b>    | <b>4</b>       | <b>4</b>    | <b>0</b>                | <b>0</b> | <b>1</b> | <b>1</b>    | <b>1</b> | <b>1</b> | <b>4</b>    |
| None                   | 4            | 1                    | 2           | 1           | 1              | 3           | 0                       | 0        | 0        | 1           | 0        | 0        | 3           |
| Don't know             | 4            | 1                    | 3           | 0           | 3              | 1           | 0                       | 0        | 1        | 0           | 1        | 1        | 1           |
| <b>MEAN</b>            | <b>0.0%</b>  | <b>0.0%</b>          | <b>0.0%</b> | <b>0.0%</b> | <b>0.0%</b>    | <b>0.0%</b> |                         |          |          | <b>0.0%</b> |          |          | <b>0.0%</b> |

Note: Question is optional. Mean calculated excludes responses of 'Don't know'.

TABLE B13:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Which of the following situations best describes why you installed the energy efficiency upgrades you outlined just now?

|                                                                                                                       | OVERALL<br># | FULL-TIME<br>WORKERS |          |          | OWN OR<br>RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------|--------------|----------------------|----------|----------|----------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                                                                                                                       |              | >5                   | 5-19     | 20+      | O              | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b>                                                                                                | <b>8</b>     | <b>2</b>             | <b>5</b> | <b>1</b> | <b>4</b>       | <b>4</b> | <b>0</b>                | <b>0</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>4</b> |
| Replacement of equipment at the end of useful life with more efficient units                                          | 5            | 2                    | 2        | 1        | 1              | 4        | 0                       | 0        | 1        | 1        | 0        | 1        | 2        |
| Early replacement of functional equipment (in other words, prior to the end of useful life) with more efficient units | 2            | 0                    | 2        | 0        | 2              | 0        | 0                       | 0        | 0        | 0        | 1        | 0        | 1        |
| Other                                                                                                                 | 1            | 0                    | 1        | 0        | 1              | 0        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |

TABLE B14:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Did you receive some form of financial assistance for these energy efficiency upgrades to your business?

|                        | OVERALL<br># | FULL-TIME<br>WORKERS |          |          | OWN OR<br>RENT |          | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |          |
|------------------------|--------------|----------------------|----------|----------|----------------|----------|-------------------------|----------|----------|----------|----------|----------|----------|
|                        |              | >5                   | 5-19     | 20+      | O              | R        | L                       | R        | S        | W        | M        | A        | O        |
| <b>SAMPLE SIZE (#)</b> | <b>8</b>     | <b>2</b>             | <b>5</b> | <b>1</b> | <b>4</b>       | <b>4</b> | <b>0</b>                | <b>0</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>4</b> |
| Yes                    | 1            | 0                    | 1        | 0        | 1              | 0        | 0                       | 0        | 0        | 0        | 0        | 0        | 1        |
| No                     | 7            | 2                    | 4        | 1        | 3              | 4        | 0                       | 0        | 1        | 1        | 1        | 1        | 3        |

TABLE B15:

[ASK IF B14='Yes'] Who provided the financial assistance?

|                 | OVERALL<br># | FULL-TIME<br>WORKERS |      |     | OWN OR<br>RENT |   | BUSINESS' MAIN ACTIVITY |   |   |   |   |   |   |
|-----------------|--------------|----------------------|------|-----|----------------|---|-------------------------|---|---|---|---|---|---|
|                 |              | >5                   | 5-19 | 20+ | O              | R | L                       | R | S | W | M | A | O |
| SAMPLE SIZE (#) | 1            | 0                    | 1    | 0   | 1              | 0 | 0                       | 0 | 0 | 0 | 0 | 0 | 1 |
| Other           | 1            | 0                    | 1    | 0   | 1              | 0 | 0                       | 0 | 0 | 0 | 0 | 0 | 1 |

TABLE B16A:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Thinking about when you decided to install energy efficiency upgrades in your business, please indicate how influential the following factors were using a response of very, somewhat, not very or not at all...

Information you received from Efficiency Nova Scotia programs targeting business clients

|                        | OVERALL<br># | FULL-TIME<br>WORKERS |      |     | OWN OR<br>RENT |     | BUSINESS' MAIN ACTIVITY |   |     |     |     |     |     |
|------------------------|--------------|----------------------|------|-----|----------------|-----|-------------------------|---|-----|-----|-----|-----|-----|
|                        |              | >5                   | 5-19 | 20+ | O              | R   | L                       | R | S   | W   | M   | A   | O   |
| SAMPLE SIZE (#)        | 8            | 2                    | 5    | 1   | 4              | 4   | 0                       | 0 | 1   | 1   | 1   | 1   | 4   |
| Very influential       | 0            | 0                    | 0    | 0   | 0              | 0   | 0                       | 0 | 0   | 0   | 0   | 0   | 0   |
| Somewhat influential   | 1            | 1                    | 0    | 0   | 1              | 0   | 0                       | 0 | 0   | 0   | 0   | 1   | 0   |
| Not very influential   | 1            | 1                    | 0    | 0   | 0              | 1   | 0                       | 0 | 0   | 0   | 0   | 0   | 1   |
| Not at all influential | 6            | 0                    | 5    | 1   | 3              | 3   | 0                       | 0 | 1   | 1   | 1   | 0   | 3   |
| Don't know             | 0            | 0                    | 0    | 0   | 0              | 0   | 0                       | 0 | 0   | 0   | 0   | 0   | 0   |
| % INFLUENTIAL          | 13           | 50                   | 0    | 0   | 25             | 0   |                         |   | 0   | 0   | 0   | 100 | 0   |
| % NOT INFLUENTIAL      | 88           | 50                   | 100  | 100 | 75             | 100 |                         |   | 100 | 100 | 100 | 0   | 100 |

TABLE B16B:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Thinking about when you decided to install energy efficiency upgrades in your business, please indicate how influential the following factors were using a response of very, somewhat, not very or not at all...

Information you read on the Efficiency Nova Scotia website

|                          | OVERALL #  | FULL-TIME WORKERS |            |            | OWN OR RENT |            | BUSINESS' MAIN ACTIVITY |          |            |            |            |            |            |
|--------------------------|------------|-------------------|------------|------------|-------------|------------|-------------------------|----------|------------|------------|------------|------------|------------|
|                          |            | >5                | 5-19       | 20+        | O           | R          | L                       | R        | S          | W          | M          | A          | O          |
| <b>SAMPLE SIZE (#)</b>   | <b>8</b>   | <b>2</b>          | <b>5</b>   | <b>1</b>   | <b>4</b>    | <b>4</b>   | <b>0</b>                | <b>0</b> | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>4</b>   |
| Very influential         | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Somewhat influential     | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not very influential     | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not at all influential   | 8          | 2                 | 5          | 1          | 4           | 4          | 0                       | 0        | 1          | 1          | 1          | 1          | 4          |
| Don't know               | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| <b>% INFLUENTIAL</b>     | <b>0</b>   | <b>0</b>          | <b>0</b>   | <b>0</b>   | <b>0</b>    | <b>0</b>   |                         |          | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   |
| <b>% NOT INFLUENTIAL</b> | <b>100</b> | <b>100</b>        | <b>100</b> | <b>100</b> | <b>100</b>  | <b>100</b> |                         |          | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |

TABLE B16C:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Thinking about when you decided to install energy efficiency upgrades in your business, please indicate how influential the following factors were using a response of very, somewhat, not very or not at all...

Information you received through Efficiency Nova Scotia communications, promotional materials or publicity

|                          | OVERALL #  | FULL-TIME WORKERS |            |            | OWN OR RENT |            | BUSINESS' MAIN ACTIVITY |          |            |            |            |            |            |
|--------------------------|------------|-------------------|------------|------------|-------------|------------|-------------------------|----------|------------|------------|------------|------------|------------|
|                          |            | >5                | 5-19       | 20+        | O           | R          | L                       | R        | S          | W          | M          | A          | O          |
| <b>SAMPLE SIZE (#)</b>   | <b>8</b>   | <b>2</b>          | <b>5</b>   | <b>1</b>   | <b>4</b>    | <b>4</b>   | <b>0</b>                | <b>0</b> | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>4</b>   |
| Very influential         | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Somewhat influential     | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not very influential     | 1          | 1                 | 0          | 0          | 0           | 1          | 0                       | 0        | 0          | 0          | 0          | 0          | 1          |
| Not at all influential   | 7          | 1                 | 5          | 1          | 4           | 3          | 0                       | 0        | 1          | 1          | 1          | 1          | 3          |
| Don't know               | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| <b>% INFLUENTIAL</b>     | <b>0</b>   | <b>0</b>          | <b>0</b>   | <b>0</b>   | <b>0</b>    | <b>0</b>   |                         |          | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   |
| <b>% NOT INFLUENTIAL</b> | <b>100</b> | <b>100</b>        | <b>100</b> | <b>100</b> | <b>100</b>  | <b>100</b> |                         |          | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |



TABLE B16D:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Thinking about when you decided to install energy efficiency upgrades in your business, please indicate how influential the following factors were using a response of very, somewhat, not very or not at all...

Past participation in a different energy efficiency program offered by Efficiency Nova Scotia (not for small businesses)

|                          | OVERALL #  | FULL-TIME WORKERS |            |            | OWN OR RENT |            | BUSINESS' MAIN ACTIVITY |          |            |            |            |            |            |
|--------------------------|------------|-------------------|------------|------------|-------------|------------|-------------------------|----------|------------|------------|------------|------------|------------|
|                          |            | >5                | 5-19       | 20+        | O           | R          | L                       | R        | S          | W          | M          | A          | O          |
| <b>SAMPLE SIZE (#)</b>   | <b>8</b>   | <b>2</b>          | <b>5</b>   | <b>1</b>   | <b>4</b>    | <b>4</b>   | <b>0</b>                | <b>0</b> | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>4</b>   |
| Very influential         | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Somewhat influential     | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not very influential     | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not at all influential   | 8          | 2                 | 5          | 1          | 4           | 4          | 0                       | 0        | 1          | 1          | 1          | 1          | 4          |
| Don't know               | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| <b>% INFLUENTIAL</b>     | <b>0</b>   | <b>0</b>          | <b>0</b>   | <b>0</b>   | <b>0</b>    | <b>0</b>   |                         |          | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   |
| <b>% NOT INFLUENTIAL</b> | <b>100</b> | <b>100</b>        | <b>100</b> | <b>100</b> | <b>100</b>  | <b>100</b> |                         |          | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |

TABLE B16E:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Thinking about when you decided to install energy efficiency upgrades in your business, please indicate how influential the following factors were using a response of very, somewhat, not very or not at all...

Information and advice from an Efficiency Nova Scotia representative

|                          | OVERALL #  | FULL-TIME WORKERS |            |            | OWN OR RENT |            | BUSINESS' MAIN ACTIVITY |          |            |            |            |            |            |
|--------------------------|------------|-------------------|------------|------------|-------------|------------|-------------------------|----------|------------|------------|------------|------------|------------|
|                          |            | >5                | 5-19       | 20+        | O           | R          | L                       | R        | S          | W          | M          | A          | O          |
| <b>SAMPLE SIZE (#)</b>   | <b>8</b>   | <b>2</b>          | <b>5</b>   | <b>1</b>   | <b>4</b>    | <b>4</b>   | <b>0</b>                | <b>0</b> | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>4</b>   |
| Very influential         | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Somewhat influential     | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not very influential     | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not at all influential   | 8          | 2                 | 5          | 1          | 4           | 4          | 0                       | 0        | 1          | 1          | 1          | 1          | 4          |
| Don't know               | 0          | 0                 | 0          | 0          | 0           | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| <b>% INFLUENTIAL</b>     | <b>0</b>   | <b>0</b>          | <b>0</b>   | <b>0</b>   | <b>0</b>    | <b>0</b>   |                         |          | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   |
| <b>% NOT INFLUENTIAL</b> | <b>100</b> | <b>100</b>        | <b>100</b> | <b>100</b> | <b>100</b>  | <b>100</b> |                         |          | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |

TABLE B16F:

[ASK IF '2020 THRU 2024' IN B8 OR NOT 'Don't know' IN B9] Thinking about when you decided to install energy efficiency upgrades in your business, please indicate how influential the following factors were using a response of very, somewhat, not very or not at all...

Recommendations from a member of the Efficiency Nova Scotia Preferred Partner Network (supplier, contractor, etc.)

|                          | OVERALL<br># | FULL-TIME<br>WORKERS |            |            | OWN OR<br>RENT |            | BUSINESS' MAIN ACTIVITY |          |            |            |            |            |            |
|--------------------------|--------------|----------------------|------------|------------|----------------|------------|-------------------------|----------|------------|------------|------------|------------|------------|
|                          |              | >5                   | 5-19       | 20+        | O              | R          | L                       | R        | S          | W          | M          | A          | O          |
| <b>SAMPLE SIZE (#)</b>   | <b>8</b>     | <b>2</b>             | <b>5</b>   | <b>1</b>   | <b>4</b>       | <b>4</b>   | <b>0</b>                | <b>0</b> | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>1</b>   | <b>4</b>   |
| Very influential         | 0            | 0                    | 0          | 0          | 0              | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Somewhat influential     | 0            | 0                    | 0          | 0          | 0              | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not very influential     | 0            | 0                    | 0          | 0          | 0              | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| Not at all influential   | 8            | 2                    | 5          | 1          | 4              | 4          | 0                       | 0        | 1          | 1          | 1          | 1          | 4          |
| Don't know               | 0            | 0                    | 0          | 0          | 0              | 0          | 0                       | 0        | 0          | 0          | 0          | 0          | 0          |
| <b>% INFLUENTIAL</b>     | <b>0</b>     | <b>0</b>             | <b>0</b>   | <b>0</b>   | <b>0</b>       | <b>0</b>   |                         |          | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   | <b>0</b>   |
| <b>% NOT INFLUENTIAL</b> | <b>100</b>   | <b>100</b>           | <b>100</b> | <b>100</b> | <b>100</b>     | <b>100</b> |                         |          | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> | <b>100</b> |

TABLE C17:

What is the main source of energy used for space heating in your establishment/main location?

|                        | OVERALL<br>% | FULL-TIME<br>WORKERS |           |          | OWN OR<br>RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|------------------------|--------------|----------------------|-----------|----------|----------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                        |              | >5                   | 5-19      | 20+      | O              | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b> | <b>30</b>    | <b>15</b>            | <b>10</b> | <b>5</b> | <b>17</b>      | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| Oil                    | 37           | 27                   | 60        | 20       | 47             | 17        | 0                       | 67       | 100      | 0        | 50       | 40       | 30        |
| Electricity            | 37           | 47                   | 40        | 0        | 35             | 42        | 75                      | 33       | 0        | 50       | 25       | 20       | 40        |
| Natural gas            | 17           | 7                    | 0         | 80       | 12             | 25        | 25                      | 0        | 0        | 50       | 0        | 20       | 20        |
| Propane                | 7            | 13                   | 0         | 0        | 0              | 17        | 0                       | 0        | 0        | 0        | 25       | 0        | 10        |
| (Other)                | 3            | 7                    | 0         | 0        | 6              | 0         | 0                       | 0        | 0        | 0        | 0        | 20       | 0         |

TABLE C18:

And what is the main source of energy used to heat water?

|                        | OVERALL<br>% | FULL-TIME<br>WORKERS |           |          | OWN OR<br>RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|------------------------|--------------|----------------------|-----------|----------|----------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                        |              | >5                   | 5-19      | 20+      | O              | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b> | <b>30</b>    | <b>15</b>            | <b>10</b> | <b>5</b> | <b>17</b>      | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| Electricity            | 83           | 87                   | 90        | 60       | 76             | 92        | 75                      | 100      | 50       | 100      | 100      | 80       | 80        |
| Natural gas            | 10           | 7                    | 0         | 40       | 12             | 8         | 25                      | 0        | 0        | 0        | 0        | 20       | 10        |
| Oil                    | 7            | 7                    | 10        | 0        | 12             | 0         | 0                       | 0        | 50       | 0        | 0        | 0        | 10        |

TABLE C19:

What is the main activity of your business?

|                                            | OVERALL<br>% | FULL-TIME<br>WORKERS |           |          | OWN OR<br>RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|--------------------------------------------|--------------|----------------------|-----------|----------|----------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                                            |              | >5                   | 5-19      | 20+      | O              | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b>                     | <b>30</b>    | <b>15</b>            | <b>10</b> | <b>5</b> | <b>17</b>      | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| Other                                      | 23           | 20                   | 30        | 20       | 29             | 17        | 0                       | 0        | 0        | 0        | 0        | 0        | 70        |
| Automotive/Car repairs/dealership          | 17           | 13                   | 10        | 40       | 12             | 17        | 0                       | 0        | 0        | 0        | 0        | 100      | 0         |
| Manufacturing                              | 13           | 13                   | 20        | 0        | 6              | 25        | 0                       | 0        | 0        | 0        | 100      | 0        | 0         |
| Lodging                                    | 13           | 20                   | 0         | 20       | 24             | 0         | 100                     | 0        | 0        | 0        | 0        | 0        | 0         |
| Retail                                     | 10           | 13                   | 10        | 0        | 12             | 8         | 0                       | 100      | 0        | 0        | 0        | 0        | 0         |
| Warehouse and storage                      | 7            | 0                    | 10        | 20       | 0              | 17        | 0                       | 0        | 0        | 100      | 0        | 0        | 0         |
| Service                                    | 7            | 7                    | 10        | 0        | 6              | 8         | 0                       | 0        | 100      | 0        | 0        | 0        | 0         |
| Office                                     | 3            | 7                    | 0         | 0        | 6              | 0         | 0                       | 0        | 0        | 0        | 0        | 0        | 10        |
| Food service (restaurant, bar, café, etc.) | 3            | 7                    | 0         | 0        | 0              | 8         | 0                       | 0        | 0        | 0        | 0        | 0        | 10        |
| Educational services                       | 3            | 0                    | 10        | 0        | 6              | 0         | 0                       | 0        | 0        | 0        | 0        | 0        | 10        |

TABLE C20:

Approximately how many full-time equivalent workers are employed with your company (at all locations as a total)?

|                        | OVERALL % | FULL-TIME WORKERS |           |          | OWN OR RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|------------------------|-----------|-------------------|-----------|----------|-------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                        |           | >5                | 5-19      | 20+      | O           | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b> | <b>30</b> | <b>15</b>         | <b>10</b> | <b>5</b> | <b>17</b>   | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| Fewer than 5           | 50        | 100               | 0         | 0        | 59          | 42        | 75                      | 67       | 50       | 0        | 50       | 40       | 50        |
| 5 to 9                 | 17        | 0                 | 50        | 0        | 12          | 25        | 0                       | 0        | 50       | 0        | 50       | 20       | 10        |
| 10 to 19               | 17        | 0                 | 50        | 0        | 24          | 8         | 0                       | 33       | 0        | 50       | 0        | 0        | 30        |
| 20 or more             | 17        | 0                 | 0         | 100      | 6           | 25        | 25                      | 0        | 0        | 50       | 0        | 40       | 10        |

TABLE C21:

Do you own or rent your business location(s)?

|                                                   | OVERALL % | FULL-TIME WORKERS |           |          | OWN OR RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|---------------------------------------------------|-----------|-------------------|-----------|----------|-------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                                                   |           | >5                | 5-19      | 20+      | O           | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b>                            | <b>30</b> | <b>15</b>         | <b>10</b> | <b>5</b> | <b>17</b>   | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| Own                                               | 57        | 67                | 60        | 20       | 100         | 0         | 100                     | 67       | 50       | 0        | 25       | 40       | 70        |
| Rent                                              | 40        | 33                | 40        | 60       | 0           | 100       | 0                       | 33       | 50       | 100      | 75       | 40       | 30        |
| Multiple locations – mix of ownership and renting | 3         | 0                 | 0         | 20       | 0           | 0         | 0                       | 0        | 0        | 0        | 0        | 20       | 0         |

TABLE C22:

How many locations does your business have in Nova Scotia?

|                        | OVERALL %  | FULL-TIME WORKERS |            |            | OWN OR RENT |            | BUSINESS' MAIN ACTIVITY |            |            |            |            |            |            |
|------------------------|------------|-------------------|------------|------------|-------------|------------|-------------------------|------------|------------|------------|------------|------------|------------|
|                        |            | >5                | 5-19       | 20+        | O           | R          | L                       | R          | S          | W          | M          | A          | O          |
| <b>SAMPLE SIZE (#)</b> | <b>30</b>  | <b>15</b>         | <b>10</b>  | <b>5</b>   | <b>17</b>   | <b>12</b>  | <b>4</b>                | <b>3</b>   | <b>2</b>   | <b>2</b>   | <b>4</b>   | <b>5</b>   | <b>10</b>  |
| 1                      | 87         | 87                | 100        | 60         | 88          | 92         | 50                      | 100        | 100        | 100        | 100        | 80         | 90         |
| 2-10                   | 10         | 7                 | 0          | 40         | 6           | 8          | 25                      | 0          | 0          | 0          | 0          | 20         | 10         |
| Refused                | 3          | 7                 | 0          | 0          | 6           | 0          | 25                      | 0          | 0          | 0          | 0          | 0          | 0          |
| <b>MEAN</b>            | <b>1.3</b> | <b>1.1</b>        | <b>1.0</b> | <b>2.2</b> | <b>1.1</b>  | <b>1.3</b> | <b>1.7</b>              | <b>1.0</b> | <b>1.0</b> | <b>1.0</b> | <b>1.0</b> | <b>1.6</b> | <b>1.3</b> |

**TABLE V1C:**

**Please indicate your business' annual electrical energy consumption. Please choose from the from the following options:**

|                                                                                         | OVERALL<br>% | FULL-TIME<br>WORKERS |           |          | OWN OR<br>RENT |           | BUSINESS' MAIN ACTIVITY |          |          |          |          |          |           |
|-----------------------------------------------------------------------------------------|--------------|----------------------|-----------|----------|----------------|-----------|-------------------------|----------|----------|----------|----------|----------|-----------|
|                                                                                         |              | >5                   | 5-19      | 20+      | O              | R         | L                       | R        | S        | W        | M        | A        | O         |
| <b>SAMPLE SIZE (#)</b>                                                                  | <b>30</b>    | <b>15</b>            | <b>10</b> | <b>5</b> | <b>17</b>      | <b>12</b> | <b>4</b>                | <b>3</b> | <b>2</b> | <b>2</b> | <b>4</b> | <b>5</b> | <b>10</b> |
| Less than 350,000 kWh annually (that is, approximately \$3600/month)                    | 80           | 80                   | 90        | 60       | 76             | 83        | 50                      | 67       | 100      | 50       | 100      | 80       | 90        |
| Over 600,000kWh (that is, approximately \$6000/month or less in electricity bill costs) | 20           | 20                   | 10        | 40       | 24             | 17        | 50                      | 33       | 0        | 50       | 0        | 20       | 10        |

## APPENDIX III

### SBES 2024 Tracking Sheet Audit

This appendix presents the main results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and properly filled out in the tracking sheet submitted by EfficiencyOne (E1)
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (gross and net energy and peak demand savings at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently.

Table 1 presents the corrected tracked savings resulting from all changes made by the Evaluator.

**Table 1: 2024 SBES Corrected Tracked Savings**

| Program Component Results                    | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|----------------------------------------------|---------------------|------|-------------------------|------|---------------------|
|                                              | Value               | Unit | Value                   | Unit | Value               |
| <b>SBES – Audit &amp; DIY</b>                |                     |      |                         |      |                     |
| Gross Energy Savings – at the Generator      | 12.790              | GWh  | 12.791                  | GWh  | 0.01%               |
| Gross Peak Demand Savings – at the Generator | 2.498               | MW   | 2.498                   | MW   | 0.00%               |
| Net Energy Savings – at the Generator        | 10.280              | GWh  | 10.281                  | GWh  | 0.01%               |
| Net Peak Demand Savings – at the Generator   | 2.011               | MW   | 2.011                   | MW   | 0.00%               |
| <b>Commercial Direct Install (CDI) Pilot</b> |                     |      |                         |      |                     |
| Gross Energy Savings – at the Generator      | 0.162               | GWh  | 0.145                   | GWh  | -10%                |
| Gross Peak Demand Savings – at the Generator | -                   | MW   | 0.023                   | MW   | -                   |
| Net Energy Savings – at the Generator        | 0.162               | GWh  | 0.145                   | GWh  | -10%                |
| Net Peak Demand Savings – at the Generator   | -                   | MW   | 0.023                   | MW   | -                   |
| <b>Total</b>                                 |                     |      |                         |      |                     |
| Gross Energy Savings – at the Generator      | 12.952              | GWh  | 12.936                  | GWh  | -0.12%              |
| Gross Peak Demand Savings – at the Generator | 2.498               | MW   | 2.521                   | MW   | 0.92%               |
| Net Energy Savings – at the Generator        | 10.442              | GWh  | 10.426                  | GWh  | -0.15%              |
| Net Peak Demand Savings – at the Generator   | 2.011               | MW   | 2.033                   | MW   | 1.09%               |

Given that the same net-to-gross ratios and line loss factors were used, SBES corrected tracked savings are very similar to those tracked by E1. Without the energy and peak demand unitary savings, it is difficult to calculate accurate corrected tracked values.

As for the CDI pilot, the difference between corrected tracked energy savings and tracked energy savings is due to interactive effects factors and adjustment ratios not taken into account in the calculation of tracked savings. There were also some errors in the tracked energy line loss factors. No peak demand savings at the generator were tracked in the tracking sheet.



## APPENDIX IV

### SBES 2024 Recommendations

The Evaluator made no specific recommendation as part of the 2024 evaluation of SBES.



PROJECT NO. 6562

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EfficiencyOne

# DEMAND RESPONSE PROGRAM

Final Report

2024 DSM EVALUATION

March 25, 2025



**ECONOLUX**

## ABBREVIATIONS

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|                 |                                           |
|-----------------|-------------------------------------------|
| <b>AMI</b>      | Advanced metering infrastructure          |
| <b>BNI</b>      | Business, non-profit, and institutional   |
| <b>DR</b>       | Demand Response (program)                 |
| <b>DSM</b>      | Demand-side management                    |
| <b>DSM MA</b>   | Demand-side Management Measure Assessment |
| <b>ENS</b>      | Efficiency Nova Scotia                    |
| <b>EUL</b>      | Effective useful life                     |
| <b>EVs</b>      | Electric vehicles                         |
| <b>M&amp;V</b>  | Measurement and verification              |
| <b>NS Power</b> | Nova Scotia Power                         |
| <b>NSUARB</b>   | Nova Scotia Utility and Review Board      |

## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life values.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Available Demand Response Capacity</b> | The capacity that is available to Nova Scotia Power (NS Power) to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure available demand response (DR) capacity. Available DR capacity is evaluated on a per-participant basis based on the average demand reduction observed for each event in which the participant was scheduled to participate. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established, providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                                                      |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or a load reduction in response to events called by the electric utility (NS Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.                                                                                                                                                                                                                                                                                             |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and that of the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                                                                 |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both electrical energy and peak demand savings. This value combines equipment life and                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|                                         |                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                         | measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                      |
| <b>Equipment life</b>                   | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                           |
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global warming potential is estimated over a timescale of 100 years.                                                                           |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual electrical energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net electrical energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                                    |
| <b>First-year savings</b>               | The first full year of electrical energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                                    |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an energy efficiency program regardless of why they participated.                                                                                                                                        |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                                 |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems (such as heating and cooling) in a building due to the installation of an energy efficiency measure.                                                                                                                                                                         |
| <b>In-service rate</b>                  | The proportion of incentivized products installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as light-emitting diode (LED) lamps.                                                |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.                        |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                                         |

|                                 |                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Line loss factor</b>         | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                                                             |
| <b>Margin of error</b>          | The amount of random sampling error.                                                                                                                                                                                                                                                                                                                        |
| <b>Market effects</b>           | The impact of a program on the market (in terms of product availability, practices, and prices) and that extends beyond changing program participant behaviours. Market effects include spillover among non-participants.                                                                                                                                   |
| <b>Net savings</b>              | Electrical energy or peak demand savings that can be reliably attributed to a program. These include effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                               |
| <b>Net-to-gross ratio</b>       | The ratio of net electrical energy savings to gross electrical energy savings.                                                                                                                                                                                                                                                                              |
| <b>Non-sampling error</b>       | Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                 |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                                |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when NS Power's 10-minute reserve is low.                                        |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                                           |
| <b>Random sampling error</b>    | An error in measurement due to the fact that measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                          |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                                          |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                                  |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                                          |
| <b>Spillover</b>                | Savings attributable to participants who implement additional energy efficiency measure(s) introduced by a program after participating in it once and without participating in the program a second time.                                                                                                                                                   |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, with the exception of the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Electrical energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                          |



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## EXECUTIVE SUMMARY

This report presents the 2024 demand-side management (DSM) results of the Demand Response (DR) program administered by EfficiencyOne (E1). This program is comprised of two components: Residential DR and Business, Non-profit, and Institutional (BNI) DR. Residential DR generated available DR capacity through the Eco Shift Pilot. BNI DR generated available DR capacity through the DR Aggregator pathway. Combined, these program components encourage homeowners and businesses to reduce their electric load during peak events called by Nova Scotia Power (NS Power) by providing financial incentives for the DR capacity made available for those events.

## Evaluation Approach

The 2024 evaluation was aimed at calculating program component results, namely new and total available DR capacity. Table 1 summarizes the types of evaluation conducted for each program component and the corresponding methodology.

**Table 1: Summary of Demand Response Program Evaluation**

| Program Component           | Evaluation Type |        |               | Methodology                                                                                                                                                                                                     |
|-----------------------------|-----------------|--------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | Process         | Market | Impact        |                                                                                                                                                                                                                 |
| Residential Demand Response |                 |        | Comprehensive | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Whole-house consumption data analysis</li><li>› Measure Assessment (MA) update</li><li>› Calculations using evaluation results</li></ul> |
| BNI Demand Response         |                 |        | Comprehensive | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Project reviews</li><li>› Calculations using evaluation results</li></ul>                                                                |

## Program Performance

Table 2 presents the participation levels and evaluated new and total available DR capacity for each program component and for the Demand Response program as a whole.

**Table 2: Overall 2024 Demand Response Participation and Evaluated Results**

|                       | Participation Level |              | Evaluated Results |      |
|-----------------------|---------------------|--------------|-------------------|------|
|                       | Value               | Unit         | Value             | Unit |
| <b>Residential DR</b> |                     |              |                   |      |
| New DR Capacity       | 353                 | Participants | 0.057             | MW   |
| Total DR Capacity     | 353                 | Participants | 0.057             | MW   |
| <b>BNI DR</b>         |                     |              |                   |      |
| New DR Capacity       | 70                  | Participants | 5.669             | MW   |
| Total DR Capacity     | 76                  | Participants | 8.034             | MW   |
| <b>Total</b>          |                     |              |                   |      |
| New DR Capacity       |                     |              | 5.726             | MW   |
| Total DR Capacity     |                     |              | 8.091             | MW   |





For 2024, Demand Response was aimed at achieving 7.240 MW in total available DR capacity at the generator. The program exceeded the planned total available DR capacity even though the Residential DR program component fell short of its target. The BNI DR program component was the largest contributor to total program available DR capacity.

The following subsections present evaluation results at the program component level.

## Residential DR Findings and Recommendations

This subsection presents the key findings and recommendations from the Residential DR evaluation.

**2024 Res DR-Finding:** In 2024, Residential DR new and total available DR capacities both amounted to 0.057 MW at the generator, thus not reaching the planned total available DR capacity of 0.210 MW.

**2024 Res DR-Finding:** Mysa thermostats were the most popular devices in Residential DR, representing 83% of all registered devices. Indeed, there were 353 participants in Residential DR, with a total of 1,307 enrolled devices composed of 1,082 Mysa thermostats, 175 Sinopé thermostats, and 50 electric vehicles (EVs) or EV chargers. Since participants continued to register throughout the season, the numbers presented above represent devices enrolled by the last event of the season. However, opted out participants and connectivity issues meant that not all enrolled devices participated in each event; of the enrolled Mysa thermostats, an average of 97% participated during the events.

**2024 Res DR-Finding:** The Evaluator decided to rely on whole-house consumption data to establish a regression model for the baseline, relying on a model that considers the time of week and outdoor temperature. Whole-house data were preferred to device-level data as they allow for the inclusion of interactive effects from equipment such as other heating systems not controlled by participating smart thermostats offsetting the reduced load associated with participating thermostats. As for the time of week method, it allows to differentiate the impact of outdoor temperature at each time of the week. The resulting 168 regression models provided sufficient accuracy. The Evaluator plans to continue using the same methodology to calculate unitary savings for thermostats in future years.

**2024 Res DR-Finding:** Preheating implementation issues prevented the program component from reaching its full potential during a few events, resulting in lower DR capacity than expected. Although the service provider intended to include 30 minutes of preheating for Events 6, 7, and 8, preheating was incorrectly implemented due to an issue being investigated and occurring during the events instead of before the events, thus resulting in negative available DR capacity for the first hour of those events. Assuming that preheat implementation errors will not occur again in future years, E1 can track available DR capacity during the next heating season using a unitary available DR capacity of 57.7 W per thermostat in comparison to the unitary available DR capacity value of 39.4 W per thermostat used in this evaluation.

**2024 Res DR Recommendation 1:** Gather and analyze the Eco Shift Pilot data again in 2025 to improve the unitary available DR capacity value accuracy and ensure it is consistent over multiple years.



## BNI DR Findings and Recommendations

This subsection presents the key findings and recommendations from the BNI DR evaluation.

**2024 BNI DR-Finding:** Total available DR capacity at the generator amounted to 8.034 MW that included 5.669 MW of new DR capacity. Therefore, BNI DR exceeded its target of 7.030 MW in total available DR capacity.

**2024 BNI DR-Finding:** Participation grew over 700% from nine participants last year to 76 participants this year. The available DR capacity per participant decreased from 263 kW in 2023 to 106 kW in 2024.

**2024 BNI DR-Finding:** Overall, the BNI DR available DR capacity calculation guidelines developed by E1 were appropriate and generally followed. The Evaluator project reviews resulted in only a small difference in available DR capacity compared to the value obtained by E1 after their project reviews. This is the result of the Evaluator mostly agreeing with the changes made by E1. Nonetheless, the Evaluator identified a few gaps in the BNI DR Baseline Considerations document to properly cover all the different adjustments encountered through the project reviews.

**2024 BNI DR Recommendation 1:** Update the BNI DR Baseline Considerations document to properly address all situations encountered through the project reviews.

- › Clearly define how to identify building operating hours and when to set the available DR capacity to zero.
- › Ensure that lookback windows are moved consistently across all similar events unless they are moved due to an abnormal load.
- › Clearly state in the document that certain events may be excluded on a per-participant basis due to missing AMI metering data because of technical issues or events not being called for participants identified as morning-only or evening-only participants.

**2024 BNI DR-Finding:** The evaluation revealed that reviewing and adjusting the results for a stratified sample of projects (20 projects with the largest available DR capacity and 10 randomly selected projects among the others) allowed the Evaluator to establish reliable evaluated available DR capacity. Indeed, the Evaluator project reviews resulted in an adjustment ratio of 0.93 with margin of error below 10%. The Evaluator also noted that, in future, sampling should be made after negative values are set to zero.

**2024 BNI DR Recommendation 2:** In the next evaluation, continue to use project reviews to establish tracked and evaluated available DR capacities.

**2024 BNI DR-Finding:** The evaluated new and total available DR capacities were 1% and less than 1% lower than the values tracked by E1 respectively. The differences are due to the adjustments made through the project reviews.

## Program Tracked and Evaluated Savings

Table 3 below presents a comparison of E1 tracked available DR capacity compared to evaluated results as well as the realization rate.

**Table 3: Comparison of 2024 Tracked and Evaluated Savings at the Generator**

|                |                                                  | Available DR Capacity |      | Realization Rate |
|----------------|--------------------------------------------------|-----------------------|------|------------------|
|                |                                                  | Value                 | Unit |                  |
| Residential DR | New Available DR Capacity                        |                       |      |                  |
|                | Tracked Available DR Capacity by E1 <sup>1</sup> | -                     | MW   | -                |
|                | Evaluation Results                               | 0.057                 | MW   |                  |
|                | Total Available DR Capacity                      |                       |      |                  |
|                | Tracked Available DR Capacity by E1 <sup>1</sup> | -                     | MW   | -                |
|                | Evaluation Results                               | 0.057                 | MW   |                  |
| BNI DR         | New Available DR Capacity                        |                       |      |                  |
|                | Tracked Available DR Capacity by E1              | 5.702                 | MW   | 99%              |
|                | Evaluation Results                               | 5.669                 | MW   |                  |
|                | Total Available DR Capacity                      |                       |      |                  |
|                | Tracked Available DR Capacity by E1              | 8.067                 | MW   | 100%             |
|                | Evaluation Results                               | 8.034                 | MW   |                  |

<sup>1</sup> For Residential DR, tracked results were not fully compiled since multiple methodologies on how to establish the available DR capacity of the measures included in 2024 were being considered. The Evaluator decided on the final methodology to be used as part of the current evaluation.

# INTRODUCTION

EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight of its DSM activities is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electricity DSM activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs, three business, non-profit, and institutional (BNI) programs, and one demand response (DR) program that are marketed to Nova Scotians through the ENS franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2024 DSM program portfolio.

This evaluation report relates to the DR program comprised of the Residential DR and BNI DR program components. Residential DR generated available DR capacity through the Eco Shift Pilot. BNI DR generated available DR capacity through the DR Aggregator pathway.

Table 4 lists the DR program components and the types of evaluations conducted in 2024.

**Table 4: Types of Evaluations Conducted for Each Program Component, 2024**

| Program         | Program Component           | Pathway         | 2024    |        |               |
|-----------------|-----------------------------|-----------------|---------|--------|---------------|
|                 |                             |                 | Process | Market | Impact        |
| Demand Response | Residential Demand Response | Eco Shift Pilot |         |        | Comprehensive |
|                 | BNI Demand Response         | DR Aggregator   |         |        | Comprehensive |

For the DR program, the Evaluator prepared this DSM evaluation report presenting key findings as well as the savings generated through DR initiatives, which are presented in terms of new and total available DR capacities. New DR capacity differs from total available DR capacity; the former corresponds to added DR capacity compared to the previous year while the latter corresponds to the total DR capacity that was still available during the evaluated period.

Available DR capacity differs from peak demand savings reported in other DSM evaluation reports since the former considers the potential load reduction that was made available instead of the actual load reduction that coincided with the actual utility peak period. This distinction was made since E1 does not control the calling of events and thus does not control how the resources made available to NS Power are used to reduce peak demand.

Available DR capacity is evaluated based on events called from December to February excluding weekends and holidays. Events called at any time during the day (morning or evening) are included. Available DR capacity is measured over the first two hours of a DR event and is evaluated on a per-participant basis based on the average demand reduction observed for each event in which the participant took part regardless of whether events are in the morning or evening. E1's total available DR capacity is the sum of each participant's available DR capacity. In addition, reported available DR capacity corresponds to events that occurred during the winter and that ended during the evaluated year, e.g. the 2024 available DR capacity corresponds to the DR capacity made available between December 2023 and February 2024 inclusively.

# 1 Residential DR Overview

This section describes the Residential DR program component, follows up on past evaluation recommendations, and provides an overview of Residential DR participation history.

## 1.1 Residential DR Description

In 2023, E1 officially launched the Residential DR program component. Since the fall of 2020, E1 has implemented several pilot initiatives focused on reducing demand during the Nova Scotia peak period. The Eco Shift Pilot launched in the fall of 2023, which is considered a pathway in the Residential DR program component for the purpose of this evaluation. The Eco Shift Pilot is the only Residential DR pathway that was evaluated in 2024.

The Eco Shift Pilot is a residential “bring your own device” program that provides NS Power with available DR capacity through three eligible device types: 1) Smart thermostats for electrically heated homes; 2) electric vehicles (EVs) and EV chargers; and 3) behind-the-meter batteries. Virtual Peaker is the technical partner providing the software that serves to control participating devices. When NS Power calls DR events, participating devices are remotely controlled by Virtual Peaker to reduce their loads. For example, smart thermostat setpoints are reduced and EV chargers stop charging if the EV battery is above 50% of its capacity. CLEAResult is the service provider that manages the Eco Shift Pilot, notably by managing enrollment, coordinating incentive payments, and acting as a go-between for E1 and Virtual Peaker. Participants were notified at 4 p.m. the day before an event, 15 minutes before the event, and once the event ended. Participants may opt out of any event. Events can last from two to four hours and be called any time between 7 a.m. and 11 a.m. or between 5 p.m. and 9 p.m. on non-holiday weekdays, and events cannot be called more than once per day. As presented in Table 5, NS Power called 10 events during the 2023-2024 winter peak season.

**Table 5: Eco Shift Pilot 2023-2024 Event Summary**

| Event # | Date       | Start Time | Duration (Hours) | Outdoor Temperature at Event Start (°C) |
|---------|------------|------------|------------------|-----------------------------------------|
| 1       | 01-09-2024 | 6 p.m.     | 2                | -5                                      |
| 2       | 01-16-2024 | 8 a.m.     | 2                | -4                                      |
| 3       | 01-19-2024 | 5 p.m.     | 3                | -5                                      |
| 4       | 01-24-2024 | 7 a.m.     | 4                | -13                                     |
| 5       | 01-31-2024 | 7 a.m.     | 3                | -10                                     |
| 6       | 02-07-2024 | 5 p.m.     | 4                | -3                                      |
| 7       | 02-08-2024 | 7 a.m.     | 2                | -6                                      |
| 8       | 02-16-2024 | 7 a.m.     | 4                | -11                                     |
| 9       | 02-21-2024 | 7 a.m.     | 3                | -15                                     |
| 10      | 02-27-2024 | 7 a.m.     | 2                | -1                                      |

For Residential DR, an enrolled device corresponds to a device that was ready to be controlled during an event, yet was not necessarily controlled, i.e., a thermostat that did not have its setpoint reduced. A participating device corresponds to a device that was controlled during an event.

A target of 0.210 MW was set for Residential DR total available DR capacity at the generator in 2024. While new and total available DR capacities are two metrics that are reported separately, this report does not differentiate between them as they are the same during the first year of the pathway. This is due to the fact that new available DR capacity is obtained by subtracting the previous year's total available DR capacity from the evaluation year's total available DR capacity.

## 1.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated Residential DR in 2023 and issued one improvement recommendation. Table 6 below provides a summary of the implementation status of the recommendation presented in the Executive Summary section of the 2023 report.

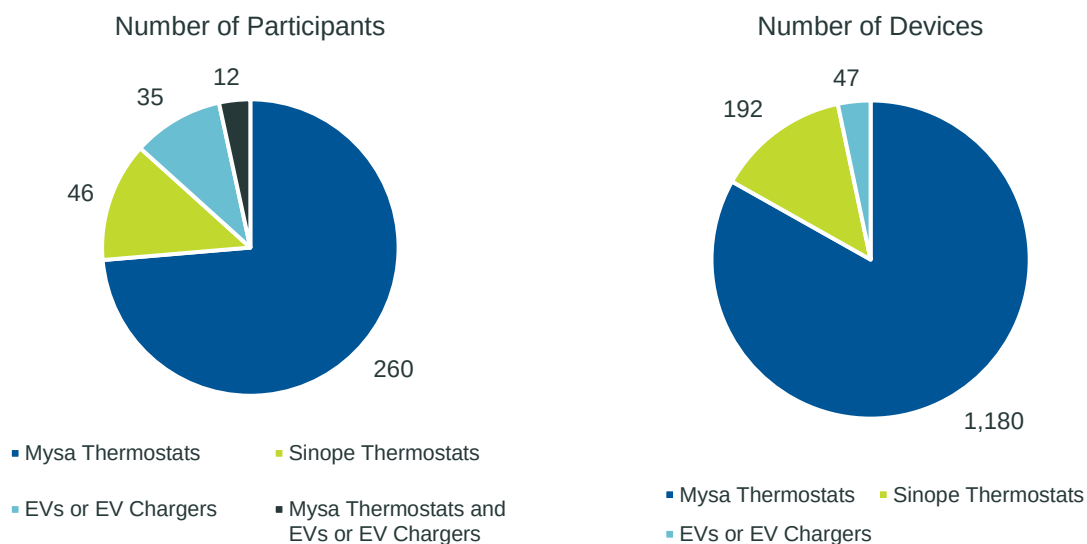
**Table 6: Implementation Status of Past Recommendation for Res DR**

| #                 | Recommendation                                                                                                                    | Status | Comments                                                                                                 |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------------------|
| 2023 –Res DR – R1 | Ensure that available DR capacity tracked by E1 includes the in-service rate as well as the unitary available DR capacity values. | N/A    | This recommendation is applicable to the DHW Direct Load Control pathway that was not evaluated in 2024. |

## 1.3 Participation History

In 2024, there were 353 participants in Residential DR, with a total of 1,307 enrolled devices.<sup>2</sup> As presented in Figure 1 below, Mysa thermostats represented the largest proportion of installed devices (83%).

**Figure 1: Overview of Residential DR Participation, 2024**



Since participants continued to enroll throughout the season and they could opt out of any event, not all enrolled devices participated in each event. Table 7 below presents the number of devices enrolled in each event. Moreover, connectivity issues meant that not all enrolled participants actually participated in each event; the number of devices that participated is discussed in Subsection 3.2.1 below.

<sup>2</sup> The number of devices used herein is the number of enrolled devices at the time of the last event of the season, as presented in Table 7.

**Table 7: Eco Shift Pilot Device Enrollment per 2023-2024 Event**

| Event # | Date       | Devices Enrolled per Event    |                  |                    |       |
|---------|------------|-------------------------------|------------------|--------------------|-------|
|         |            | Connected EVs and EV Chargers | Mysa Thermostats | Sinopé Thermostats | Total |
| 1       | 01-09-2024 | 17                            | 934              | 140                | 1,091 |
| 2       | 01-16-2024 | 36                            | 947              | 141                | 1,124 |
| 3       | 01-19-2024 | 34                            | 951              | 144                | 1,129 |
| 4       | 01-24-2024 | 35                            | 983              | 145                | 1,163 |
| 5       | 01-31-2024 | 39                            | 1,035            | 170                | 1,244 |
| 6       | 02-07-2024 | 49                            | 1,055            | 170                | 1,274 |
| 7       | 02-08-2024 | 49                            | 1,055            | 170                | 1,274 |
| 8       | 02-16-2024 | 50                            | 1,076            | 171                | 1,297 |
| 9       | 02-21-2024 | 50                            | 1,075            | 171                | 1,296 |
| 10      | 02-27-2024 | 50                            | 1,082            | 175                | 1,307 |

## 2 Residential DR Evaluation Approach

The 2024 Residential DR evaluation comprised a comprehensive impact evaluation. The main objective of the 2024 Residential DR evaluation was as follows:

- › Calculate Residential DR results, namely new and total available DR capacities

The Evaluator identified key research questions aimed at achieving this objective. Table 8 outlines the Residential DR evaluation objectives and maps them to the research questions and methods established by the Evaluator. Each method is described further below.

**Table 8: 2024 Residential DR Evaluation Approach**

| Evaluation Objectives                   | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Methodology                                                                                                                                             |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Calculate available DR capacity results | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› What was the average peak demand reduction achieved by all participants during each peak demand event?</li><li>› What is the unitary available DR capacity value that should be used for Mysa smart thermostats?</li><li>› Did participants' systems respond to all peak demand events?</li><li>› What is the persistence (effective useful life or EUL) of available DR capacity achieved by the pilot?</li><li>› What are the new and total available DR capacities achieved by the pilot?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Metering data analysis</li><li>› Calculations using evaluation results</li></ul> |

### Tracking Sheet Audit

Prior to performing the available DR capacity calculation review, the Evaluator audited the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. It should be noted that, for Residential DR, E1 did not track results since the Evaluator established the final methodology to be used as part of the current evaluation. Therefore, the tracking sheet audit served to ensure that E1 provided all information needed to establish the savings and that the information was complete and accurate instead of serving to validate tracked results. The results obtained are presented in Appendix I.

### Metering Data Analysis

To establish the available DR capacity generated from Mysa thermostats, the Evaluator analyzed the available participant whole-house consumption meter data and established a unitary available DR capacity value per participant, which was then converted to a unitary available DR capacity per thermostat and multiplied by the number of enrolled thermostats. Whole-house data were preferred to device-level data since they included interactive effects. The detailed methodology and results obtained are presented in Subsection 3.2.2. The 2024-2025 Demand-side Management Measure Assessment<sup>3</sup> (DSM MA) was updated accordingly.

<sup>3</sup> The 2024-2025 DSM MA is a reference document that provides an in-depth review of all necessary parameters to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through E1's DSM program portfolio. In addition, the Measure Assessment includes effective useful life values for all measures offered in E1's program portfolio. For the evaluations conducted during the last two years of the 2023-2025 DSM cycle, the Evaluator refers to the values presented in the 2024-2025 DSM MA.





The Evaluator did not assess the available DR capacity for other products included in the Eco Shift Pilot pathway as the number of participants for EV products and batteries were not sufficient to obtain reliable results and the data for Sinopé thermostats were incomplete. For 2024, the Mysa thermostat unitary available DR capacity can be used for Sinopé thermostats since the control strategy was similar and Sinopé setbacks were greater than Mysa setbacks when averaged over all events. It should be noted that, although there were enrolled EVs in 2024, the Evaluator was unable to establish a unitary available DR capacity due to low participation. Indeed, not all enrolled EVs are connected and charging when events are called. Therefore, no available DR capacity was claimed for EVs and batteries in the 2024 evaluation.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the new and total amount of available DR capacity as per the calculation methodology presented in Section 3 below.

### Note on Margins of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator typically aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>4</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.

As part of the Residential DR evaluation, the Evaluator calculated the margins of error for the unitary and per-event available DR capacities. Although the entire population of Mysa thermostats was included in the analysis, this was considered a sample since the unitary savings are intended to be used for future program years. The margins of error are listed alongside results in the applicable sections herein. Considering the relatively small number of participants used for Residential DR analyses and the complexity of estimating hourly load profiles due to the variability around consumption patterns, higher margins of error were considered acceptable; the Evaluator ensured that the results were statistically significant. Examples of calculations used to establish margins of error are provided in Appendix II of the 2024 DSM Programs Evaluation Executive Summary document.

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<sup>4</sup> Precision refers to how reproducible a set of measurements is. Moreover, it does not consider how close the measured values are to the true values; this would refer to accuracy.



## 3 Residential DR Impact Evaluation

The objective of the 2024 Residential DR impact evaluation was to determine new and total available DR capacities.

### 3.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. It should be noted that, for Residential DR, E1 did not track results since the Evaluator established the final methodology to be used as part of the current evaluation. Therefore, the tracking sheet audit served to ensure that E1 provided all information needed to establish the savings and that the information was complete and accurate instead of serving to validate tracked results. The verification and corrective actions taken by the Evaluator, where applicable, are described in Appendix I.

### 3.2 Demand Response Capacity

For Residential DR, the metric is the available DR capacity that corresponds to the load reduction made available for peak demand events in participant homes. For the Eco Shift Pilot pathway, the Evaluator established a unitary available DR capacity value that was multiplied by the number of participating thermostats to obtain the evaluated available DR capacity. While new and total available DR capacities are two metrics reported separately, no distinction is made between them throughout this report as they are the same during the first year of the pathway. It should be noted that, although there enrolled EVs in 2024, the Evaluator was unable to establish a unitary available DR capacity due to low participation.

#### 3.2.1 In-service Rates

For the Eco Shift Pilot pathway, not all devices participated in each event since participants continued to be registered throughout the season and participants could opt out of any event. Additionally, connectivity issues meant that not all enrolled devices actually participated in each event. Since participants were not removed from the whole-house data analysis if they opted out of an event or had connectivity issues, the in-service rate is directly included in the unitary available DR capacity. Indeed, not removing those participants reduced the average available DR capacity, and this would also have been the case if an in-service rate and a unitary savings that does not encompass an in-service rate had been used. An in-service rate would have been needed if device-level data had been used.

The number of participating devices and the resulting in-service rate are presented in Table 9 below for information purposes.

**Table 9: Eco Shift Pilot Mysa Thermostat In-service Rate per 2023-2024 Event**

| Event # | Date       | Devices Enrolled per Event |                                 |                 |
|---------|------------|----------------------------|---------------------------------|-----------------|
|         |            | Number of Enrolled Devices | Number of Participating Devices | In-service Rate |
| 1       | 01-09-2024 | 934                        | 919                             | 98%             |
| 2       | 01-16-2024 | 947                        | 928                             | 98%             |
| 3       | 01-19-2024 | 951                        | 940                             | 99%             |
| 4       | 01-24-2024 | 983                        | 952                             | 97%             |
| 5       | 01-31-2024 | 1,035                      | 996                             | 96%             |
| 6       | 02-07-2024 | 1,055                      | 1,025                           | 97%             |
| 7       | 02-08-2024 | 1,055                      | 1,020                           | 97%             |
| 8       | 02-16-2024 | 1,076                      | 1,036                           | 96%             |
| 9       | 02-21-2024 | 1,075                      | 1,028                           | 96%             |
| 10      | 02-27-2024 | 1,082                      | 1,061                           | 98%             |
| Average |            | 1,019                      | 991                             | 97%             |

### 3.2.2 Unitary Available DR Capacity

For the Eco Shift Pilot pathway, the available DR capacity was only quantified for Mysa thermostats in the 2024 evaluation. The Evaluator relied on a unitary available DR capacity value, more precisely the average available DR capacity per thermostat. To establish this unitary available DR capacity value, the Evaluator developed a model that predicts the expected average hourly load per participant and then compared the expected and actual hourly loads during events.



## Metering Data Analysis Methodology

After reviewing existing literature to identify the most appropriate baseline methodology for the 2024 evaluation, the Evaluator decided to rely on whole-house consumption data to establish a regression model for the baseline, relying on a model that considers the time of week and outdoor temperature. Whole-house data were preferred to device-level data as they allow for the inclusion of interactive effects such as other heating systems not controlled by participating smart thermostats offsetting the reduced load associated with participating thermostats. Regression models were preferred since they were the most common methodology for similar smart thermostat programs in the jurisdictions reviewed.<sup>5</sup> Moreover, regression models are based on a large dataset that includes datapoints for cold temperatures comparable to those of the events, while using a day-matching approach to establish a baseline may result in not using days that are as cold as the event days. As for the use of time of week, it allows to differentiate the impact of outdoor temperature at each time of the week, which is preferred since the setpoints are likely to be different at different hours of the day and days of the week.

The model used by the Evaluator consists of 168 regression models, i.e. one for each hour of the week. Each regression model establishes a correlation between the average participant hourly load at a given time of the week and the corresponding heating degree days.<sup>6</sup> To do so, all datapoints for a given time of week were grouped together to establish one of the 168 regressions. To obtain reliable results, the Evaluator excluded some participants because they had inconsistent loads, notably participants with EVs and participants that moved during the evaluation period. The Evaluator also excluded some data because of missing or incoherent datapoints. After cleaning the data from the initial 272 households with Mysa thermostats, 199 households were included in the analysis. More details on the methodology, including the data cleaning process and the margin of error calculation, are included in Appendix II. The resulting coefficients for each regression are presented in Appendix III.

## Metering Data Analysis Results

Using the methodology presented above, the Evaluator established the DR capacity made available at each event hour of the 2023-2024 heating season. As mentioned in the introduction, available DR capacity is measured over the first two hours of a DR event. Table 10 below therefore presents the results for the two first hours of each event of the 2023-2024 heating season.

As indicated in red text in Table 10 below, a few of the event hours had negative DR capacity, meaning that participants had a higher load during the event than the expected load in the absence of the event. It should be noted that the service provider intended to include 30 minutes of preheating for Events 6, 7, and 8 (cells highlighted in red in Table 10); however, preheating was incorrectly implemented due to an issue being investigated and occurred during the events instead of before the events, thus resulting in a load higher than the baseline and in negative available DR capacity for the first hour for those events.

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<sup>5</sup> CADMUS, prepared for CenterPoint Energy, *2023 Demand Response Impact Evaluation FINAL REPORT*, March 2024. Retrieved from: <https://midwest.centerpointenergy.com/assets/downloads/planning/irp/IRP-vectren-demand-response-evaluation.pdf> (last accessed 04-10-2024).

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CADMUS, prepared for Portland General Electric Company, *Direct Install Smart Thermostat Pilot Evaluation Report*, September 2021. Retrieved from: <https://edocs.puc.state.or.us/efdocs/HAD/um1708had165015.pdf> (last accessed 04-10-2024).

<sup>6</sup> Heating degree days were selected in lieu of outdoor temperature to better represent the heating load associated to each hour of the week.

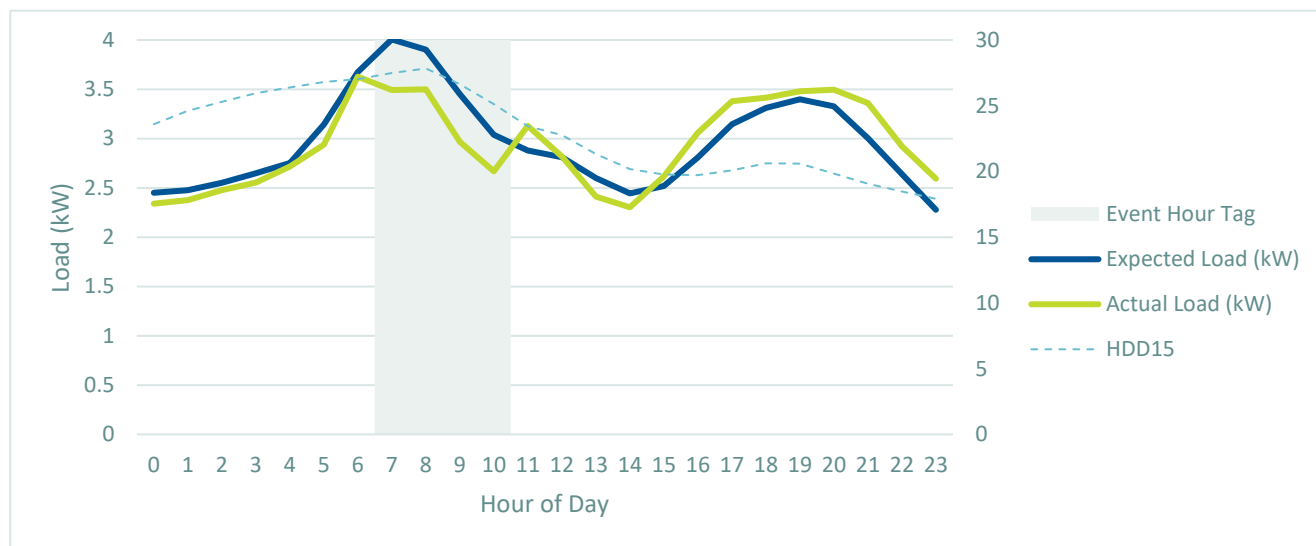
**Table 10: Available DR Capacity per Participant per Event**

| Event Number                                               | Event Date | Event Hour | Available DR Capacity (W) | Margin of Error (W) |
|------------------------------------------------------------|------------|------------|---------------------------|---------------------|
| 1                                                          | 01-09-2024 | 18         | 291                       | 202                 |
|                                                            |            | 19         | 373                       | 230                 |
| 2                                                          | 01-16-2024 | 8          | 76                        | 232                 |
|                                                            |            | 9          | -111                      | 237                 |
| 3                                                          | 01-19-2024 | 17         | 388                       | 203                 |
|                                                            |            | 18         | 428                       | 215                 |
| 4                                                          | 01-24-2024 | 7          | 514                       | 247                 |
|                                                            |            | 8          | 403                       | 255                 |
| 5                                                          | 01-31-2024 | 7          | 381                       | 222                 |
|                                                            |            | 8          | 127                       | 245                 |
| 6                                                          | 02-07-2024 | 17         | -458                      | 232                 |
|                                                            |            | 18         | 335                       | 214                 |
| 7                                                          | 02-08-2024 | 7          | -454                      | 250                 |
|                                                            |            | 8          | 559                       | 212                 |
| 8                                                          | 02-16-2024 | 7          | -580                      | 263                 |
|                                                            |            | 8          | 508                       | 234                 |
| 9                                                          | 02-21-2024 | 7          | 337                       | 274                 |
|                                                            |            | 8          | 193                       | 275                 |
| 10                                                         | 02-27-2024 | 7          | 120                       | 201                 |
|                                                            |            | 8          | 113                       | 228                 |
| Average available DR capacity for all events               |            |            | 177                       | 105                 |
| Average available DR capacity excluding Events 6, 7, and 8 |            |            | 259                       | 165                 |

While not all hours of all events resulted in statistically significant available DR capacity, the average available DR capacity observed across all events was statistically significant.

To visualize the impact of each event, the Evaluator created charts illustrating the expected and actual load for each event day. Figure 2 below illustrates Event 4, which lasted four hours, while the other charts are presented in Appendix IV. The blue line represents the expected load in the absence of an event while the green line represents the actual load during the event day. As there was no preheating for Event 4, the load reduction starts in the first event hour and continues throughout the event. A slight load increase can be observed after the event ends, which is expected when thermostat setpoints are returned to normal.

Figure 2: Event 4 Expected and Actual Loads



### Unitary Available DR Capacity

As outlined in Table 10 above, the average available DR capacity across all events was 177 W per household. The household data included in the metering analysis were used to establish an average of 4.5 thermostats per household. Using this average and the average available DR capacity per household, the Evaluator established a unitary available DR capacity of **39.4 W per thermostat**. The Evaluator used that value for the 2023-2024 period.

If E1 and the service provider are able to ensure that no preheating implementation error occurs in the future, the Evaluator expects the average available DR capacity to increase. **Therefore, the Evaluator recommends that Eco Shift Pilot data be gathered and analyzed again in 2025.**

With that in mind, the Evaluator established an expected unitary available DR capacity for informational purposes only. Using the average available DR capacity per household, excluding Events 6, 7, and 8 (highlighted in light red in Table 10 above), and the average number of thermostats per participant, the Evaluator established an expected unitary available DR capacity of 57.7 W per thermostat. This value represents the unitary available DR capacity that should be used for program tracking assuming preheating issues are resolved. This value was not used to obtain the 2023-2024 evaluated savings since it does not represent the savings achieved for all events for the evaluated year.

### 3.2.3 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency products has an impact on the energy consumption of other elements such as heating and cooling. For the Eco Shift Pilot pathway, all interactive effects from reducing smart thermostat setpoints are included in the evaluation analysis since it is based on whole-house metering data. The Evaluator preferred participant whole-house consumption data (advanced metering infrastructure [AMI]) to device-level data since the former allows for the inclusion of interactive effects from equipment such as other heating systems (e.g. heat pumps) not controlled by participating smart thermostats and offsetting the reduced load associated with participating thermostats.

### 3.2.4 Effective Useful Life

Although no electrical energy savings are expected from DR initiatives, the Evaluator established an EUL value since the available DR capacity can persist over time. For the Eco Shift Pilot pathway, an EUL value of one year should be used with total available DR capacity since participation includes all active participants, not only new participants; therefore, the available DR capacity of a participant will be counted each year and does not need to be extrapolated over its lifetime. With no data yet available on how long a participant might continue in the program, an EUL of one year should also be used for new DR capacity.

### 3.2.5 Evaluated New and Total Available DR Capacities

Available DR capacity is obtained by multiplying the number of controlled thermostats by the unitary available DR capacity value as presented in the equations below.

$$\text{Available DR Capacity} = \text{Number of Thermostats} \times \text{Unitary Available DR Capacity}$$

Table 11 below presents the new and total available DR capacities results for Residential DR in 2024. While new and total available DR capacities are two metrics reported separately, no distinction is made between both throughout this report as they are equal due to this being the first year of the pathway. In 2024, the new and total available DR capacities amounted to 0.057 MW at the generator.

The available DR capacity at the generator was estimated using the residential line loss factor. Line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>7</sup>

**Table 11: Evaluated 2024 Residential DR New and Total Available DR Capacities**

|                                                      | Results                  |
|------------------------------------------------------|--------------------------|
| <b>Number of Enrolled Thermostats</b>                | <b>1,257<sup>8</sup></b> |
| Unitary Available DR Capacity (Watts per thermostat) | 39.4                     |
| <b>Available DR Capacity – at the Meter (MW)</b>     | <b>0.050</b>             |
| Line Loss Factor                                     | 1.1466                   |
| <b>Available DR Capacity – at the Generator (MW)</b> | <b>0.057</b>             |

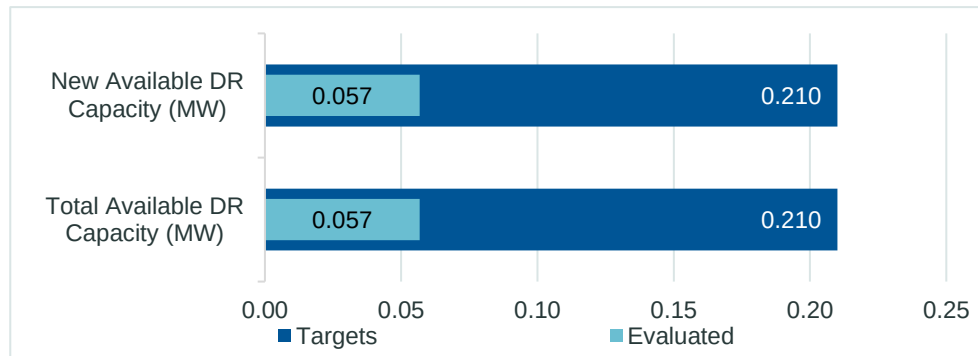
If preheat implementation errors had not occurred, Residential DR would have generated 0.083 MW in available DR capacity at the generator. This value was calculated by multiplying the unitary available DR capacity value obtained when excluding events 6, 7, and 8 by the number of units and the line loss factor.

<sup>7</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

<sup>8</sup> The number of units used herein is the number of Mysa and Sinopé thermostats enrolled at the time of the last event of the season, as presented in Table 7.

Figure 3 outlines the net evaluated and targeted available DR capacity.

**Figure 3: 2024 Residential DR Targets and Evaluated Available DR Capacity**







## 4 Residential DR Key Findings and Recommendations

As mentioned previously, the main objective of the 2024 Residential DR evaluation was as follows:

- › Calculate Residential DR results, namely new and total available DR capacities

This section provides the Evaluator's key findings in relation to this objective.

### **2024 Res DR-Finding: Residential DR did not achieve its total available DR capacity target.**

In 2024, Residential DR new and total available DR capacities both amounted to 0.057 MW at the generator, thus not reaching the planned total available DR capacity of 0.210 MW.

### **2024 Res DR-Finding: Mysa thermostats were the most popular devices in Residential DR, representing 83% of all registered devices.**

In 2024, there were 353 participants in Residential DR, with a total of 1,307 enrolled devices composed of 1,082 Mysa thermostats, 175 Sinopé thermostats, and 50 EVs or EV chargers. Since participants continued to register throughout the season, the numbers presented above represent devices enrolled by the last event of the season. However, opted out participants and connectivity issues meant that not all enrolled devices actually participated in each event; of the enrolled Mysa thermostats, an average of 97% participated during the events.

### **2024 Res DR-Finding: Residential DR available DR capacity was established using a regression model that considers the time of week and outdoor temperature and uses whole-house consumption data.**

The Evaluator decided to rely on whole-house consumption data to establish a regression model for the baseline, relying on a model that considers the time of week and outdoor temperature. Whole-house data were preferred to device-level data as the former allows for the inclusion of interactive effects from equipment such as other heating systems not controlled by participating smart thermostats offsetting the reduced load associated with participating thermostats. As for the time of week method, it allows to differentiate the impact of outdoor temperature at each time of the week. The resulting 168 regression models provided sufficient accuracy with margins of error under 3%. The Evaluator plans to continue using the same methodology to calculate unitary savings for thermostats in future years.

### **2024 Res DR-Finding: Preheating implementation issues prevented the program from reaching its full potential during a few events, resulting in lower DR capacity than expected.**

Although the service provider intended to include 30 minutes of preheating for Events 6, 7, and 8, preheating was incorrectly implemented and occurred during the events instead of before the events, thus resulting in negative available DR capacity for the first hour of those events.

If E1 and the service provider are able to refine the implementation process to avoid this issue, the Evaluator expects the average available DR capacity to increase. Assuming that preheat implementation errors will not occur again in future years, E1 can track available DR capacity during the next heating season using a unitary available DR capacity of 57.7 W per thermostat, which corresponds to the average available DR capacity when excluding events with a preheat implementation error. In comparison, a unitary available DR capacity value of 39.4 W per thermostat was used in this evaluation.

**2024 Res DR Recommendation 1: Gather and analyze the Eco Shift Pilot data again in 2025 to improve the unitary available DR capacity value accuracy and ensure it is consistent over multiple years.**

## 5 BNI DR Overview

This section describes the Business, Non-profit, and Institutional (BNI) Demand Response (DR) program component, follows up on past evaluation recommendations, and provides an overview of BNI DR participation history.

### 5.1 BNI DR Description

In 2023, E1 officially launched the BNI DR program component. Since the fall of 2020, E1 implemented several pilot initiatives focused on reducing demand during the Nova Scotia peak period. One of them was the DR Aggregator Pilot launched in the fall 2022, which is herein considered a pathway in the BNI DR program component.

Through the DR Aggregator pathway, E1 hires aggregators that subscribe groups of BNI customers that can reduce their load upon request. While some participants were recruited through a different aggregator, Parsons Inc. was the aggregator for the DR Aggregator Pilot for the period covered by this evaluation. When NS Power calls DR events, aggregators either remotely control some energy consuming systems in participant buildings or they contact participants to deploy their load reduction procedure that was developed with support from their aggregator. The actions taken to reduce loads typically include shutting down electricity consuming systems such as space heating or cooling (sometimes accompanied by pre-heating or pre-cooling), ventilation, water heating, or lighting. The event scheduling criteria are presented in Table 12.

**Table 12: DR Aggregator Event Criteria**

| Criteria                  | Requirement                                                                                                                                                                         |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Event Season              | Winter is from December through February.                                                                                                                                           |
| Event Windows             | From 7:00-11:00 am and 5:00-9:00 pm, Monday to Friday excluding holidays, during winter.                                                                                            |
| Event Initiation Criteria | Events are called based on NS Power's day ahead forecasting of times of high load, often corresponding with colder temperatures.                                                    |
| Number of Events          | Maximum of 12 events per season.                                                                                                                                                    |
| Event Durations           | Maximum event duration of 4 hours.<br>All events must be entirely contained within the event windows.                                                                               |
| Event Frequency           | No more than 1 event called per day per participant.<br>No more than 3 events called within any given week (Monday to Friday).<br>No more than 2 events called on consecutive days. |
| Event Notification        | NS Power provides notice to Parsons Inc. by 4:00 pm the day before an event is scheduled.                                                                                           |

As presented in Table 13 below, NS Power called 10 events during the 2023-24 winter peak season.

**Table 13: Summary of Event History**

| Month                                                                                                                                                                                                  | Number of Morning Events | Number of Evening Events | Total Number of Events | Average Length of Events (Hours) |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|------------------------|----------------------------------|
| December                                                                                                                                                                                               | 0                        | 0                        | 0                      | N/A                              |
| January                                                                                                                                                                                                | 3                        | 2                        | 5                      | 2.8                              |
| February                                                                                                                                                                                               | 4                        | 2                        | 5                      | 3                                |
| Total                                                                                                                                                                                                  | 7                        | 4                        | 10*                    | 2.9                              |
| * One event in February occurred during two time windows on the same day, one in the morning and one in the evening. Participants were contacted for only the morning or evening portion of the event. |                          |                          |                        |                                  |

BNI DR was aimed at achieving 7.030 MW in total available DR capacity at the generator in 2024.

Throughout this report, **enrolled** available DR capacity corresponds to the potential available DR capacity estimated by the aggregator when a participant is recruited, i.e. before participating in the program. **Tracked** available DR capacity corresponds to the available DR capacity established by E1 based on metering data, while **evaluated** available DR capacity corresponds to the available DR capacity established by the Evaluator.

## 5.2 Follow-up on Past Evaluation Report Recommendations

The Evaluator evaluated BNI DR for the first time during the 2022-2023 pilot season and issued improvement recommendations. Table 14 below provides a summary of the implementation status of each recommendation presented in the Executive Summary section of the 2023 report.

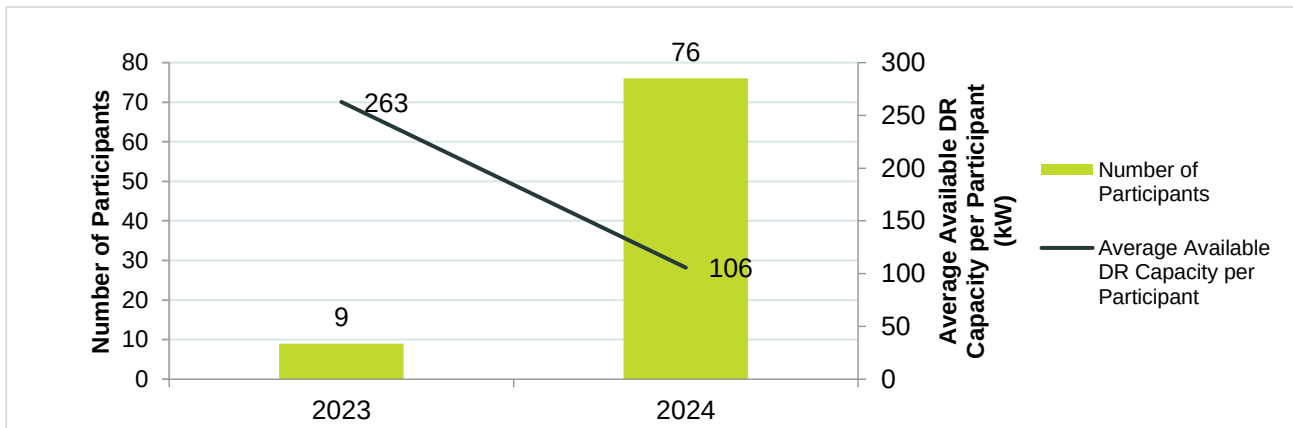
**Table 14: Implementation Status of Past Recommendation for BNI DR**

| #                  | Recommendation                                                                                                            | Status      | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------|---------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2023 – BNI DR – R1 | Use an additive same-day adjustment factor to establish the baseline load instead of a scalar same-day adjustment factor. | Complete    | E1 updated their methodology to use an additive adjustment factor. Scalar adjustments are only used in some instances of reviewed projects with weather driven loads.                                                                                                                                                                                                                                                                                                                                                                     |
| 2023 – BNI DR – R2 | Establish enrolled capacity based on test events when feasible.                                                           | In progress | E1 will establish enrolled capacity based on test events when feasible. Program staff will recommend test events for new participants. Returning participants who wish to add capacity will be reassessed and complete testing will be recommended. For participants who do not complete a test event, program staff will review the engineering calculations used to determine enrolled capacity to ensure they are realistic. A few test events occurred, but none were conducted to establish enrolled capacity for 2024 participants. |
| 2023 – BNI DR – R3 | Determine which participants are best suited for morning events only, evening events only, or morning and evening events. | In progress | E1 identified participants best suited for morning and/or evening events. Program staff developed morning and evening platoons prior to the end of the 2023/24 season and will continue this practice for the 2024/25 season. When two events will be called on the same day, the platoons will be used to call events based on each participant's potential, and enrolled capacity will be established based on the selected time of day. Events will be called for all participants when there will be only one event in a day.         |

### 5.3 Participation History

As presented in Figure 4 below, BNI DR had a total of 76 participating facilities in 2024, a 744% increase compared to the nine facilities from 2023. Each BNI DR participant has at least one NS Power meter enrolled in curtailment events, although some participants have multiple enrolled meters. In 2024, there were a total of 93 participating meters. Herein, a project refers to a meter. The available DR capacity per participant decreased from 263 kW in 2023 to 106 kW in 2024. Given last year was the first year of the pilot program, it is expected that the average DR capacity per participant decreased this year since efforts last year were only focused on a few large participants while many smaller participants were added this year.

**Figure 4: Overview of BNI DR 2024 Participation**



### Participation in Events

Based on the review of 30 projects, it was found that participants did not participate in events around 31% of the time. In conducting project reviews, participants with a lower available DR capacity were found to have participated in fewer events than those with a higher available DR capacity. Non-participation was considered to have been when there was no substantial decrease in demand for a participant during an event or if the event occurred outside of facility operational hours. When considering the participation rate of the reviewed projects and extrapolating this ratio to all projects, the average number of meters participating in an event was established at 64.

Also, in response to a recommendation made in the 2023 evaluation, projects were categorized as being best suited to participate in morning events or evening events. Of the 93 projects, 74 were considered to be best suited for morning participation, and 19 were considered to be best suited for evening participation. Using those categories, events were not called for all projects in two instances. For one morning event, only morning-suited projects were called to participate. For the other event where the categories were used, both a morning and evening event were called and projects participated in only one of them based on their category.

## 6 BNI DR Evaluation Approach

The 2024 BNI DR evaluation comprised a comprehensive impact evaluation. The main objective of the 2024 BNI DR evaluation was as follows:

- › Calculate BNI DR results, namely new and total available DR capacities

The Evaluator identified key research questions aimed at achieving this objective. Table 15 outlines the BNI DR evaluation objective and maps it to the research questions and methods established by the Evaluator. Each method is described further below.

**Table 15: 2024 BNI DR Evaluation Approach**

| Evaluation Objectives                                                 | Research Questions                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Methodology                                                                                                                                             |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Establish available DR capacity results for the DR Aggregator pathway | <ul style="list-style-type: none"><li>› Are the data in the tracking sheet complete, accurate, and consistent?</li><li>› Was the measurement and verification (M&amp;V) methodology applied consistent with the approach recommended by the Evaluator in the 2023 evaluation?</li><li>› Are the new M&amp;V rules dealing with inconsistencies in the sampled participant data appropriate?</li><li>› What are the new and total available DR capacities achieved by the pilot?</li></ul> | <ul style="list-style-type: none"><li>› Tracking sheet audit</li><li>› Project reviews (n=30)</li><li>› Calculations using evaluation results</li></ul> |

### Tracking Sheet Audit

Prior to performing the available DR capacity calculation review, the Evaluator audited the final 2024 tracking sheet to ensure it was complete and the entered data were consistent. The results obtained are presented in Appendix VI.

### Project Reviews with Meter Data Analysis

E1 staff sampled and reviewed a total of 30 projects to establish tracked available DR capacity. The sample was stratified so that the 20 projects generating the largest amount of tracked available DR capacity were all reviewed and then a second stratum of ten randomly selected projects among the smaller projects were also reviewed. This stratified approach minimizes the sampling margin of error on adjustment ratios since there is effectively no margin of error on the strata that includes large projects and represents 83% of all available DR capacity.

The Evaluator reviewed all 30 projects that were reviewed by E1 staff and validated all adjustments that were made beyond last year's M&V methodology to obtain revised baseline demand, same-day adjustments, and total demand response capacity. These project reviews served both to establish the evaluated available DR capacity based on the Evaluator review findings and to validate the appropriateness of the new M&V rules used by E1 to review BNI DR projects. The results obtained are presented in Subsection 3.2.1 below.

## Calculations Using Evaluation Results

Building on all the above methods and collected data, the Evaluator calculated the new and total amount of available DR capacities.

### Note on Margin of Error

For evaluation activities that yield quantitative results based on a sample, the Evaluator aimed to achieve a maximum margin of error of 10% at a confidence level of 90%. This means that, if measurements were conducted many times with different samples, the data would be within 10 percentage points above or below the percentage reported 90% of the time. Thus, the margin of error indicates the relative level of precision<sup>9</sup> of a measurement, while its associated confidence level indicates the probability of a measurement falling within the margin of error.<sup>10</sup>

For BNI DR, a margin of error was calculated for the adjustment ratio obtained from the project reviews as presented in Subsection 7.2.1 below.

---

<sup>9</sup> Precision refers to how reproducible a set of measurements is. However, it does not consider how close the measured values are to the true values; this would refer to accuracy.

<sup>10</sup> As part of this evaluation, the confidence levels and margins of error only take random sampling errors into account; they do not reflect non-sampling errors or biases such as data entry errors, inaccurate responses from respondents, or the inability to contact certain people.



## 7 BNI DR Impact Evaluation

The main objective of the 2024 BNI DR impact evaluation was to determine new and total available DR capacities. In addition, the Evaluator validated the correct application with the M&V methodology approach recommended by the Evaluator in the 2023 evaluation and assessed the appropriateness of the new M&V rules.

### 7.1 Tracking Sheet Audit

To ensure program component results were reliably compiled, the Evaluator first performed a tracking sheet audit aimed at verifying the completeness and consistency of the data submitted by E1. The verification and corrective actions taken by the Evaluator, where applicable, are described in Appendix VI. The tracked available DR capacity results presented in this report therefore refer to the corrected tracked available DR capacity obtained by the Evaluator.

### 7.2 Demand Response Capacity

For BNI DR, the evaluated metric is referred to as available DR capacity and corresponds to the load reduction made available for peak demand events in participating businesses.

#### 7.2.1 Project Reviews and Meter Data Analysis

For the Aggregator pathway, available DR capacity is established by comparing the predicted loads (baseline) to the actual loads during DR events using meter data. Baselines for DR events are established based on an average load during similar days prior to an actual event. More precisely, the baseline was the average load during the same hours of the event for the six days with the highest loads among the ten eligible days prior to an event (top six-of-ten), to which a same-day additive adjustment factor was applied. The eligible days correspond to non-holiday weekdays excluding event days and days preceding an event. The same-day additive adjustment factor is the difference between the average load of the selected baseline days for a two-hour window starting three hours before the event (e.g. the load between 2 pm and 4 pm for an event starting at 5 pm) and the load on the event day for the same hours. As recommended in the 2023 evaluation, E1 changed their M&V methodology to use an additive adjustment factor in place of a scalar one.

While the methodology presented in the previous paragraph is the foundation of how available DR capacity is obtained for the Aggregator pathway, E1 also reviewed the results for a stratified sample of 30 projects including the 20 projects with the most available DR capacity (stratum 1 using a census approach) and another 10 randomly selected projects (stratum 2). The adjustment ratio established for stratum 2 was extrapolated to the calculated available DR capacity of all smaller projects, including those that were not reviewed.

E1 reviews served to establish the tracked available DR capacity, thus the tracked available DR capacity differs from the values directly obtained from applying the Aggregator pathway calculation methodology. The E1 review process follows guidelines that were laid out in a document titled BNI DR Baseline Considerations, which is provided in Appendix VIII.





The Evaluator conducted project reviews to verify that the calculation approach and project review guidelines established in the previous evaluation and the BNI DR Baseline Consideration document were followed by E1 as well as to assess the appropriateness of the new rules set out in the BNI DR Baseline Consideration document. The projects reviewed by the Evaluator were the same as those reviewed by E1, i.e. the 20 largest projects from stratum 1 and the same sample of 10 random projects from stratum 2. The template used for project reviews is provided in Appendix IX.

## Project Review Findings

The most frequent adjustment made by E1 to the available DR capacity calculation was to set the available DR capacity to zero due to non-participation in events. If no obvious load shed was observable for an event with either positive or negative available DR capacity, the available DR capacity was set to zero. That was notably the case for all events with negative available DR capacity. Events that occur outside of a building's operational hours, as determined with the building load profile, were also considered to have been from non-participants and had available DR capacity set to zero. These adjustments were made consistently by E1 and were considered by the Evaluator as acceptable practices in determining available DR capacity, yet they are not explicitly stated in the BNI DR Baseline Consideration document. **The Evaluator recommends explicitly stating how and when to set available DR capacity to zero due to non-participation.** While the Evaluator agreed with all changes related to non-participation made by E1, the available DR capacity of three additional instances were set to zero by the Evaluator. The Evaluator also adjusted the available DR capacity for one event that occurred around the end of a facility's daily operational hours so that only the available DR capacity observable during the portion of the event that occurred within the facility operational hours was considered, thus setting to zero the available DR capacity for the portion of the event that occurred outside of operational hours.

The Evaluator noticed that, for some events, E1 excluded the event from the average available DR capacity calculation due to incorrect or missing metering data because of technical issues. Other events were also excluded by E1 since no event was called for some projects that were identified as morning-only or evening-only projects. E1 assigned projects to these groups in answer to a recommendation from the 2023 evaluation. **The Evaluator agrees with excluding events in these circumstances, but this is not explicitly stated in the BNI DR Baseline Consideration document and therefore should be added to it.**

Another common adjustment made by E1 was to move the lookback window used to determine same-day adjustment factors. Moving the lookback window is allowed as per BNI DR Baseline Considerations and is intended to account for any abnormalities that occur in event day consumption. This adjustment was appropriately applied by E1 in most cases, but the Evaluator corrected it for some events. For some buildings, the Evaluator noted that lookback windows were moved by E1 for some events with no abnormal load during the lookback windows because it visually improved the baseline estimate, yet such change was not made for other events from the same time of day. For example, the lookback window was moved to after the event for some 7 am events of a given project with a consistent load profile because using the operating load provided a better estimated baseline load, yet the change was not made for all 7 am events. The Evaluator considers it acceptable to move the lookback window for events, even if there is no abnormality in consumption, when the lookback window does not accurately capture a facility daily load, such as if the lookback window occurs prior to the facility opening for the day, although that change should be made consistently. **The Evaluator corrected this by ensuring lookback windows were consistently adjusted in these cases and recommends that this rule be added to the BNI DR Baseline Considerations for same time of day events unless the adjustment is due to abnormal consumption.**

Globally, the Evaluator found that E1 project reviews were appropriate and followed E1 guidelines.



## Available DR Capacity

In their compilation, E1 automatically set the available DR capacity to zero when an event resulted in negative available DR capacity. The Evaluator agreed with this compilation approach since all reviewed events that had negative available DR capacity were adjusted to zero by both E1 and the Evaluator in the project reviews. It is thus reasonable to assume that all non-reviewed projects with negative available DR capacity would be adjusted to zero if they were reviewed. Adjustment ratios were therefore calculated by comparing the calculated available DR capacity with negative values set to zero to the reviewed values.

It should be noted that the 20 largest projects to be reviewed were identified before the negative available DR capacity values were replaced by zero since E1's decision to set those values to zero resulted from the findings of project reviews. This resulted in two projects that should have been included in the 20 largest projects to not be selected for project reviews. **In the future, the sampling should be made after negative values are set to zero.**

Table 16 below presents the available DR capacity following the project reviews conducted by E1 and the Evaluator. As highlighted in Table 16, the Evaluator project reviews resulted in only small differences compared to E1 project reviews, with 1% less available DR capacity for stratum 1 projects and 1% more for stratum 2 projects.

**Table 16: Reviewed Available DR Capacity**

| Metric                                           | Stratum 1 Projects |                  |                | Stratum 2 Projects |                  |                |
|--------------------------------------------------|--------------------|------------------|----------------|--------------------|------------------|----------------|
|                                                  | E1 Values          | Evaluator Values | Difference (%) | E1 Values          | Evaluator Values | Difference (%) |
| Available DR Capacity Before Project Review (kW) | 6,167              | 6,167            | N/A            | 419                | 419              | N/A            |
| Adjustment Ratio                                 | 1.00               | 0.99             | N/A            | 0.72               | 0.73             | N/A            |
| Available DR Capacity After Project Review (kW)  | 6,157              | 6,124            | -1%            | 302                | 305              | 1%             |

Table 17 presents the adjustment ratios for each stratum as well as the overall adjustment ratio that was applied to all projects to determine evaluated available DR capacity.

**Table 17: Evaluated Adjustment Ratios**

| Stratum   | Adjustment Ratio | Margin of Error | Percentage of Total Available DR Capacity |
|-----------|------------------|-----------------|-------------------------------------------|
| Stratum 1 | 0.99             | 0%              | 81%                                       |
| Stratum 2 | 0.73             | 16%             | 19%                                       |
| Overall   | <b>0.93</b>      | <b>7%</b>       | <b>100%</b>                               |

Overall, the Evaluator project reviews resulted in an adjustment ratio of 0.93 with a margin of error of 7%.

Since it is only the second year of the Aggregator pathway, the Evaluator expects improved participation in events in future years, thus fewer events being adjusted to zero available DR capacity. Therefore, the Evaluator recommends conducting the same project reviews process again in future years. In a few years, E1 could consider reducing the frequency of this review process if the adjustment ratio is stable.

## 7.2.2 Interactive Effects

In a building, interactive effects occur when the implementation of energy efficiency products has an impact on the energy consumption of other elements such as heating and cooling. For the Aggregator pathway, interactive effects are included in the available DR capacity calculation since meter data encompass whole building consumption.

## 7.2.3 Effective Useful Life

Although no energy savings were expected under the Aggregator pathway, the Evaluator established an effective useful life (EUL) value to express for how many years available DR capacity might persist, i.e. as long as participants continue with the program. For the Aggregator pathway, an EUL value of one year should be used for total available DR capacity since participation includes all active participants, not only new participants; therefore, the available DR capacity of a participant is counted each year and does not need to be extrapolated over its lifetime. The average number of winters that participants subscribe to the pathway should be used as the EUL value with new available DR capacity. With no data yet available on how long a participant might continue in the program, an EUL of one year should also be used for new DR capacity.

## 7.2.4 Evaluated New and Total Available DR Capacities

Table 18 below presents the new and total available DR capacity results of BNI DR for 2024. For BNI DR, the new available DR capacity was defined as the increase in available DR capacity compared to the previous year. This includes changes in available DR capacity from previous participants and available DR capacity generated by new participants. As presented in Table 18, new and total available DR capacities respectively amounted to 5.669 MW and 8.034 MW at the generator.

The available DR capacity at the generator was estimated using the appropriate line loss factors for each participant based on the relevant rate code. The values presented in Table 18 are therefore weighted average line loss factors. The line loss factors correspond to the values submitted to the Nova Scotia Utility and Review Board (NSUARB) as part of the 2014 Cost of Service Study Progress Update.<sup>11</sup>

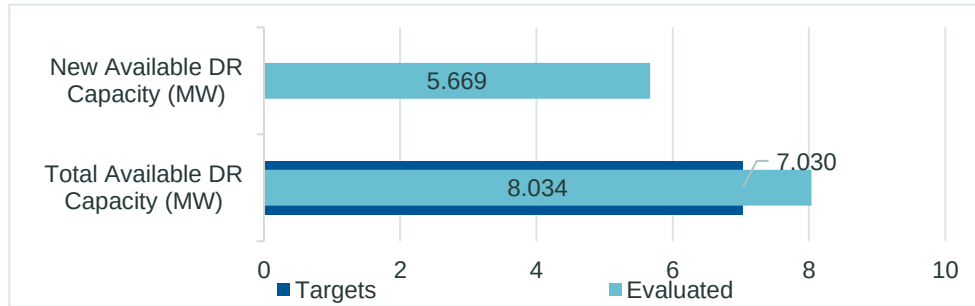
**Table 18: Evaluated 2024 BNI DR Available DR Capacity**

|                                                                                                                                                                    | Results                   |                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------------|
|                                                                                                                                                                    | New Available DR Capacity | Total Available DR Capacity |
| Number of Participants*                                                                                                                                            | 70                        | 76                          |
| Available DR Capacity Before Adjustment Ratio – at the Meter (MW)                                                                                                  | 5.775                     | 8.181                       |
| Adjustment Ratio                                                                                                                                                   | 0.93                      | 0.93                        |
| Available DR Capacity – at the Meter (MW)                                                                                                                          | <b>5.356</b>              | <b>7.587</b>                |
| Line Loss Factor                                                                                                                                                   | 1.0586                    | 1.0589                      |
| Available DR Capacity – at the Generator (MW)                                                                                                                      | <b>5.669</b>              | <b>8.034</b>                |
| * Only new participants were included herein, while the additional available DR capacity of continuing participants was included in the new available DR capacity. |                           |                             |

Figure 5 outlines the net evaluated and targeted available DR capacity.

<sup>11</sup> Nova Scotia Utility and Review Board, Matter M06555, 2014 Cost of Service Study Progress Update, Exhibit N-2.09, Appendix I1.

**Figure 5: 2024 BNI DR Targets and Evaluated Available DR Capacity**



## Comparison of Enrolled and Evaluated Available DR Capacity

Table 19 presents the difference between enrolled DR capacity and evaluated DR capacity.

**Table 19: Evaluated 2024 BNI DR Available DR Capacity**

| Metric                          | Stratum 1 Projects | Stratum 2 Projects | Overall |
|---------------------------------|--------------------|--------------------|---------|
| Enrolled DR Capacity (MW)       | 5.699              | 6.525              | 12.224  |
| Evaluated DR Capacity (MW)      | 6.124              | 1.463              | 7.587   |
| Percentage Achieved of Estimate | 107%               | 22%                | 62%     |

In a few years, available DR capacity is expected to be a reliable resource to reduce electric system loads during peak events; thus, it is important to establish proper estimates of expected available DR capacity (enrolled DR capacity).

As presented in Table 19 above, stratum 1 projects had higher available DR capacity than estimated, while stratum 2 projects had 78% lower available DR capacity than estimated. Overall, participants achieved 62% of estimated demand reductions. The largest reason for participants not achieving their enrolled available DR capacity was due to non-participation in events.

## 7.3 Program Realization Rate

Table 20 below compares the available DR capacity established through this evaluation to the value in the 2024 tracking sheet. The realization rates, representing the ratio of evaluated available DR capacity to tracked available DR capacity, were established at 99% and 100% for new and total available DR capacities respectively.

**Table 20: Comparison of 2024 BNI DR Tracked and Evaluated  
New and Total Available DR Capacities at the Generator**

|                                     | Available DR Capacity |      |      |
|-------------------------------------|-----------------------|------|------|
|                                     | Value                 | Unit |      |
| New Available DR Capacity           |                       |      |      |
| Available DR Capacity Tracked by E1 | 5.702                 | MW   | 99%  |
| Evaluation Results                  | 5.669                 | MW   |      |
| Total Available DR Capacity         |                       |      |      |
| Available DR Capacity Tracked by E1 | 8.067                 | MW   | 100% |
| Evaluation Results                  | 8.034                 | MW   |      |

Evaluated new and total available DR capacities were slightly lower than the values tracked by E1. The differences are due to the adjustments made during project reviews as discussed in Subsection 3.2.1 above.



## 8 BNI DR Key Findings and Recommendations

As mentioned previously, the main objective of the 2024 BNI DR evaluation was as follows:

- › Calculate BNI DR results, namely new and total available DR capacities

This section provides the Evaluator's key findings and recommendations in relation to this objective.

### **2024 BNI DR-Finding: BNI DR exceeded the available DR capacity target.**

Total available DR capacity at the generator amounted to 8.034 MW that included 5.669 MW of new DR capacity. Therefore, BNI DR exceeded its target of 7.030 MW in total available DR capacity.

### **2024 BNI DR-Finding: BNI DR participation substantially increased compared to last year, while average available DR capacity per participant decreased.**

Participation grew over 700% from nine participants last year to 76 participants this year. The available DR capacity per participant decreased from 263 kW in 2023 to 106 kW in 2024.

### **2024 BNI DR-Finding: Overall, the BNI DR available DR capacity calculation guidelines developed by E1 were appropriate and generally followed.**

The Evaluator project reviews resulted in only a small difference in available DR capacity compared to the value obtained by E1 after their project reviews. This is the result of the Evaluator mostly agreeing with the changes made by E1. Nonetheless, the Evaluator identified a few gaps in the BNI DR Baseline Considerations document to properly cover all the different adjustments encountered through the project reviews.

While the Evaluator agreed with setting the available DR capacity to zero for events with no obvious participation, including events with negative available DR capacity, events with no observable load reduction on the plotted daily load, or events happening outside building operating hours, the baseline adjustment guidelines do not clearly define how to identify building operating hours. Additionally, the guidelines should mention that, for events occurring partly during and outside of building operating hours, the available DR capacity for the portion of the time outside building operating hours should be set to zero.

In some cases, the methodology to calculate a same-day adjustment did not accurately adjust the expected load, such as when the lookback window captures an abnormal load or hours outside operating hours. In these circumstances, it is acceptable to move the adjustment window to a different time during the day. However, when this change is made for another reason than abnormal consumption level, such a change should be made consistently for all events of a given participant for which the circumstance applies.

### **2024 BNI DR Recommendation 1: Update the BNI DR Baseline Considerations document to properly address all situations encountered through the project reviews.**

- › Clearly define how to identify building operating hours and when to set the available DR capacity to zero.
- › Ensure that lookback windows are moved consistently across all similar events unless they are moved due to an abnormal load.
- › Clearly state in the document that certain events may be excluded on a per-participant basis due to missing AMI metering data because of technical issues or events not being called for participants identified as morning-only or evening-only participants.



**2024 BNI DR-Finding: E1's sampled project review allowed establishing a reliable adjustment ratio at the program level to obtain accurate tracked available DR capacity.**

The evaluation revealed that reviewing and adjusting the results for a stratified sample of projects (20 projects with the largest available DR capacity and 10 randomly selected projects among the others) allowed to establish reliable evaluated available DR capacity. Indeed, the Evaluator project reviews resulted in an adjustment ratio of 0.93 with margin of error below 10%. The Evaluator also noted that, in future, sampling should be made after negative values are set to zero.

**2024 BNI DR Recommendation 2: In the next evaluation, continue to use project reviews to establish tracked and evaluated available DR capacities.**

**2024 BNI DR-Finding: The evaluated available DR capacity determined by the Evaluator was slightly lower than the available DR capacity tracked by E1.**

The evaluated new and total available DR capacities were 1% and less than 1% lower than the values tracked by E1 respectively. The differences are due to the adjustments made through the project reviews.

## CONCLUSION

Table 21 presents the participation levels and evaluated new and total available DR capacity for each program component and for the Demand Response program as a whole.

**Table 21: Overall 2024 Demand Response Participation and Evaluated Results**

|                       | Participation Level |              | Evaluated Results |      |
|-----------------------|---------------------|--------------|-------------------|------|
|                       | Value               | Unit         | Value             | Unit |
| <b>Residential DR</b> |                     |              |                   |      |
| New DR Capacity       | 353                 | Participants | 0.057             | MW   |
| Total DR Capacity     | 353                 | Participants | 0.057             | MW   |
| <b>BNI DR</b>         |                     |              |                   |      |
| New DR Capacity       | 70                  | Participants | 5.669             | MW   |
| Total DR Capacity     | 76                  | Participants | 8.034             | MW   |
| <b>Total</b>          |                     |              |                   |      |
| New DR Capacity       |                     |              | 5.726             | MW   |
| Total DR Capacity     |                     |              | 8.091             | MW   |

Figure 6 and Figure 7 below respectively illustrate the new and total evaluated available DR capacity for each program component, Demand Response as a whole, as well as whether targets were achieved in 2024. The program exceeded the planned total available DR capacity even though Residential DR fell short of its target. BNI DR was the largest contributor to total program available DR capacity.

**Figure 6: 2024 Demand Response Evaluated New Available DR Capacity**

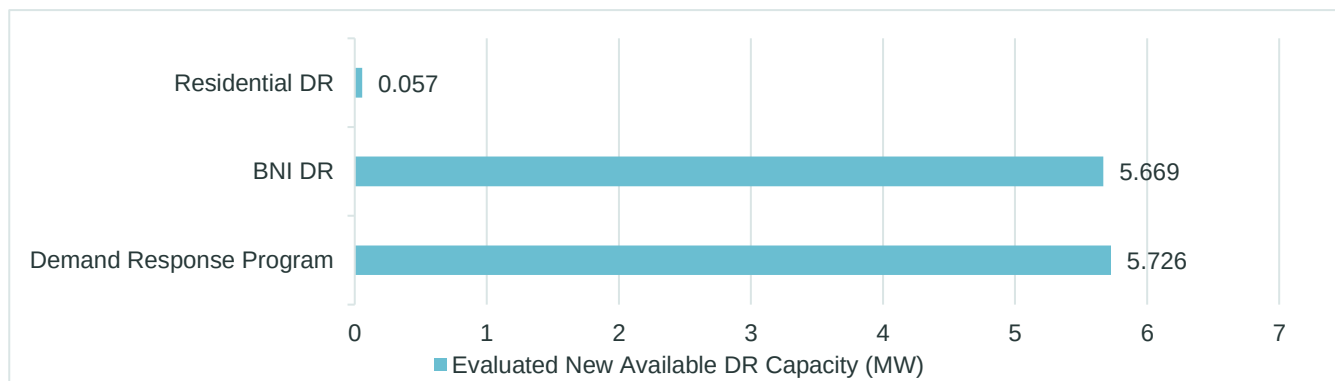
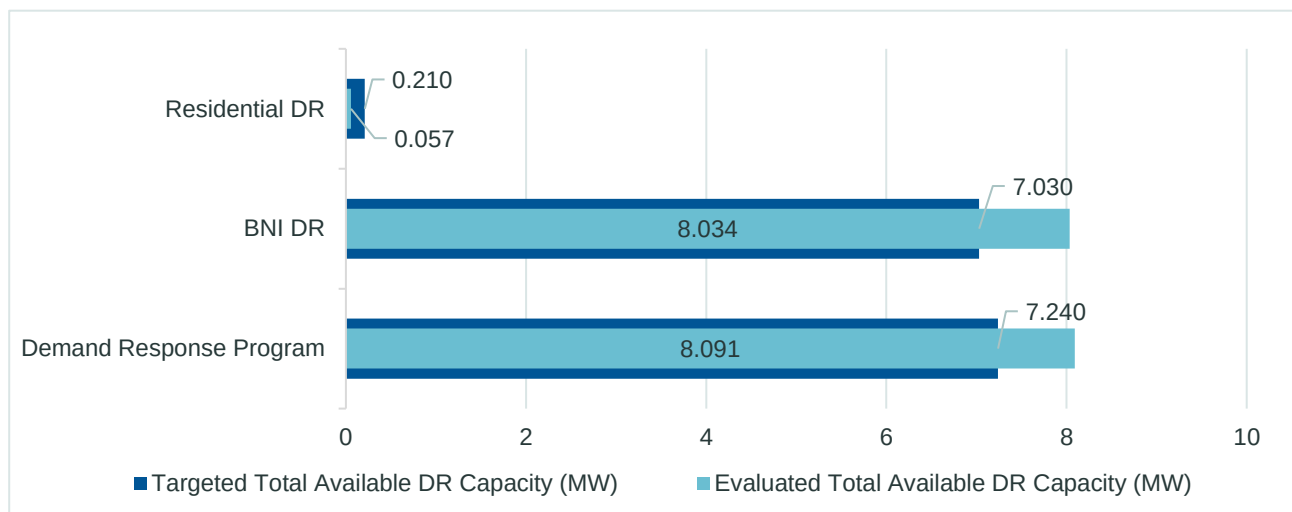


Figure 7: 2024 Demand Response Targeted and Evaluated Total Available DR Capacity







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Appendix II Residential DR: Detailed Metering Data Analysis Methodology

Appendix III Residential DR: Regression Coefficients

Appendix IV Residential DR: Event Day Graphs of Expected Vs Actual Loads

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Appendix VII BNI DR: Available DR Capacity Calculation Example

Appendix VIII BNI DR: Baseline Considerations

Appendix IX BNI DR: Project Review Protocol

Appendix X BNI DR: 2024 Recommendations



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EfficiencyOne

# DEMAND RESPONSE PROGRAM

Final Appendix Report

2024 DSM EVALUATION

March 25, 2025



**ECONOLUX**

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## APPENDIX I

### Residential DR: Tracking Sheet Audit

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This document presents the detailed results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by EfficiencyOne (E1)

For Residential DR, E1 did not track results (available DR capacity) since the Evaluator established the final methodology to be used as part of the current evaluation. Instead, E1 provided spreadsheets with participants' raw thermostat and whole-house consumption data, which were herein considered the tracking sheets. Instead of validating tracked results as done in typical tracking sheet audits, the Evaluator audited the tracking sheets to ensure that E1 provided all the information needed to establish savings and that the information was complete and accurate. After review, the spreadsheets provided by E1 were sufficient for the Evaluator to calculate Residential DR results.



## APPENDIX II

# Residential DR: Detailed Metering Data Analysis Methodology

This appendix summarizes the methodology used by the Evaluator to establish the available DR capacity as part of the 2024 evaluation of Residential DR.

For the Eco Shift Pilot pathway, available DR capacity was only quantified for Mysa thermostats in the 2024 evaluation. The Evaluator relied on a unitary available DR capacity value, more precisely the average available DR capacity per thermostat. To establish this available DR capacity value, the Evaluator developed a model that predicts the expected average hourly load per participant and then compared the expected and actual hourly loads during events. The average available DR capacity per household obtained from the previous step was then divided by the average number of thermostats per household to calculate a unitary available DR capacity. The average number of thermostats per household was obtained using the number of enrolled devices and number of participants specific to each event. The Evaluator used participant whole-house consumption data (advanced metering infrastructure [AMI]) to quantify the available DR capacity. Whole-house data were preferred to device-level data as they allow for the inclusion of interactive effects from equipment such as other heating systems not controlled by participating smart thermostats offsetting the reduced load associated with participating thermostats.

### Form of the Regression

After reviewing existing literature to identify the most appropriate baseline methodology for this evaluation, the Evaluator decided to use a regression model that considers the time of week and outdoor temperature to establish a baseline. Such models take into account the impact of outdoor temperature on electricity consumption, thus creating a predictive model that can be extrapolated using the known temperature at the time of events while also recognizing that electricity consumption in a household varies based on other factors. Since the population consists only of residential households, the influence of such factors is expected to be similar on the entire population at a given time of the week, hence the creation of the time of week and temperature model. Regression models were preferred since they are the most common methodology for similar smart thermostat programs in the jurisdictions reviewed.<sup>1</sup> Moreover, regression models are based on a large dataset that includes datapoints for cold temperatures comparable to those of the events, while using previous similar days to establish a baseline may result in not using days that are as cold as the event days. As for the use of time of week, it allows to differentiate the impact of outdoor temperature at each time of the week, which is preferred since the setpoints are likely to be different at different hours of the day and days of the week.

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<sup>1</sup> CADMUS, prepared for CenterPoint Energy, *2023 Demand Response Impact Evaluation FINAL REPORT*, March 2024. Retrieved from: <https://midwest.centerpointenergy.com/assets/downloads/planning/irp/IRP-vectren-demand-response-evaluation.pdf> (last accessed 04-10-2024).

Demand Side Analytics, prepared for PG&E, *2022-2023 Load Impact Evaluation of Pacific Gas and Electric's Smart Thermostat Control Pilot*, May 2024. Retrieved from: [https://www.calmac.org/publications/PY2022-2023\\_Smart\\_Thermostat\\_Control\\_Pilot\\_Evaluation\\_Report\\_Final\\_\(003\).pdf](https://www.calmac.org/publications/PY2022-2023_Smart_Thermostat_Control_Pilot_Evaluation_Report_Final_(003).pdf) (last accessed 04-10-2024).

Navigant, prepared for Eversource MA, Eversource CT, National Grid MA, and Unitil MA, *2019 Residential Wi-Fi Thermostat Direct Load Control Offering Evaluation*, April 2020. Retrieved from: <https://ma-eeac.org/wp-content/uploads/2019-Residential-Wi-Fi-Thermostat-DLC-Evaluation-Report-2020-04-01-with-Infographic.pdf> (last accessed 04-10-2024).

EPRI, prepared for Lincoln Electric, *Lincoln Electric System Demand Response Pilot Evaluation (Generic Version) - 2017 Technical Report*, May 2017. Retrieved from: <https://www.epri.com/research/products/3002011250> (last accessed 04-10-2024).

CADMUS, prepared for Portland General Electric Company, *Direct Install Smart Thermostat Pilot Evaluation Report*, September 2021. Retrieved from: <https://edocs.puc.state.or.us/efdocs/HAD/um1708had165015.pdf> (last accessed 04-10-2024).

The model used by the Evaluator consists of 168 regression models, i.e. one for each hour of the week. Each regression model establishes a correlation between the average participant hourly load at a time of week and the corresponding heating degree days.<sup>2</sup> To do so, all datapoints for a given time of week were grouped together to establish one of the 168 regressions. For example, if the dataset includes 20 participants and each participant's subset includes 10 datapoints for "Monday at 8 a.m.", the regression for "Mondays at 8 a.m." would be built based on 200 datapoints. Each of the 168 regressions is represented by the equation below; the coefficients ( $\alpha_{D,H}$  and  $\beta_{D,H}$ ) obtained by the Evaluator for each regression are presented in Appendix III.

$$\text{Baseline } kW_{D,H} = \alpha_{D,H} \times x^* + \beta_{D,H}$$

Where:

- ›  $\text{Baseline } kW_{D,H}$  is the calculated baseline load in kW on a specified day of week (D) and hour of day (H), for a given temperature.
- ›  $D, H$  is the time of the week where D is from 1 to 7 (Sunday to Saturday) and H is from 00 to 24 (midnight to 11 p.m.), representing each of the 168 hours of the week (1\_00 to 7\_23).
- ›  $\alpha_{D,H}$  is the coefficient to be multiplied by the heating degree days (HDD) to obtain the portion of the load attributable to heating.
- ›  $x^*$  is the heating degree days (HDD) for a balance point of 15 °C at the event time at which the baseline is assessed.
- ›  $\beta_{D,H}$  is the portion of the load that is not attributable to heating.

To ensure a close match between outdoor temperature and participant location, all participants were assigned to one of eight weather stations based on their postal code and zones associated to each weather station instead of using one weather dataset for all participants.

## Data Cleaning

The initial dataset included all participants (272) with Mysa thermostats. Among those, only 247 participants had AMI data available. The Evaluator only kept participants that did not have a participating EV charger (40 of the 247 participants had an EV charger) since the load from EV chargers created substantial noise in the dataset. In parallel, two participants with less than half the expected datapoints were excluded. Also, six participants were excluded as they had two premise addresses<sup>3</sup> and were therefore considered to have moved during the metering period, resulting in a total of 199 participants being included in the final analysis.

The Evaluator adjusted the initial 15-minute kW data to hourly data to be able to match them with hourly weather data. Hourly datapoints that did not include a full hour of data (four datapoints) were excluded. The Evaluator also excluded hourly datapoints that showed a load above 15 kW (0.3% of total datapoints) since they were considered outliers.

<sup>2</sup> Heating degree days were selected in lieu of outdoor temperature to better represent the heating load associated to each hour of the week. The heating degree days herein correspond to heating degree hours since they were calculated for each hour.

<sup>3</sup> Seven participants had two premise addresses, but one was already excluded because of their EV.

## Margin of Error

Once regression analyses were completed, the Evaluator ensured that all coefficients were significant (p-value < 0.05). The following equation was used to establish the margin of error on the **predicted load** for each hour (h).

$$Predicted\ kWh \pm E_{Predicted} = (\alpha_{D,H} \cdot x^* + \beta_{D,H}) \pm 1.64 \cdot RMSE_h \sqrt{\frac{1}{n_h} + \frac{(x^* - \bar{x}_h)^2}{n_h \sigma_h^2}}$$

Where:

- ›  $\beta_{D,H}$  is the regression intercept.
- ›  $\alpha_{D,H}$  is the regression slope.
- ›  $RMSE_h$  is the hourly model root mean square error.
- ›  $n_h$  is the number of observations.
- ›  $\bar{x}_h$  is the mean HDD.
- ›  $\sigma_h^2$  is the variance in HDD.
- ›  $x^*$  is the desired HDD at which evaluations are performed.

The actual load is the average of all participant loads at a given hour, and the margin of error is therefore obtained by multiplying the standard error of the average by the Student's t distribution variable ( $t_v$ ) as demonstrated in the following equation:

$$E_{Actual} = t_v \times Standard\ Error$$

Then, the predicted and actual load errors were propagated using the equation below to obtain the uncertainty on the calculated load reduction for each hour (h) of each event (EventX):

$$E_{Load\ Reduction, EventX, h} = \sqrt{E_{Predicted}^2 + E_{Actual}^2}$$

Finally, the error on the average load reduction per participant during events, which corresponds to the unitary available DR capacity, is calculated as:

$$E_{Unitary\ Savings} = \frac{\sqrt{\sum E_{LoadReduction, EventX, h}^2}}{n_{Events}}$$



## APPENDIX III

### Residential DR: Regression Coefficients

| Hour of Week | Baseload<br>( $\beta_{D,H}$ ) | HDD Coefficient<br>( $\alpha_{D,H}$ ) |
|--------------|-------------------------------|---------------------------------------|
| 1_00         | 0.595                         | 0.0882                                |
| 1_01         | 0.532                         | 0.0830                                |
| 1_02         | 0.661                         | 0.0756                                |
| 1_03         | 0.397                         | 0.0907                                |
| 1_04         | 0.390                         | 0.0930                                |
| 1_05         | 0.425                         | 0.0996                                |
| 1_06         | 0.535                         | 0.1066                                |
| 1_07         | 0.670                         | 0.1107                                |
| 1_08         | 0.966                         | 0.1034                                |
| 1_09         | 1.024                         | 0.1072                                |
| 1_10         | 0.951                         | 0.1136                                |
| 1_11         | 1.051                         | 0.1053                                |
| 1_12         | 1.103                         | 0.1020                                |
| 1_13         | 1.037                         | 0.1001                                |
| 1_14         | 1.041                         | 0.0980                                |
| 1_15         | 1.069                         | 0.0989                                |
| 1_16         | 1.155                         | 0.1071                                |
| 1_17         | 1.316                         | 0.1095                                |
| 1_18         | 1.316                         | 0.1134                                |
| 1_19         | 1.169                         | 0.1241                                |
| 1_20         | 0.959                         | 0.1292                                |
| 1_21         | 0.902                         | 0.1172                                |
| 1_22         | 0.723                         | 0.1091                                |
| 1_23         | 0.570                         | 0.1022                                |

| Hour of Week | Baseload<br>( $\beta_{D,H}$ ) | HDD Coefficient<br>( $\alpha_{D,H}$ ) |
|--------------|-------------------------------|---------------------------------------|
| 2_00         | 0.431                         | 0.0979                                |
| 2_01         | 0.451                         | 0.0872                                |
| 2_02         | 0.390                         | 0.0894                                |
| 2_03         | 0.407                         | 0.0890                                |
| 2_04         | 0.471                         | 0.0905                                |
| 2_05         | 0.603                         | 0.0941                                |
| 2_06         | 0.786                         | 0.1060                                |
| 2_07         | 1.017                         | 0.1054                                |
| 2_08         | 1.080                         | 0.0995                                |
| 2_09         | 1.033                         | 0.0935                                |
| 2_10         | 0.975                         | 0.0866                                |
| 2_11         | 0.981                         | 0.0833                                |
| 2_12         | 0.888                         | 0.0915                                |
| 2_13         | 0.812                         | 0.0910                                |
| 2_14         | 0.854                         | 0.0896                                |
| 2_15         | 1.001                         | 0.0842                                |
| 2_16         | 1.201                         | 0.0874                                |
| 2_17         | 1.414                         | 0.0889                                |
| 2_18         | 1.610                         | 0.0840                                |
| 2_19         | 1.560                         | 0.0886                                |
| 2_20         | 1.326                         | 0.0968                                |
| 2_21         | 1.056                         | 0.1016                                |
| 2_22         | 0.865                         | 0.0944                                |
| 2_23         | 0.683                         | 0.0872                                |

| Hour of Week | Baseload<br>( $\beta_{D,H}$ ) | HDD Coefficient<br>( $\alpha_{D,H}$ ) |
|--------------|-------------------------------|---------------------------------------|
| 3_00         | 0.539                         | 0.0803                                |
| 3_01         | 0.435                         | 0.0827                                |
| 3_02         | 0.402                         | 0.0837                                |
| 3_03         | 0.347                         | 0.0893                                |
| 3_04         | 0.391                         | 0.0911                                |
| 3_05         | 0.480                         | 0.1002                                |
| 3_06         | 0.636                         | 0.1180                                |
| 3_07         | 0.637                         | 0.1336                                |
| 3_08         | 0.615                         | 0.1263                                |
| 3_09         | 0.610                         | 0.1106                                |
| 3_10         | 0.684                         | 0.0948                                |
| 3_11         | 0.718                         | 0.0894                                |
| 3_12         | 0.705                         | 0.0864                                |
| 3_13         | 0.666                         | 0.0850                                |
| 3_14         | 0.799                         | 0.0776                                |
| 3_15         | 1.028                         | 0.0710                                |
| 3_16         | 1.214                         | 0.0787                                |
| 3_17         | 1.299                         | 0.0889                                |
| 3_18         | 1.296                         | 0.0992                                |
| 3_19         | 1.251                         | 0.1045                                |
| 3_20         | 1.160                         | 0.1053                                |
| 3_21         | 0.951                         | 0.1058                                |
| 3_22         | 0.831                         | 0.0948                                |
| 3_23         | 0.633                         | 0.0896                                |

| Hour of Week | Baseload<br>( $\beta_{D,H}$ ) | HDD Coefficient<br>( $\alpha_{D,H}$ ) |
|--------------|-------------------------------|---------------------------------------|
| 4_00         | 0.572                         | 0.0796                                |
| 4_01         | 0.553                         | 0.0782                                |
| 4_02         | 0.454                         | 0.0829                                |
| 4_03         | 0.422                         | 0.0858                                |
| 4_04         | 0.525                         | 0.0844                                |
| 4_05         | 0.662                         | 0.0925                                |
| 4_06         | 0.944                         | 0.1010                                |
| 4_07         | 0.976                         | 0.1102                                |
| 4_08         | 0.928                         | 0.1068                                |
| 4_09         | 0.904                         | 0.0956                                |
| 4_10         | 0.946                         | 0.0833                                |
| 4_11         | 0.887                         | 0.0849                                |
| 4_12         | 0.781                         | 0.0892                                |
| 4_13         | 0.773                         | 0.0857                                |
| 4_14         | 0.913                         | 0.0759                                |
| 4_15         | 1.092                         | 0.0723                                |
| 4_16         | 1.314                         | 0.0758                                |
| 4_17         | 1.518                         | 0.0811                                |
| 4_18         | 1.531                         | 0.0863                                |
| 4_19         | 1.460                         | 0.0942                                |
| 4_20         | 1.307                         | 0.1019                                |
| 4_21         | 1.132                         | 0.0982                                |
| 4_22         | 0.967                         | 0.0904                                |
| 4_23         | 0.761                         | 0.0847                                |

| Hour of Week | Baseload<br>( $\beta_{D,H}$ ) | HDD Coefficient<br>( $\alpha_{D,H}$ ) |
|--------------|-------------------------------|---------------------------------------|
| 5_00         | 0.573                         | 0.0856                                |
| 5_01         | 0.539                         | 0.0835                                |
| 5_02         | 0.499                         | 0.0864                                |
| 5_03         | 0.498                         | 0.0881                                |
| 5_04         | 0.575                         | 0.0859                                |
| 5_05         | 0.760                         | 0.0881                                |
| 5_06         | 1.108                         | 0.0933                                |
| 5_07         | 1.044                         | 0.1154                                |
| 5_08         | 0.940                         | 0.1146                                |
| 5_09         | 0.930                         | 0.1034                                |
| 5_10         | 0.805                         | 0.0996                                |
| 5_11         | 0.742                         | 0.0997                                |
| 5_12         | 0.715                         | 0.0997                                |
| 5_13         | 0.708                         | 0.0949                                |
| 5_14         | 0.747                         | 0.0887                                |
| 5_15         | 0.915                         | 0.0855                                |
| 5_16         | 1.122                         | 0.0926                                |
| 5_17         | 1.295                         | 0.0971                                |
| 5_18         | 1.321                         | 0.1033                                |
| 5_19         | 1.230                         | 0.1094                                |
| 5_20         | 1.161                         | 0.1092                                |
| 5_21         | 0.968                         | 0.1118                                |
| 5_22         | 0.746                         | 0.1076                                |
| 5_23         | 0.610                         | 0.0980                                |

| Hour of Week | Baseload<br>( $\beta_{D,H}$ ) | HDD Coefficient<br>( $\alpha_{D,H}$ ) |
|--------------|-------------------------------|---------------------------------------|
| 6_00         | 0.520                         | 0.0861                                |
| 6_01         | 0.495                         | 0.0844                                |
| 6_02         | 0.429                         | 0.0875                                |
| 6_03         | 0.393                         | 0.0912                                |
| 6_04         | 0.458                         | 0.0916                                |
| 6_05         | 0.608                         | 0.0962                                |
| 6_06         | 0.809                         | 0.1083                                |
| 6_07         | 0.959                         | 0.1143                                |
| 6_08         | 0.901                         | 0.1160                                |
| 6_09         | 0.890                         | 0.1082                                |
| 6_10         | 0.939                         | 0.0951                                |
| 6_11         | 0.936                         | 0.0893                                |
| 6_12         | 0.817                         | 0.0936                                |
| 6_13         | 0.796                         | 0.0900                                |
| 6_14         | 0.804                         | 0.0898                                |
| 6_15         | 0.911                         | 0.0899                                |
| 6_16         | 1.121                         | 0.0921                                |
| 6_17         | 1.189                         | 0.1034                                |
| 6_18         | 1.149                         | 0.1114                                |
| 6_19         | 1.109                         | 0.1165                                |
| 6_20         | 1.091                         | 0.1101                                |
| 6_21         | 0.954                         | 0.1087                                |
| 6_22         | 0.787                         | 0.1057                                |
| 6_23         | 0.669                         | 0.0976                                |

| Hour of Week | Baseload<br>( $\beta_{D,H}$ ) | HDD Coefficient<br>( $\alpha_{D,H}$ ) |
|--------------|-------------------------------|---------------------------------------|
| 7_00         | 0.550                         | 0.0916                                |
| 7_01         | 0.542                         | 0.0843                                |
| 7_02         | 0.498                         | 0.0875                                |
| 7_03         | 0.482                         | 0.0876                                |
| 7_04         | 0.515                         | 0.0886                                |
| 7_05         | 0.560                         | 0.0939                                |
| 7_06         | 0.708                         | 0.1018                                |
| 7_07         | 0.921                         | 0.1025                                |
| 7_08         | 1.117                         | 0.0998                                |
| 7_09         | 1.213                         | 0.0964                                |
| 7_10         | 1.183                         | 0.0943                                |
| 7_11         | 1.077                         | 0.0997                                |
| 7_12         | 1.014                         | 0.1020                                |
| 7_13         | 0.893                         | 0.1034                                |
| 7_14         | 0.884                         | 0.0994                                |
| 7_15         | 1.052                         | 0.0931                                |
| 7_16         | 1.203                         | 0.0948                                |
| 7_17         | 1.419                         | 0.0947                                |
| 7_18         | 1.447                         | 0.0973                                |
| 7_19         | 1.405                         | 0.0971                                |
| 7_20         | 1.264                         | 0.0970                                |
| 7_21         | 1.087                         | 0.1006                                |
| 7_22         | 0.922                         | 0.0943                                |
| 7_23         | 0.715                         | 0.0919                                |

## APPENDIX IV

### Residential DR: Event Day Graphs of Expected Vs Actual Loads

Figure 1: Event 1 Expected and Actual Loads

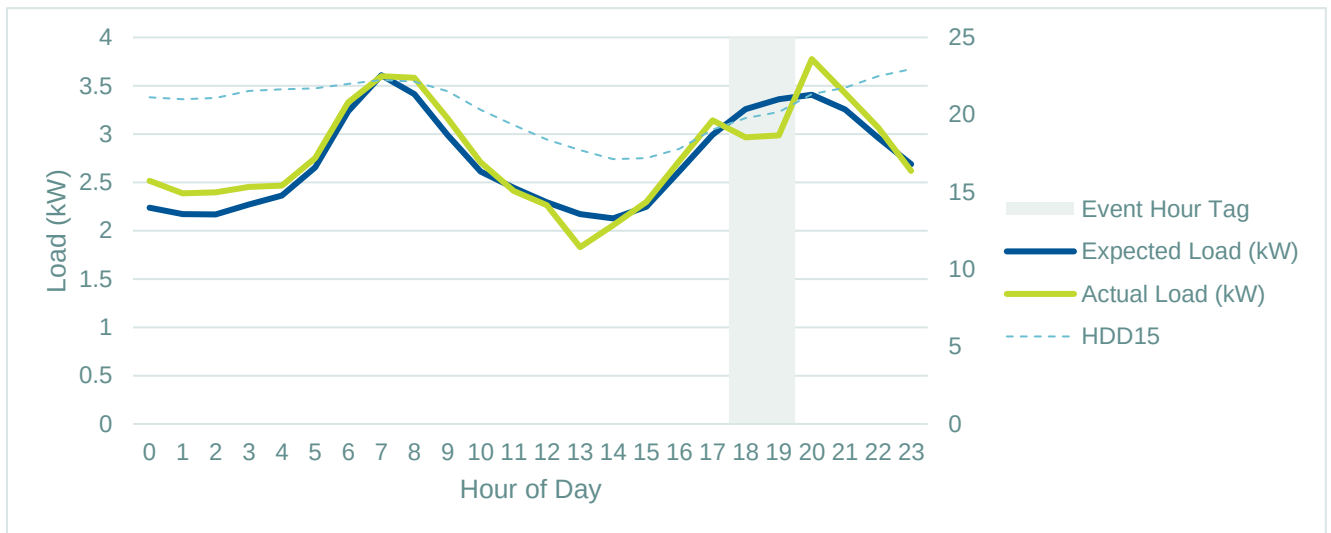


Figure 2: Event 2 Expected and Actual Loads

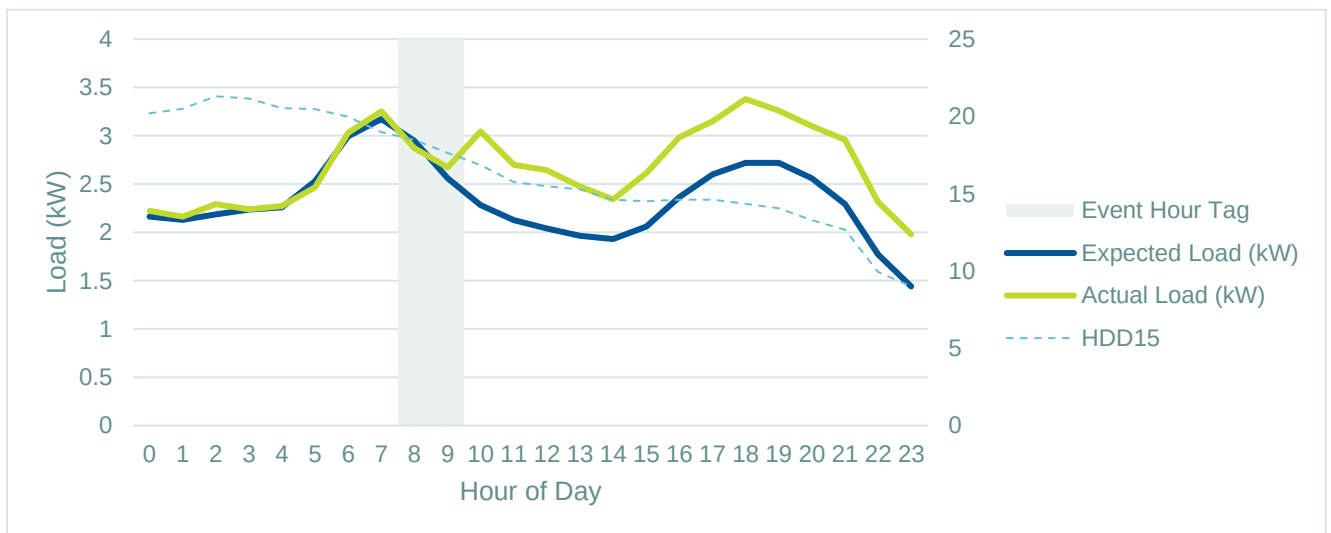


**Figure 3: Event 3 Expected and Actual Loads**

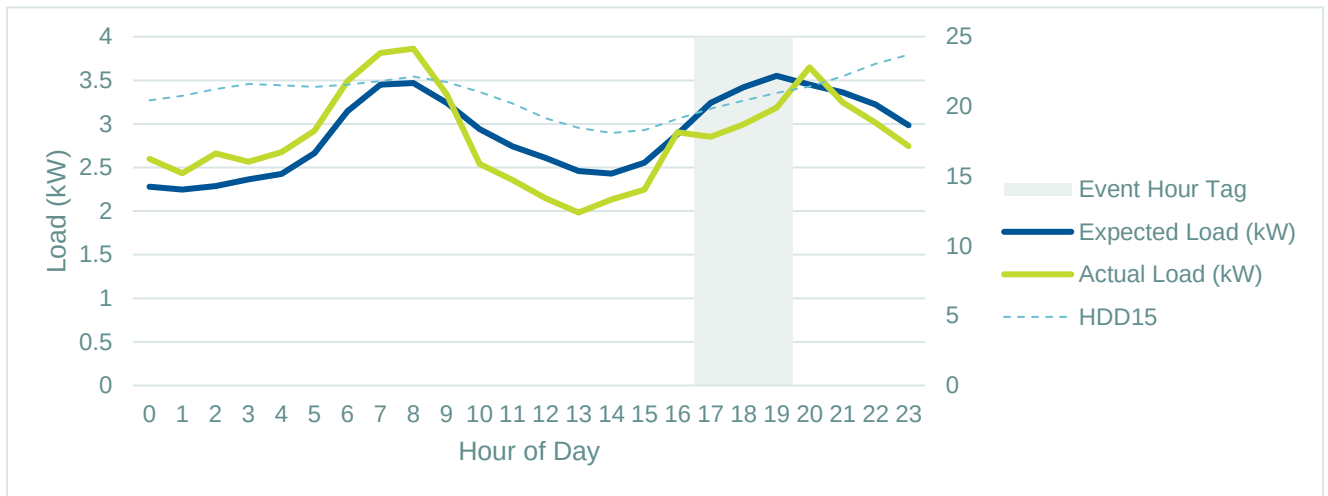


**Figure 4: Event 4 Expected and Actual Loads**

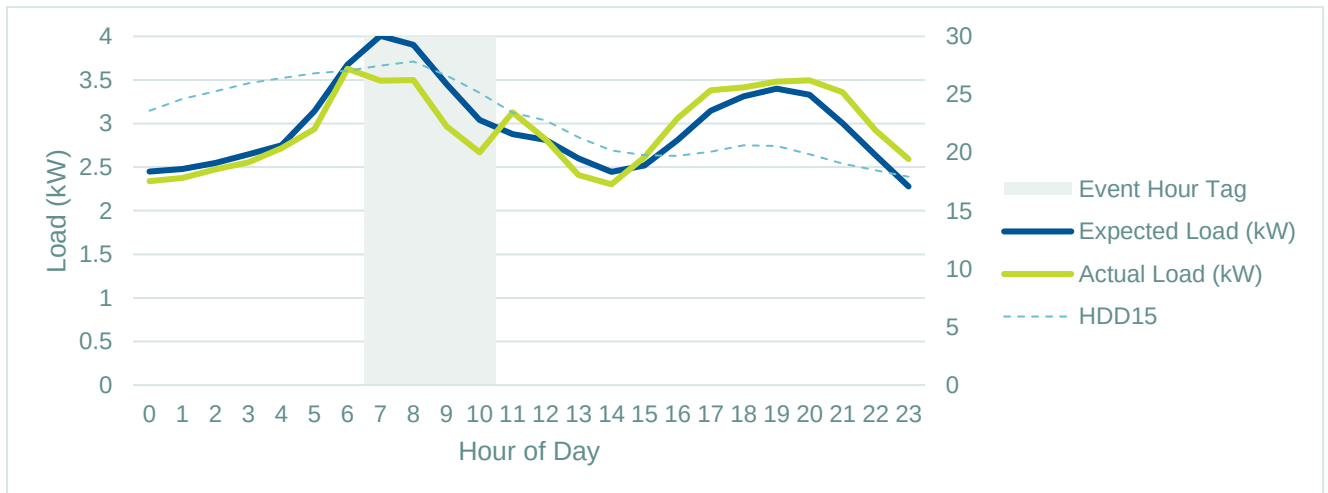


**Figure 5: Event 5 Expected and Actual Loads**

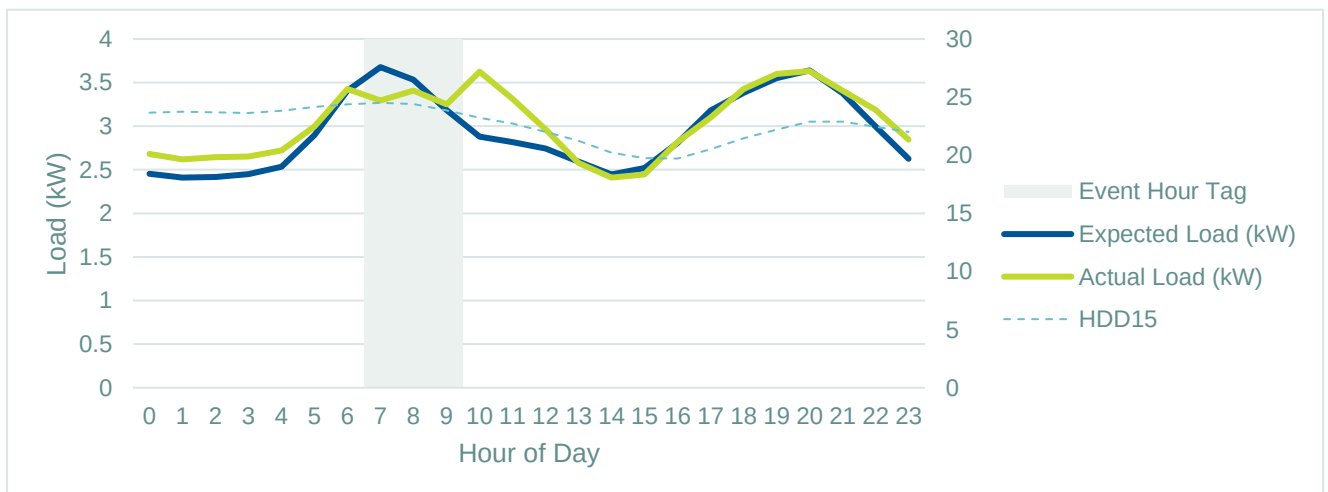


**Figure 6: Event 6 Expected and Actual Loads**

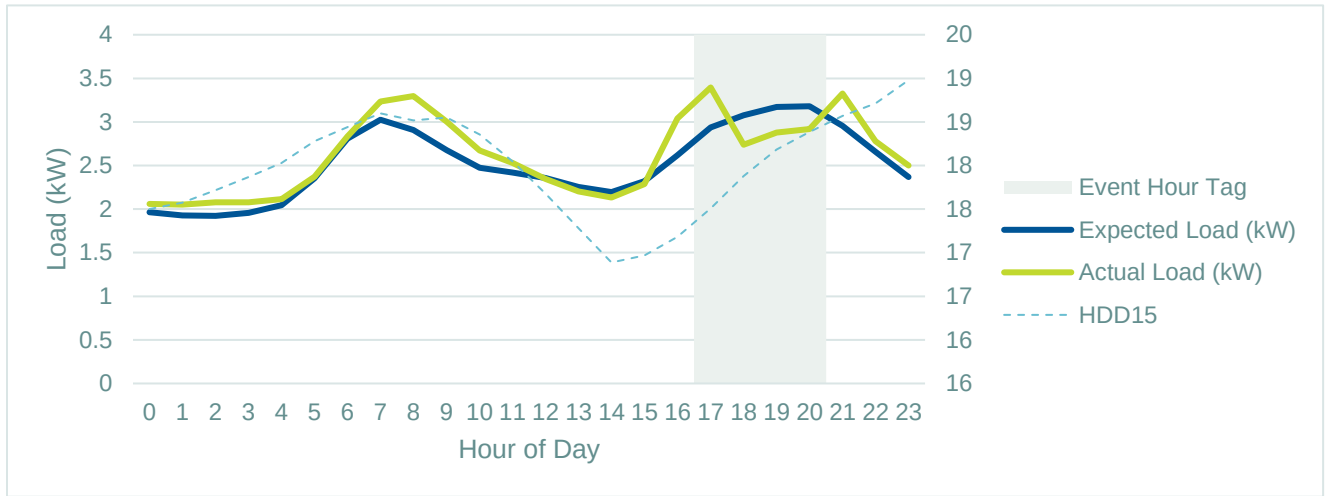


**Figure 7: Event 7 Expected and Actual Loads**

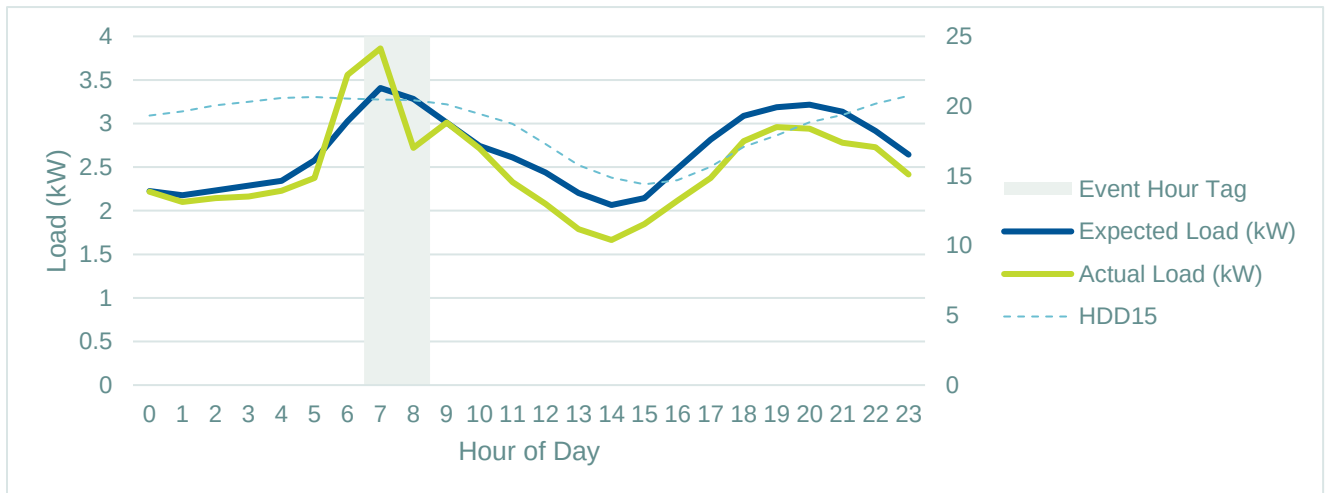


**Figure 8: Event 8 Expected and Actual Loads**

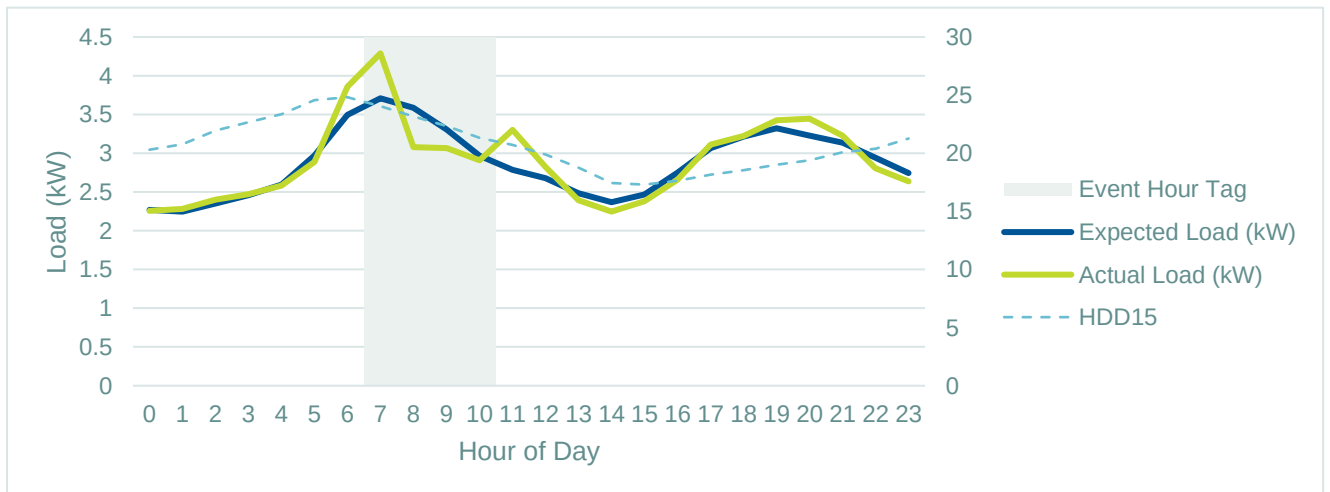


**Figure 9: Event 9 Expected and Actual Loads**

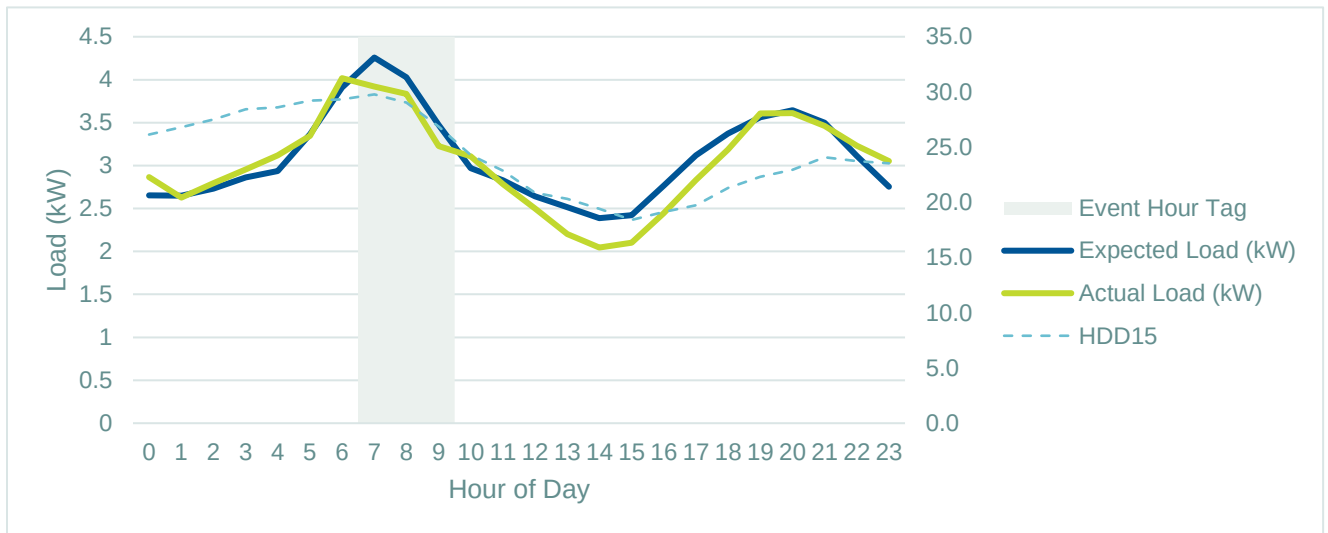
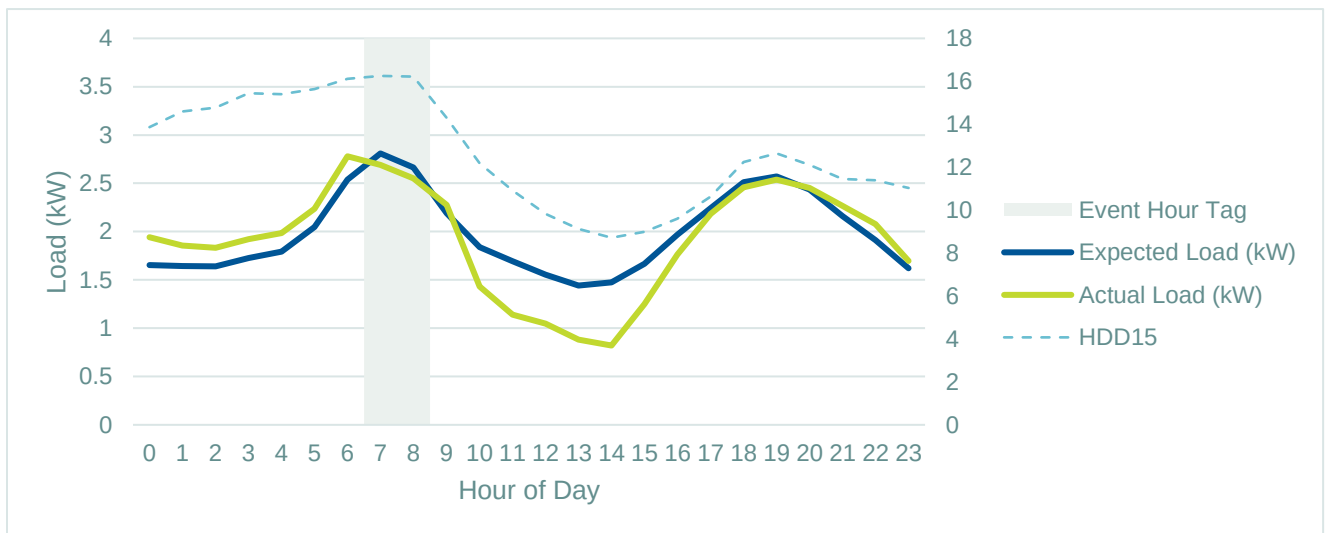


**Figure 10: Event 10 Expected and Actual Loads**







## APPENDIX V

### Residential DR: 2024 Recommendations

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This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 evaluation of Residential DR.

| Section           | Recommendations                                                                                                                                                                                      |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | 2024 Res DR Recommendation 1: Gather and analyze the Eco Shift Pilot data again in 2025 to improve the unitary available DR capacity value accuracy and ensure it is consistent over multiple years. |

## APPENDIX VI

### BNI DR: Tracking Sheet Audit

This document presents the detailed results of the tracking sheet audit performed by the Evaluator, which was aimed at:

- › Verifying that all data fields required for the evaluation were included and filled out in the tracking sheet submitted by E1
- › Ensuring that tracked results were accurate by:
  - › Verifying that parameters used to calculate program results (new and available DR capacities at the generator) were consistent with previous evaluation results
  - › Validating that all calculation steps were performed consistently

Table 1 presents the corrected tracked new and available DR capacities. The slight difference is due to the Evaluator correcting the methodology used by E1 to determine average savings for some participants with events that should have been excluded.

**Table 1: 2024 BNI DR Corrected Tracked Available DR Capacity**

| Program Component Result    | Value Tracked by E1 |      | Corrected Tracked Value |      | Relative Difference |
|-----------------------------|---------------------|------|-------------------------|------|---------------------|
|                             | Value               | Unit | Value                   | Unit | Value               |
| New Available DR Capacity   | 5.553               | MW   | 5.702                   | MW   | 3%                  |
| Total Available DR Capacity | 7.917               | MW   | 8.067                   | MW   | 2%                  |



## APPENDIX VII

### BNI DR: Available DR Capacity Calculation Example

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As per the definition agreed upon by E1 and NSP, available DR capacity is evaluated based on events called from December to February excluding weekends and holidays. Events called at any time during the day (morning or evening)<sup>4</sup> are included. Available DR capacity is evaluated on a per-participant basis based on the average demand reduction observed for each event that the participant was scheduled to participate in regardless of whether events are in the morning or evening. As per this definition, E1's total available DR capacity is the sum of each participant's available DR capacity.

As per the definition, only performances of participants for which the event was called are included in the available DR capacity calculation. If there is an event for which a given participant is not called on to participate, the participant is not included in the available capacity calculation, even though they contributed 0 kW in load reduction during this event. By averaging load reductions at the participant level first (as required by the available DR capacity definition) rather than averaging events, this will yield a higher average available DR capacity if some participants are not called on in all events. In 2024, there were two instances of participants not being called for a given event: (1) For one morning event, only participants best suited to respond in the morning were called to participate and (2). For one day, both a morning event and evening event were called and participants participated in only one of the events based on which event is best suited for the participant. All participants are categorized by E1 as either being better suited to morning or to evening events, and for each event, E1 can decide to only call participants that are better suited to that time, or to call all participants to take part in that event.

To illustrate how available DR capacity is calculated, the Evaluator prepared the example presented in Table 1. The example was developed using only five participants and five events to better visualize the impact of events not called for all participants. Numbers provided are for illustrative purposes only and are not based on actual participant data. In this example, Event 3 was only called for morning-suited participants, while Event 5 included morning (Event 5.1) and evening (Event 5.2) event windows for which each participant took part in only the morning or evening window, based on the type of event for which they were best suited.

---

<sup>4</sup> Available DR capacity for morning peak events includes all events prior to 12 p.m. and available DR capacity for evening peak events includes all events between 12 p.m. and 12 a.m. However, the events are typically called around 7 a.m. and 5 p.m.

**Table 1: Available DR Capacity Calculation Example**

| Event Number                     | Event Period | Type of Participants for Which the Event Was Called | Load Reduction per Participant per Event (kW) |                |                |                |                | Sum of Load Reduction per Event (kW) |
|----------------------------------|--------------|-----------------------------------------------------|-----------------------------------------------|----------------|----------------|----------------|----------------|--------------------------------------|
|                                  |              |                                                     | Part. #1                                      | Part. #2       | Part. #3       | Part. #4       | Part. #5       |                                      |
|                                  |              |                                                     | Evening-suited                                | Evening-suited | Morning-suited | Morning-suited | Evening-suited |                                      |
| 1                                | Evening      | All                                                 | 690                                           | 470            | 530            | 660            | 380            | 2,730                                |
| 2                                | Morning      | All                                                 | 330                                           | 540            | 610            | 290            | 920            | 2,690                                |
| 3                                | Morning      | Morning-suited                                      |                                               |                | 520            | 910            |                | 1,430                                |
| 4                                | Morning      | All                                                 | 640                                           | 850            | 650            | 380            | 170            | 2,690                                |
| 5.1                              | Morning      | Morning-suited                                      |                                               |                | 100            | 570            |                | 670                                  |
| 5.2                              | Evening      | Evening-suited                                      | 260                                           | 260            |                |                | 980            | 1,500                                |
| Average Load Reduction per Event |              |                                                     |                                               |                |                |                |                | 1,952                                |
| Average Available DR Capacity    |              |                                                     | 480                                           | 530            | 482            | 562            | 613            | 2,667                                |

In Table 1, the available DR capacity presented in the bottom right corner (2,667 kW) is the sum of the average available DR capacity of each participant (bottom line), which corresponds to E1's definition of available DR capacity. Therefore, E1 will sum the participant average instead of the event average when reporting on average available DR capacity. As aforementioned, this value differs from the average of the load reduction per event (last column), which is 1,952 kW.

If all events had been called for all participants, the available DR capacity would be identical to the average load reduction per event. The magnitude of the difference between the two results will increase if a higher proportion of events are called only for a portion of participants. As noted above, out of the 10 events called during the 2023-2024 winter, E1 called one morning event only for morning-suited participants, and one double-event day for which participants took part only in the morning or the evening part of the event. Moving forward, E1 intends to call events for all participants on days with only one event and aims to call on morning and evening-suited participants separately on days with more than one event.



## APPENDIX VIII

# BNI DR: Baseline Considerations

---

### General Guidelines

The general guidelines that serve as the de facto assumptions for any DR M&V are presented below:

- › High 6 of 10 baseline
- › Additive adjustment
- › Adjustment lookback window spans two hours
- › Adjustment lookback window starts three hours before the event begins, i.e. the first hour before an event not included in adjustments
- › Adjustments are symmetric, i.e. curtailment can be adjusted up or down
- › Holidays and Weekends are excluded from the baseline
- › Adjustments are capped at  $\pm 20\%$

### Additive Adjustment

Additive adjustments involve a fixed kW adjustment across all event time intervals. It's suitable for situations where there's a known, constant change in the load that is not proportional to the baseline, like the addition or removal of a piece of equipment with a constant load.

---

*Example: an industrial process is running on the day of the event which does not normally run and is not present in the baseline days. Or, it was a slow day and a process was shut down that is normally operational on baseline days.*

---

|            |                |
|------------|----------------|
| Article I. | Business Rules |
|------------|----------------|

- 1) Always use additive adjustments unless the curtailed load is temperature-sensitive.

### Scalar Adjustment

Scalar adjustment are a percentage multiplier applied across all event time intervals. It's appropriate when the baseline needs to be adjusted proportionally due to predictable changes that affect the entire load profile, such as consistent changes in operational hours or production levels.

---

*Example: the load being curtailed is primarily HVAC and is sensitive to outdoor temperature. It is a particularly cold day, and load was higher than on baseline days.*

---



## Business Rules

- 2) Only use a scaler adjustment if the curtailed load is known to be sensitive to changes in temperature.

### Lookback window

Following are considerations when making adjustments to the lookback window:

#### Define Objectives

Determine what the lookback window should achieve, such as reflecting typical usage patterns, operational hours, or accounting for seasonal variations.

#### Analyze Historical Data

Look at historical consumption data to identify normal usage patterns and any anomalies.

#### Consider Variability

Account for variability in operations, weather conditions, and other factors that could affect energy usage.

#### Select Duration

Choose a duration that is long enough to provide a representative sample of usage but not so long that it includes outdated values.

#### Set Timing

Align the timing of the lookback window with the DR event's expected impact on consumption.

#### Test and Validate

Test the lookback window against past DR events to validate its effectiveness.

#### Review and Adjust

Regularly review the lookback window's performance and make adjustments as necessary.

#### Document and Communicate

Clearly document the methodology and communicate it to all stakeholders.

## Business rules

- 3) If the lookback window is observing an abnormal condition such as a building opening or closing earlier than normal, consider whether this point in time is a valid point of comparison.

Consider the example below. The facility shut down from ~10 AM to 4 PM. The facility then resumed normal operation. A DR event was scheduled for 5 PM, one hour before the facility normally closes. The adjustment window “sees” the abnormal shut down and creates a significant, negative additive adjustment. Because the facility resumed normal operation, the temporary one-off shut down before the event should not be used to calculate an adjustment.

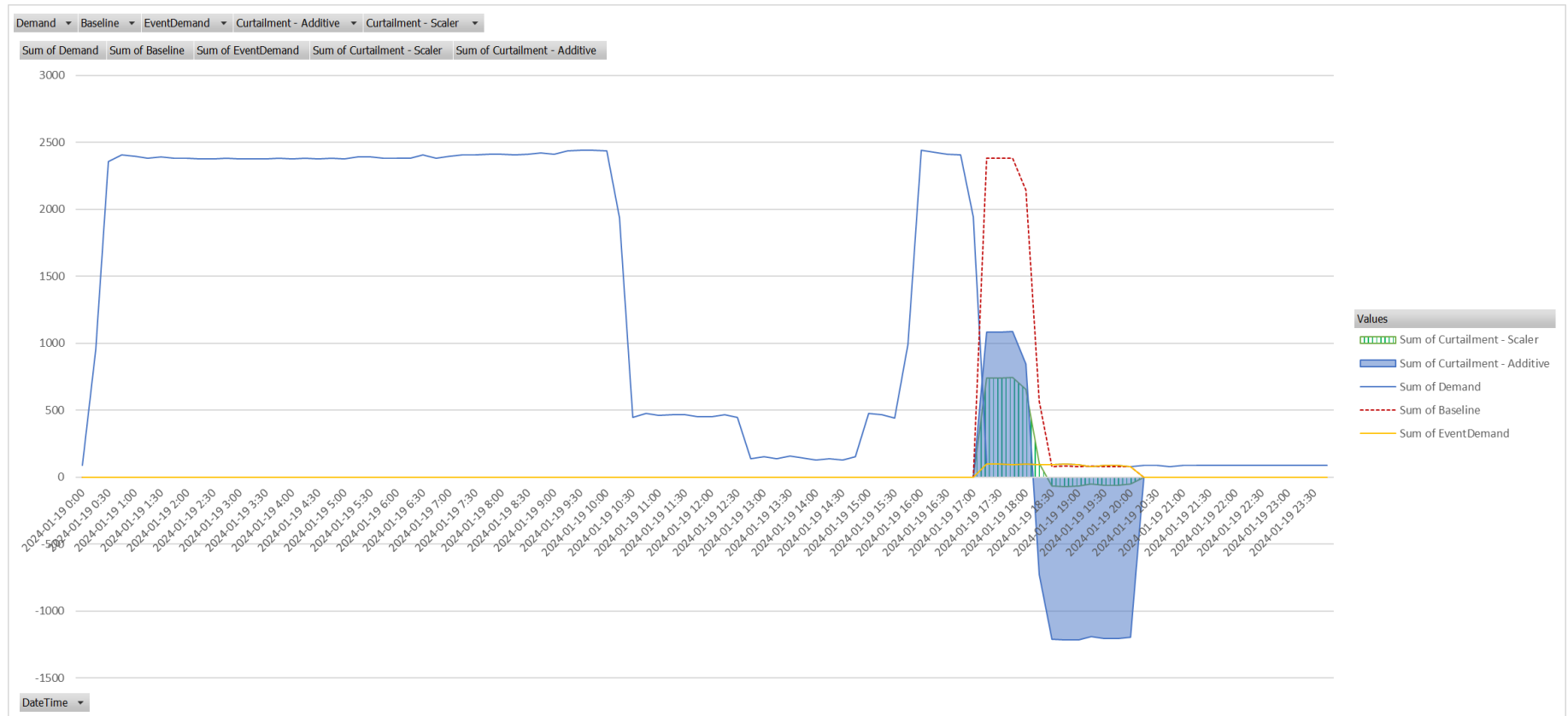


Figure 1: Business rule 3 example. Solid blue line load throughout the day; the dotted red line is the baseline before adjustment; the green shaded area is curtailment after scaler adjustment is applied; the blue shaded area is curtailment after additive adjustment is applied; the solid yellow line is the demand during the event, it always overlaps 100% with the solid blue line, and is only shown to isolate the load observed during the DR event.



## Adjustment Cap

Following are considerations when making adjustments to the adjustment cap:

### Reflect Actual Conditions

The cap should reflect the actual conditions and operational changes that could reasonably affect the DR event day's load.

### Prevent Overcompensation

It should prevent overcompensation for reductions that would have occurred without the DR event.

### Based on Historical Data

The cap can be based on a percentage of historical adjustments observed during similar DR events or established through statistical analysis.

### Consider Program Goals

The cap should align with the overall goals of the DR program, whether it's peak shaving, load shifting, or emergency response.

### Ensure Fairness

It should be fair and not disadvantage any participants, regardless of their size or consumption patterns.

### Be Transparent

The methodology for establishing the cap should be transparent and well-documented to maintain stakeholder trust.

### Allow for Exceptions

There should be provisions for exceptional circumstances where the standard cap may not be appropriate, with clear guidelines on how these exceptions are handled.

### Regular Review and Update

The cap should be reviewed and updated regularly to ensure it remains relevant and effective as grid conditions and participant behaviors change.

## Business Rules

- 4) If the default 20% adjustment cap does not accurately encompass the total curtailment for the specified event day, i.e. a very abnormal day was confirmed by the business, consider allowing for an exception on the default adjustment cap.





## Symmetry

Adjustments are applied symmetrically, i.e. results could go up or down. The symmetric approach considers that day-of conditions can have a real impact on customer demand in both directions and therefore it can be argued that symmetric adjustments maximize the accuracy of a baseline calculation. The  $\pm 20\%$  cap stated in the General Guidelines above will help reduce any negative consequences of a downward adjustment.

It is also worthwhile to consider moving the adjustment window to earlier than 2 hours before the event, or even moving it to after the event, to yield a better adjustment factor.

### Business Rules

- 5) If the lookback window provides an abnormal positive or negative adjustment factor, the event should be flagged and considered with more detailed, as a new adjustment period may need to be selected, including the hours proceeding the event, for a more accurate depiction of the customer's load. If the lookback window is observing an abnormal condition such as a building opening or closing earlier than normal, consider whether this point in time is a valid point of comparison.

## Exclusion rules

Exclusion rules – Some days are excluded from consideration such as holidays, previous DR event days, weekends, thresholds and scheduled shutdowns (as these are not representative of “normal” operation).

---

*Example: A facility was closed for a week due to renovations. During this time, Energy usage was abnormally low and is not representative of typical operation; these days should be excluded from the baseline calculation.*

---

### Business Rules

- 6) If there are known irregularities in customer usage that are not representative of typical operation, such days should be excluded from the baseline calculation. Rationale for exclusion must be documented in CIS for that customer.

## APPENDIX IX

### BNI DR: Project Review Protocol

Presented below is the template used by the Evaluator to review projects to determine evaluated savings.

|                                                                     |                |                |                |                |                |                |                |                |                |                 |         |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|---------|
| PID                                                                 |                |                |                |                |                |                |                |                |                |                 |         |
| Customer Name                                                       |                |                |                |                |                |                |                |                |                |                 |         |
| Agreed Curtailment (kW)                                             |                |                |                |                |                |                |                |                |                |                 |         |
|                                                                     | Event 1        | Event 2        | Event 3        | Event 4        | Event 5        | Event 6        | Event 7        | Event 8        | Event 9        | Event 10        | Average |
| Savings (kW) - Unadjusted                                           |                |                |                |                |                |                |                |                |                |                 |         |
| Savings (kW) - Unadjusted, no Negatives                             |                |                |                |                |                |                |                |                |                |                 |         |
| Savings (kW) - Adjusted                                             |                |                |                |                |                |                |                |                |                |                 |         |
| 2 Hr Energy Savings from Project Excel                              |                |                |                |                |                |                |                |                |                |                 |         |
| <b>Analyses with Graphs</b>                                         |                |                |                |                |                |                |                |                |                |                 |         |
| Is there a weekly consumption pattern?                              |                |                |                |                |                |                |                |                |                |                 |         |
| Is there a daily consumption pattern?                               |                |                |                |                |                |                |                |                |                |                 |         |
| Is consumption weather dependent?                                   |                |                |                |                |                |                |                |                |                |                 |         |
| <b>Adjustment</b>                                                   | <b>Event 1</b> | <b>Event 2</b> | <b>Event 3</b> | <b>Event 4</b> | <b>Event 5</b> | <b>Event 6</b> | <b>Event 7</b> | <b>Event 8</b> | <b>Event 9</b> | <b>Event 10</b> |         |
| Was there any adjustment made to the calculations?                  |                |                |                |                |                |                |                |                |                |                 |         |
| - If not, should they have adjusted it? (based on their guidelines) |                |                |                |                |                |                |                |                |                |                 |         |
| - If yes, what adjustments were made?                               |                |                |                |                |                |                |                |                |                |                 |         |
| Do E1 guidelines support the adjustments?                           |                |                |                |                |                |                |                |                |                |                 |         |
| Do we agree with the adjustments?                                   |                |                |                |                |                |                |                |                |                |                 |         |
| <b>Evaluated Savings (kW)</b>                                       |                |                |                |                |                |                |                |                |                |                 |         |



## APPENDIX X

### BNI DR: 2024 Recommendations

---

This appendix summarizes all the recommendations made by the Evaluator as part of the 2024 evaluation of BNI DR.

| Section           | Recommendations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Executive Summary | <p>2024 BNI DR Recommendation 1: Update the BNI DR Baseline Considerations document to properly address all situations encountered through the project reviews.</p> <ul style="list-style-type: none"><li>› Clearly define how to identify building operating hours and when to set the available DR capacity to zero.</li><li>› Ensure that lookback windows are moved consistently across all similar events unless they are moved due to an abnormal load.</li><li>› Clearly state in the document that certain events may be excluded on a per-participant basis due to missing AMI metering data because of technical issues or events not being called for participants identified as morning-only or evening-only participants.</li></ul> |
| Executive Summary | <p>2024 BNI DR Recommendation 2: In the next evaluation, continue to use project reviews to establish tracked and evaluated available DR capacities.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



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EfficiencyOne

# 2024-2025 DSM MEASURE ASSESSMENT

Final Report

2024 EVALUATION EDITION

March 25, 2025



**ECONOLUX**



## ABBREVIATIONS

|               |                                                                           |
|---------------|---------------------------------------------------------------------------|
| <b>ADL</b>    | Average number of dried loads                                             |
| <b>AHRI</b>   | Air-Conditioning, Heating, and Refrigeration Institute                    |
| <b>AHRI</b>   | Air-Conditioning, Heating, and Refrigeration Institute                    |
| <b>AMH</b>    | Affordable Multi-family Homes (program component)                         |
| <b>ARet</b>   | Appliance Retirement (program component)                                  |
| <b>ASFH</b>   | Affordable Single-family Home (program component)                         |
| <b>ASHP</b>   | Air-source heat pump                                                      |
| <b>ASHRAE</b> | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| <b>BER</b>    | Business Energy Rebates (program component)                               |
| <b>BER-AR</b> | Business Energy Rebates – Application Rebates (program component service) |
| <b>BER-IR</b> | Business Energy Rebates – Instant Rebates (program component service)     |
| <b>BNI</b>    | Business, non-profit, and institutional                                   |
| <b>BOpt</b>   | Building Optimization                                                     |
| <b>CASHP</b>  | Central air-source heat pump                                              |
| <b>CDD</b>    | Cooling degree days                                                       |
| <b>CDI</b>    | Commercial Direct Install                                                 |
| <b>CEE</b>    | Consortium for Energy Efficiency                                          |
| <b>CEF</b>    | Combined energy factor                                                    |
| <b>CFL</b>    | Compact fluorescent lamp                                                  |
| <b>CFM</b>    | Cubic feet per minute                                                     |
| <b>COP</b>    | Coefficient of performance                                                |
| <b>CUWCC</b>  | California Urban Water Conservation Council                               |
| <b>DCV</b>    | Demand-controlled ventilation                                             |
| <b>DEER</b>   | Database for Energy Efficiency Resources                                  |
| <b>DHW</b>    | Domestic hot water                                                        |
| <b>DOE</b>    | U.S. Department of Energy                                                 |
| <b>DR</b>     | Demand Response                                                           |
| <b>DSM</b>    | Demand-side management                                                    |
| <b>DWHR</b>   | Drain water heat recovery                                                 |
| <b>DWHT</b>   | Domestic water heater timer                                               |
| <b>ECM</b>    | Electronically commutated motor                                           |



|               |                                                            |
|---------------|------------------------------------------------------------|
| <b>EER</b>    | Energy efficiency ratio                                    |
| <b>EISA</b>   | Energy Independence and Security Act                       |
| <b>E1</b>     | EfficiencyOne                                              |
| <b>EPI</b>    | Efficient Product Installation (program component)         |
| <b>ERS</b>    | Energy Resource Solutions                                  |
| <b>ESPF</b>   | Energy savings per foot of tape                            |
| <b>e-TRM</b>  | e-Technical Reference Manual                               |
| <b>EUL</b>    | Effective useful life                                      |
| <b>GSHP</b>   | Ground-source heat pump                                    |
| <b>HDD</b>    | Heating degree days                                        |
| <b>HEA</b>    | Home Energy Assessment (program component)                 |
| <b>HOU</b>    | Hours of use                                               |
| <b>HPWH</b>   | Heat pump water heater                                     |
| <b>HSPF</b>   | Heating seasonal performance factor                        |
| <b>HVAC</b>   | Heating, ventilation, and air conditioning                 |
| <b>HVLS</b>   | High Volume Low Speed                                      |
| <b>IESO</b>   | Independent Electricity System Operator                    |
| <b>IMEF</b>   | Modified Energy Factor                                     |
| <b>IMH</b>    | Ice-making heat                                            |
| <b>ISR</b>    | In-service rate                                            |
| <b>LED</b>    | Light-emitting diode                                       |
| <b>MA</b>     | Measure Assessment                                         |
| <b>MH</b>     | Metal halide                                               |
| <b>MHEEP</b>  | Mi'kmaw Home Energy Efficiency Project (program component) |
| <b>MSHP</b>   | Mini-split heat pump                                       |
| <b>NC</b>     | New Construction                                           |
| <b>NEEP</b>   | Northeast Energy Efficiency Partnership                    |
| <b>NEMA</b>   | National Electrical Manufacturers Association              |
| <b>NERHOU</b> | Northeast Residential Lighting Hours-of-Use study          |
| <b>NHC</b>    | New Home Construction (program component)                  |
| <b>NRCan</b>  | Natural Resources Canada                                   |
| <b>NYDPS</b>  | New York Department of Public Service                      |
| <b>OPA</b>    | Ontario Power Authority                                    |
| <b>OTF</b>    | Operational Testing Factor                                 |



|              |                                                     |
|--------------|-----------------------------------------------------|
| <b>PCF</b>   | Peak coincidence factor                             |
| <b>PTHPs</b> | Packaged Terminal Heat Pumps                        |
| <b>PUC</b>   | Pennsylvania Public Utility Commission              |
| <b>PV</b>    | Solar photovoltaic                                  |
| <b>RCU</b>   | Remote condensing unit                              |
| <b>RLHOU</b> | Residential Lighting Hours-of-Use Quick Hit Study   |
| <b>RSF</b>   | Reduced Speed Factor                                |
| <b>RTU</b>   | Rooftop unit                                        |
| <b>SBES</b>  | Small Business Energy Solutions (program component) |
| <b>SCU</b>   | Split system unit / self-contained unit             |
| <b>SEER</b>  | Seasonal energy efficiency ratio                    |
| <b>SEM</b>   | Strategic Energy Management (program component)     |
| <b>TEWH</b>  | Three-element water heater                          |
| <b>TRM</b>   | Technical Reference Manual                          |
| <b>UMP</b>   | Uniform Methods Project                             |
| <b>VFD</b>   | Variable frequency drive                            |
| <b>VSD</b>   | Variable speed drive                                |



## DEFINITIONS

|                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Accuracy</b>                           | Reflects the proximity of measurements to the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Adjustment ratio</b>                   | The ratio of evaluated results to tracked results. This ratio expresses the adjustment made to tracked savings or other tracked values such as effective useful life.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Available demand response capacity</b> | The capacity which is available to NSP to reduce system peak demand. This capacity is calculated based on the first two hours of all events called between December and February, excluding weekends and holidays. If an event is shorter than two hours, only the first hour is used to measure the available DR capacity. Available DR capacity is evaluated on a per-participant basis, based on the average demand reduction observed for each event that the participant was scheduled to participate in. E1's total available DR capacity is the sum of each participant's available DR capacity. |
| <b>Baseline</b>                           | To determine gross savings, a baseline (or base case) is established providing detailed information about the reference (e.g. pre-existing or standard) measure or equipment chosen to be compared with the efficient measure or equipment. For the reference measure or equipment, the baseline may include such information as the hours of operation, wattage, and base consumption.                                                                                                                                                                                                                 |
| <b>Bias</b>                               | Systematic deviations of measurements from the true value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Billing calibration</b>                | An activity that consists of adjusting the expected energy savings based on the relative difference between the results of energy simulations and the actual energy consumption of a building or system.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Confidence interval</b>                | The estimated range of values that is likely to include unknown population parameters.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Demand response</b>                    | Demand response measures generate savings in the form of available capacity or load reduction in response to events called by the electric utility (Nova Scotia Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for two to four hours during peak periods.                                                                                                                                                                                                                                                |
| <b>Displaced wattage</b>                  | The displaced wattage is defined as the difference between the wattage values of the baseline equipment or product and the efficient equipment or product.                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>EnerGuide rating</b>                   | An EnerGuide (official brand of Natural Resources Canada) rating is a standard measure of home energy performance. It is a measure of the efficiency of the building only and does not take into account occupant behaviour. It shows how energy efficient a home is through modelled home heat losses based on several factors including building envelope characteristics, heated volume, heating systems, and air leakage.                                                                                                                                                                           |
| <b>Effective useful life</b>              | The period a measure is expected to be in service and provide both energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Equipment life</b>                     | The number of years installed equipment will operate before it fails.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

|                                         |                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Equivalent CO2</b>                   | A unit of measurement indicating the amount of carbon dioxide to which various kinds of emitted greenhouse gases are equivalent in terms of warming effects. In this report, gas global-warming potential is estimated over a timescale of 100 years.                                                                |
| <b>Equivalent effective useful life</b> | The number of years by which the first-year savings estimate is multiplied to obtain lifetime energy savings. This value takes into account variations in annual energy savings throughout the effective useful life due to increased baselines.                                                                     |
| <b>Evaluated savings</b>                | Gross and net energy or peak demand savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, interactive effects, net-to-gross ratios, etc.) validated or measured during the evaluation process. Unless otherwise specified, evaluated savings are first-year savings. |
| <b>Evaluation plan</b>                  | The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget, and schedule.                                                                                                                                                                         |
| <b>First-year savings</b>               | The first full year of energy or peak demand savings generated by an energy efficiency measure.                                                                                                                                                                                                                      |
| <b>Free-ridership</b>                   | Percentage of gross savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.                                                                                                                         |
| <b>Gross savings</b>                    | Change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program regardless of why they participated.                                                                                                                                    |
| <b>Induced consumption</b>              | Energy consumption of appliances that would have been unplugged and not replaced by participants in the absence of the program.                                                                                                                                                                                      |
| <b>Interactive effects</b>              | Effects on the energy consumption of other systems in a building (such as heating and cooling) due to the installation of an energy-efficiency measure.                                                                                                                                                              |
| <b>In-service rate</b>                  | The proportion of incentivized products that are installed and operating. This rate is usually applied to programs through which rebates are offered in-store and products are likely to be stored for a certain period before being installed, such as LED lamps.                                                   |
| <b>Installation rate</b>                | The proportion of incentivized products reported as installed and that remain installed and operating at the time of evaluation. This rate is usually applied to direct install or mail-in rebate programs through which measures are expected to be installed immediately at the time of participation.             |
| <b>Lifetime energy savings</b>          | The energy savings that occur over the lifetime of an energy efficiency measure. Lifetime energy savings account for a measure's effective useful life and any increase in the baseline efficiency level (which reduces attributable annual savings) over its lifetime.                                              |
| <b>Line loss factor</b>                 | The multiplier to convert savings at the customer meter to savings at the utility generator. It accounts for the electrical losses of the transmission and distribution system.                                                                                                                                      |
| <b>Margin of error</b>                  | The amount of random sampling error.                                                                                                                                                                                                                                                                                 |

|                                 |                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Market effects</b>           | The impact of a program on the market (in terms of increased product availability, practices, and prices) that extends beyond changing program participant behaviours. This includes spillover among non-participants.                                                                                                                       |
| <b>Net savings</b>              | Energy or peak demand savings that can be reliably attributed to a program. This includes effects such as free-ridership and spillover that negatively or positively affect the savings attributable to a program.                                                                                                                           |
| <b>Net-to-gross ratio</b>       | The ratio of net energy savings to gross energy savings.                                                                                                                                                                                                                                                                                     |
| <b>Non-sampling error</b>       | Errors arising during all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.                                                                                                                                                                                |
| <b>Peak coincidence factor</b>  | The percentage of measure demand savings that coincide in time with the annual peak demand of the entire electricity system.                                                                                                                                                                                                                 |
| <b>Peak demand savings</b>      | The demand savings that coincide in time with the expected annual peak demand period of the entire electricity system. For industrial participants on an interruptible rate, peak demand savings may include savings on non-firm loads, i.e. loads that may be interrupted when Nova Scotia Power's 10-minute reserve is low.                |
| <b>Precision</b>                | The extent to which repeated measurements agree with one another.                                                                                                                                                                                                                                                                            |
| <b>Random sampling error</b>    | An error in measurement because measurements are taken from a subset of the population and not the entire population.                                                                                                                                                                                                                        |
| <b>Realization rate</b>         | The ratio of evaluated savings to tracked savings.                                                                                                                                                                                                                                                                                           |
| <b>Sample size</b>              | The number of observations or replicates included in a statistical sample.                                                                                                                                                                                                                                                                   |
| <b>Secondary market impacts</b> | Energy consumption of appliances that would have been transferred to the secondary market if said appliances had not been retired.                                                                                                                                                                                                           |
| <b>Spillover</b>                | Savings attributable to participants who implement the energy efficiency measure(s) introduced by a program after participating in it once, without participating in the program a second time.                                                                                                                                              |
| <b>Tracked savings</b>          | Gross and net savings calculated based on various parameters such as number of participants or units installed or sold, unitary savings values, installation rates, interactive effects, and net-to-gross ratios. Those parameters, except the number of participants or units installed or sold, are obtained from the previous evaluation. |
| <b>Unitary savings</b>          | Energy or peak demand savings established on a unitary basis. A unit can either be a product (e.g. an 8 W LED lamp), a capacity (e.g. one-tonne capacity of an air-source heat pump), or a participant (e.g. one participant taking part in a behaviour-based program).                                                                      |



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# RESIDENTIAL MEASURE ASSESSMENT CHANGE LOG

**Table 1: Measure Assessment Change Log**

| Change Type | Section                                                                                                      | Description                                                                                                                                                                                                               | Date       |
|-------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Update      | 1.1.1(7) Pipe Insulation                                                                                     | Update EUL value                                                                                                                                                                                                          | 2023-03-09 |
| New Measure | 1.1.1(10) Smart Thermostats for Electrical Heating Systems                                                   | Renamed from the smart thermostats for electric baseboards measure to smart thermostats for electrical heating systems and updated it to include smart thermostats for heat pumps and for in-floor radiant heating system | 2023-03-09 |
| New Measure | 1.1.1(8) Efficient Washer-Dryer Combination Units                                                            | Added efficient washer-dryer combination units as a new measure in Instant Savings                                                                                                                                        | 2023-03-09 |
| Update      | 1.1.1(5) LED Nightlights                                                                                     | Update interactive effects factor                                                                                                                                                                                         | 2023-03-09 |
| Update      | 1.1.1(1) LED Lamps                                                                                           | Update EUL values and rationale for using an equivalent EUL to account for LED lamps becoming the baseline in 2025                                                                                                        | 2023-03-09 |
|             | 1.1.1(2) LED Fixtures                                                                                        |                                                                                                                                                                                                                           |            |
| Update      | 1.1.1(4) Domestic Water Heater Load Controls                                                                 | Update savings value based on 2022 metering data                                                                                                                                                                          | 2023-03-09 |
| Update      | 2.4.3(6) Clothes Dryer Replacements                                                                          | Update savings value and combined energy factor of baseline for ARet                                                                                                                                                      | 2023-03-09 |
| Update      | All Sections with EPI Mail-out Kit Measures (1.1.1(1), 1.1.1(5), 1.1.1(4), 1.1.1(5), 1.1.1(7), and 1.1.1(7)) | Updated sections with measures in the EPI Mail-out Kit pilot to include the assumptions for the pilot                                                                                                                     | 2023-03-09 |
| New Measure | 1.1.1(6) Solar Fixtures                                                                                      | Added solar fixtures as an Instant Savings measure                                                                                                                                                                        | 2023-03-09 |
| Update      | 2.4.3 (2) Refrigerator Retirements/Replacements<br>2.4.3 (3) Freezer Retirements/Replacements                | Update savings calculation methodology, savings values, and savings parameter values                                                                                                                                      | 2023-03-09 |
| Update      | 1.1.1(4) Room Air Conditioner Retirements                                                                    | Update savings values based on information from the 2022 tracking sheet and an updated source for the energy efficiency ratio of the retired equipment                                                                    | 2023-03-09 |
| Update      | 1.1.1(5) Dehumidifier Replacements                                                                           | Update savings values to consider the performance of replacement units installed in 2022                                                                                                                                  | 2023-03-09 |
| Update      | 1.1.1(1) Clotheslines and Outdoor Drying Racks                                                               | Update number of loads based on more recent and regional data                                                                                                                                                             | 2023-03-09 |
| Update      | 1.1.1(6) Clothes Dryer Replacement/ENERGY STAR® Certified Clothes Dryers                                     | Update number of loads based on more recent and regional data as well as ARet efficiency levels                                                                                                                           | 2023-03-09 |
| Update      | 1.1.1(7) Efficient Clothes Washers                                                                           | Update number of loads based on more recent and regional data                                                                                                                                                             | 2023-03-09 |
| Update      | 1.1.1(2) Central Air-source Heat Pumps                                                                       | Update unitary peak demand savings value based on data from the 2022 tracking sheet                                                                                                                                       | 2023-03-09 |
| Update      | 1.1.1(1) LED Lamps                                                                                           | Update unitary savings based on data from the Instant Savings 2022 tracking sheet                                                                                                                                         | 2023-03-09 |
|             | 1.1.1(2) LED Fixtures                                                                                        |                                                                                                                                                                                                                           |            |
| Update      | 1.1.1(1) Drain Water Heat Recovery                                                                           | Update unitary savings based on HOT2000 simulations                                                                                                                                                                       | 2023-03-09 |
| Update      | 1.1.1(1) Solar Domestic Hot Water                                                                            | Update unitary savings value for HEA                                                                                                                                                                                      | 2023-03-09 |
| New Measure | 1.1.1(8) Window Film Kits                                                                                    | Added window film kits as an EPI measure                                                                                                                                                                                  | 2023-03-09 |

| Change Type | Section                                                                                                                                                   | Description                                                                                                                                                                                                                                                                                                        | Date       |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Removal     | 1.1.1(1) Drain Water Heat Recovery (for HEA only), 1.1.1(6) Solar Air Heating and Solar DHW (for HEA only)<br>1.1.1(4) Low-flow Showerheads (for IS only) | Measures no longer incented as of 2022                                                                                                                                                                                                                                                                             | 2024-03-12 |
| New Measure | 2.4.3 (10) ENERGY STAR Certified Dishwashers                                                                                                              | Addition of ENERGY STAR certified dishwashers for IS                                                                                                                                                                                                                                                               | 2024-03-12 |
| Removal     | 2.6.4 (1) Three-element Water Heaters, (2) Domestic Water Heater Timers and (3) Electric Thermal Storage (for HEA only)                                   | These products were incorrectly listed as being available under HEA, while they were not                                                                                                                                                                                                                           | 2024-03-12 |
| Removal     | 2.4.3 (6) Clothes Dryer Replacements (ARet)                                                                                                               | No longer offered                                                                                                                                                                                                                                                                                                  | 2024-03-12 |
| Update      | 2.4.3 (2) Refrigerator Replacements and (3) Freezer Replacements                                                                                          | Measures are now listed under HomeWarming and MHEEP in place of ARet                                                                                                                                                                                                                                               | 2024-03-12 |
| Update      | 2.6.3 (4) Domestic Water Heater Load Controls                                                                                                             | Updated unitary savings values                                                                                                                                                                                                                                                                                     | 2024-03-12 |
| Update      | 3 Effective Useful Life                                                                                                                                   | Added AMH EUL values to the lists. Added MHEEP to the program for which a few EUL values were applicable                                                                                                                                                                                                           | 2024-03-12 |
| Update      | 2.3.3 (7) Air Sealing Kits                                                                                                                                | Name changed to Air Sealing Products, and savings are now presented per product rather than by kit                                                                                                                                                                                                                 | 2024-03-12 |
| Update      | 2.1.1 Interactive Effects                                                                                                                                 | Updated heat pump Coefficient of performance (COP) value. Updated space heating and cooling system distribution for Instant Savings                                                                                                                                                                                | 2025-03-19 |
| Update      | 2.1.3(1) LED Lamps                                                                                                                                        | Updated HOU values. Updated EUL and equivalent EUL values to account for LED lamps becoming the baseline in 2025. Removed mention of mail-out pilot kit for EPI. Unitary savings values updated with final Instant Savings 2024 TS data. Updated EPI installation rate according to 2024 EPI on-site visit results | 2025-03-19 |
| Update      | 2.1.3(2) LED Fixtures                                                                                                                                     | Updated HOU values for recessed downlight fixtures and LED fixtures. Updated EUL and equivalent EUL values to account for LED lamps becoming the baseline in 2025. HOU values for LED fixtures with motion sensors and unitary savings values updated with final Instant Savings 2024 TS data                      | 2025-03-19 |
| Update      | 2.1.3(3) Dimmer Switches                                                                                                                                  | Updated HOU value and controlled wattage. Added as an EPI measure                                                                                                                                                                                                                                                  | 2025-03-19 |
| Update      | 2.1.3(4) Motion Sensors                                                                                                                                   | Updated outdoor representative lamp mix. Added as an EPI measure (indoor and outdoor only)                                                                                                                                                                                                                         | 2025-03-19 |
| Update      | 2.1.3(5) LED Nightlights                                                                                                                                  | Updated EUL and equivalent EUL values to account for LED lamps becoming the baseline in 2025. Removed mention mail-out pilot kit. Updated installation rate according to 2024 EPI on-site visit results                                                                                                            | 2025-03-19 |
| Update      | 2.1.3(6) Solar Fixtures                                                                                                                                   | Updated EUL value and outdoor representative lamp mix. Added as an EPI measure                                                                                                                                                                                                                                     | 2025-03-19 |
| Update      | 2.2.1 Interactive Effects                                                                                                                                 | Updated heat pump COP value based on HSPF2                                                                                                                                                                                                                                                                         | 2025-03-19 |

| Change Type | Section                                                            | Description                                                                                                                                                                                                                                                                                                                  | Date       |
|-------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Update      | 2.2.3(3) Heat Pump Water Heaters                                   | Updated space heating system distribution for IS. Updated share of electric water heaters for IS with EPI 2022-2023 TS data. Updated EUL value                                                                                                                                                                               | 2025-03-19 |
| Update      | 2.2.3(4) Low-flow Showerheads                                      | Removed mention of mail-out pilot kit. Updated installation rate and number of showerheads per household according to 2024 EPI on-site visit results. Updated electric water heating efficiency                                                                                                                              | 2025-03-19 |
| Update      | 2.2.3(5) Faucet Aerators                                           | Removed mention of mail-out pilot kit. Updated installation rate and number of faucets per household according to 2024 EPI on-site visit results. Updated electric water heating efficiency                                                                                                                                  | 2025-03-19 |
| Update      | 2.2.3(6) Thermostatic Shower Valves                                | Updated available flow rates to only include 2.5 gpm since other flow rates were discontinued. Updated installation rate and number of showerheads per household according to 2024 EPI on-site visit results. Updated electric water heating efficiency                                                                      | 2025-03-19 |
| Update      | 2.2.3(7) Pipe Insulation                                           | Removed mention of mail-out pilot kit                                                                                                                                                                                                                                                                                        | 2025-03-19 |
| Update      | 2.2.3(8) Hot Water Tank                                            | Updated installation rate according to 2024 EPI on-site visit results. Updated electric water heating efficiency                                                                                                                                                                                                             | 2025-03-19 |
| Update      | 2.3.3(1) Mini-split Heat Pumps                                     | Unitary savings values to be updated with GH and HEA billing analyses                                                                                                                                                                                                                                                        | 2025-03-19 |
| Update      | 2.3.3(3) Ground-source Heat Pumps                                  | Updated efficiencies to HSPF2 and SEER2. Updated FLH based on HEA heating load                                                                                                                                                                                                                                               | 2025-03-19 |
| Update      | 2.3.3(4) Wood and Pellet Stoves/Fireplace Inserts                  | Updated heat pump COP based on HSPF2. Unitary savings values to be updated with GH and HEA billing analyses                                                                                                                                                                                                                  | 2025-03-19 |
| Update      | 2.3.3(7) Air Sealing Products                                      | Updated unitary savings values following 2023 change in delivery in which products were delivered individually and not in a kit. Updated heat pump COP based on HSPF2. Removed mention of mail-out pilot kit. Updated installation rate according to 2024 EPI on-site visit results                                          | 2025-03-19 |
| Update      | 2.3.3(8) Window Film Kits                                          | Updated heat pump COP value based on HSPF2. Updated installation rate according to 2024 EPI on-site visit results. Updated unitary energy savings and unitary peak demand savings values to correct rounding error                                                                                                           | 2025-03-19 |
| Update      | 2.3.3(9) Programmable Thermostats                                  | Updated unitary savings value in IS to reflect an electronic thermostat baseline. Updated algorithm to provide two unitary savings values in MHEEP with an electronic thermostat baseline and an analog thermostat baseline                                                                                                  | 2025-03-19 |
| Update      | 2.3.3(10) Smart Thermostats for Electrical Heating Systems         | Updated average heating energy with HEA 2021-2023 TS data. Updated heat pump COP based on HSPF2. Updated installation rate according to 2024 EPI on-site visit results. Applied reduction to apartment unitary energy savings value to account for differences between single-family home and apartment heating loads in EPI | 2025-03-19 |
| New Measure | 2.3.3(11) Advanced Learning Thermostat for Central Heating Systems | Added measure                                                                                                                                                                                                                                                                                                                | 2025-03-19 |
| Removal     | 2.4.3(1) Clotheslines and Outdoor                                  | Removed product in EPI as it is no longer a                                                                                                                                                                                                                                                                                  | 2025-03-19 |

| Change Type | Section                                                                               | Description                                                                                                                                                                                                                                                                                                         | Date       |
|-------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
|             | Drying Racks                                                                          | measure in that program component                                                                                                                                                                                                                                                                                   |            |
| Update      | 2.4.3(2) Refrigerator Retirements/Replacements                                        | Updated annual consumption per size for appliances after 2002 for ARet. Updated product characteristics based on 2021-2023 average for ASFH and MHEEP through ARet. Proportion of refrigerators updated with final ARet 2024 TS                                                                                     | 2025-03-19 |
| Update      | 2.4.3(3) Freezer Retirements/Replacements                                             | Updated annual consumption per size for appliances after 2002 for ARet. Updated product characteristics based on 2021-2023 average for ASFH and MHEEP through ARet. Proportion of freezers updated with final ARet 2024 TS                                                                                          | 2025-03-19 |
| Update      | 2.4.3(4) Room Air Conditioner Retirements                                             | Updated Energy efficiency ratio (EER). Updated average capacity based on 2021-2023 average                                                                                                                                                                                                                          | 2025-03-19 |
| Update      | 2.4.3(5) Dehumidifier Replacements or Retirements/ENERGY STAR Certified Dehumidifiers | Energy factor of efficient dehumidifier updated with final 2024 TS for ASFH and MHEEP through ARet                                                                                                                                                                                                                  | 2025-03-19 |
| Update      | 2.4.3(6) ENERGY STAR Certified Clothes Dryers                                         | Updated baseline unit combined energy. New unit combined energy factor updated with final Instant Savings 2024 TS data                                                                                                                                                                                              | 2025-03-19 |
| Update      | 2.4.3(7) Efficient Clothes Washers                                                    | Updated calculation of electric water heating percentage to exclude internal heaters. Updated DHW tank distribution with EPI 2022-2023 TS data. Integrated Modified Energy Factor updated with final Instant Savings 2024 TS data                                                                                   | 2025-03-19 |
| Update      | 2.4.3(8) Efficient Washer-Dryer Combination Units                                     | Updated baseline unit combined energy factor. Updated calculation of electric water heating percentage to exclude internal heaters. Updated DHW tank distribution with EPI 2022-2023 TS data. New unit combined energy factor and Integrated Modified Energy Factor updated with final Instant Savings 2024 TS data | 2025-03-19 |
| Update      | 2.4.3(10) ENERGY STAR Certified Dishwashers                                           | Updated baseline unit consumption. Updated percentage of electric DHW savings. Efficient unit consumption updated with final Instant Savings 2024 TS data                                                                                                                                                           | 2025-03-19 |
| New Measure | 2.4.3(11) Humidity Sensors for Bathroom Exhaust Fans                                  | Added measure                                                                                                                                                                                                                                                                                                       | 2025-03-19 |
| Update      | 2.5.3(1) Smart Power Controllers for Audiovisual Equipment                            | Updated unitary savings value and installation rate for IS. Updated EPI installation rate according to 2024 EPI on-site visit results                                                                                                                                                                               | 2025-03-19 |
| Update      | 2.5.3(2) Power Bars with Integrated Timers                                            | Updated idle lighting wattage                                                                                                                                                                                                                                                                                       | 2025-03-19 |
| New Measure | 2.7.3(1) Solar Photovoltaic Systems                                                   | Measure added (already existed, just not in the MA). Updated EUL                                                                                                                                                                                                                                                    | 2025-03-19 |
| Update      | 2.3.3.(1) Mini-split Heat Pumps                                                       | Updated unitary savings according to 2024 billing analysis                                                                                                                                                                                                                                                          | 2025-03-19 |
| Update      | 2.3.3(4) Wood and Pellet Stoves/Fireplace Inserts                                     | Updated unitary savings according to 2024 billing analysis                                                                                                                                                                                                                                                          | 2025-03-19 |





# INTRODUCTION

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The 2024-2025 DSM Measure Assessment (MA) presents the results of an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through the EfficiencyOne (E1) Demand-side management (DSM) program portfolio. The 2024 edition presents the results of an in-depth review of all residential measures and of the top-10 commercial measures.

This document is focused only on gross electric energy and peak demand savings. Appendix V presents the approach reviewed by the Evaluator in 2024 to determine net-to-gross ratios and, ultimately, net savings.

## Purpose

The objectives of this document are to:

- › Ensure consistency in gross savings values throughout the three-year DSM cycle and thus improve E1's ability to define and track targets for energy and peak demand savings
- › Consolidate E1's gross savings values into a single reference document that can easily be referred to by program staff and useful to populate E1's internal e-Technical Reference Manual (e-TRM)

## Use and Application

For the evaluations conducted during the last two years of the 2023-2025 demand-side management (DSM) cycle, the Evaluator will refer to the values presented in the 2024-2025 DSM MA.

The MA includes the following elements:

- › Interactive effects
- › Peak demand-to-energy ratios and peak coincidence factors
- › Installation and in-service rates
- › Unitary savings

In addition to the elements listed above, the MA includes effective useful life (EUL) values for all measures offered in E1's program portfolio. Also, the savings for some programs targeting demand response (DR) are called available DR capacity. DR measures differ from demand reduction measures because they only generate savings when events are called while demand reduction measures generate peak demand savings throughout the peak demand period.

## Development and Review Process

Savings are established using one or more of the following approaches: Literature reviews of TRMs; metering studies and evaluation reports; engineering calculations; adjustments based on data collected through participant surveys or site visits; and secondary research about household/facility characteristics such as types of heating and cooling systems.



The Evaluator established guidelines to determine how average parameters are calculated from tracking sheet data. For Instant Savings, the Evaluator used all 2024 data to establish product characteristic averages, given the rapid changes from year to year in this program. For all other parameters taken from tracking sheets (e.g. number of people per household, heating loads, equipment capacity), the Evaluator used an average value over the last three complete years available, namely 2021 to 2023. Using an average value over three years that is updated once every DSM cycle takes into consideration trends in parameters while limiting the impact of yearly variations. An exception to this rule may be made if there is a clear increase or decrease of the parameter year over year, which would make the 2023 value the most relevant one for future years – if an exception is made, it will be clearly noted. In some cases, parameters were not updated because they are no longer available in the tracking sheet; footnotes indicate where that is the case.

The parameters used in this 2024 edition of the MA will be valid throughout the DSM cycle except for the following parameters that will be updated annually in the MA:

- › LED lamps and fixtures for Instant Savings
  - › Baseline and efficient wattages
- › Major appliances for Instant Savings
  - › Baseline and efficient wattages, sizes and performance metrics
- › Freezer and refrigerator retirements<sup>1</sup>
  - › Proportion of units per manufacture-year class
  - › Average unit size

The parameters listed above have been updated as part of this edition.

Other parameters will also be updated in 2025 based on either applicable comprehensive evaluation results or changes to program offerings or delivery.

If new measures are introduced to the portfolio in a given year, they are reviewed as part of that year's evaluation, and the Evaluator updates the 2024-2025 MA accordingly. In the 2024 evaluation, the following measures were added: advanced learning thermostats for central heating systems, humidity sensor for bathroom exhaust fan, solar photovoltaic systems (residential), light-emitting diode (LED) roadway lighting, horticultural lighting, smart thermostats for electric baseboards in commercial facilities, solar photovoltaic systems (commercial). In addition, all measures from E1's commercial CIRx Screening Tool have been integrated to the MA.

## Savings Calculations Equations

The savings calculations are based on the equations outlined below.

### Electrical Energy Savings

The following equation is used to calculate electrical energy savings.

$$\begin{aligned} \text{Electrical Energy Savings (kWh)} \\ &= \text{Unitary Energy Savings (kWh)} \times (1 \\ &+ \text{Interactive Effects Factor for Energy Savings (\%)}) \times \text{"Installation Rate" or "In} \\ &- \text{service Rate" (\%)} \end{aligned}$$

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<sup>1</sup> The average retired appliance efficiency levels and sizes are likely to evolve overtime as the year of manufacturing of these retired appliances becomes more recent.





## Peak Demand Savings

Peak demand savings correspond to the demand savings that coincide in time with the peak demand of the electricity system. The projected electricity peak demand period in Nova Scotia is between 5 p.m. and 7 p.m. from December to February on non-holiday weekdays.

The following equation is used to calculate peak demand savings.

$$\begin{aligned} \text{Peak Demand Savings (W)} &= \text{Unitary Peak Demand Savings (W)} \times (1 \\ &+ \text{Interactive Effects Factor for Peak Demand Savings (\%)}) \times \text{"Installation Rate " or " In} \\ &- \text{service Rate" (\%)} \end{aligned}$$

## Available Demand Response Capacity

Available DR capacity differs from peak demand savings since the former considers the potential load reduction that was made available instead of the actual load reduction that coincided with the actual utility peak. This distinction was made since E1 does not control the calling of events and thus does not control how well the resources made available are used to reduce peak demand. Available DR capacity is calculated based on the following assumptions:

- › Capacity is evaluated based on events called from December to February excluding weekends and holidays. Events called at any time during the day (morning or evening) can be included.
- › Available demand response capacity is measured over the first two hours of a DR event.
- › If an event is longer than two hours, only the first two hours are used to measure capacity.
- › If an event is shorter than two hours, only the first hour is used to measure available capacity.
- › Available DR capacity is evaluated on a per-participant basis based on the average demand reduction observed for each event in which the participant was scheduled to participate.
- › E1's total available DR capacity is the sum of each participant's available DR capacity.

The following equation is used to calculate available DR capacity.

$$\begin{aligned} \text{Available DR Capacity (W)} &= \text{Unitary Available DR Capacity (W)} \times (1 \\ &+ \text{Interactive Effects Factor for Peak Demand Savings (\%)}) \times \text{"Installation Rate " or " In} \\ &- \text{service Rate" (\%)} \end{aligned}$$

## Lifetime Energy Savings

Lifetime energy savings correspond to the savings that occur over the lifetime of the measures installed. The following equation is used to calculate lifetime energy savings.

$$\text{Lifetime Energy Savings (kWh)} = \text{Electrical Energy Savings (kWh)} \times \text{Effective Useful Life (years)}$$

# 1 Residential Measure Assessment Scope

Table 2 below lists the residential measures and associated programs included in the 2024-2025 DSM MA. The MA includes all necessary parameters and calculations to obtain gross energy and peak demand savings for all portfolio prescriptive and semi-prescriptive measures. In addition, effective useful life values are included for all prescriptive, semi-prescriptive, and custom measures.

For reference, savings calculations for prescriptive measures use fixed assumptions for all participants. The savings are identical for all units installed and represent the average savings for all units. Conversely, savings calculations for custom measures use inputs that are specific to each unit installed and thus represent the actual savings for each unit. Semi-prescriptive measures use a mix of two previous approaches by using unit-specific inputs as well as certain non-specific inputs to determine savings.

**Table 2: Included Residential Measures**

| Measure                       | Program Component |
|-------------------------------|-------------------|
| <b>Lighting</b>               |                   |
| LED Lamps                     | EPI               |
|                               | Instant Savings   |
| LED Fixtures                  | Instant Savings   |
| Dimmer Switches               | Instant Savings   |
| Motion Sensors                | Instant Savings   |
| LED Nightlights               | EPI               |
| Solar Fixtures                | Instant Savings   |
| <b>Water Heating</b>          |                   |
| Drain Water Heat Recovery     | MHEEP             |
| Solar Domestic Hot Water      | Green Heat        |
| Heat Pump Water Heaters       | HEA               |
|                               | MHEEP             |
|                               | Instant Savings   |
| Low-flow Showerheads          | EPI               |
| Faucet Aerators               | EPI               |
| Thermostatic Shower Valves    | EPI               |
| Pipe Insulation               | EPI               |
| Hot Water Tank Wraps          | EPI               |
| <b>Space Heating</b>          |                   |
| Mini-split Heat Pumps         | Green Heat        |
|                               | HEA               |
|                               | MHEEP             |
| Central Air-source Heat Pumps | Green Heat        |
|                               | HEA               |
| Ground-source Heat Pumps      | Green Heat        |

| Measure                                                                      | Program Component |
|------------------------------------------------------------------------------|-------------------|
|                                                                              | HEA               |
| Wood and Pellet Stove/Fireplace Inserts                                      | HEA               |
|                                                                              | Green Heat        |
| Wood and Pellet Boilers and Furnaces                                         | HEA               |
|                                                                              | Green Heat        |
| Solar Air Heating                                                            | Green Heat        |
| Air Sealing Products                                                         | EPI               |
| Window Film Kits                                                             | EPI               |
| Programmable Thermostats                                                     | Instant Savings   |
|                                                                              | MHEEP             |
| Smart Thermostats for Electric Heating Systems                               | Instant Savings   |
|                                                                              | EPI               |
|                                                                              | MHEEP             |
| Advanced Learning Thermostats for Central Heating Systems                    | EPI               |
| <b>Appliances</b>                                                            |                   |
| Clotheslines and Outdoor Drying Racks                                        | Instant Savings   |
| Refrigerator Retirements/Replacements                                        | ARet              |
|                                                                              | Home Warming      |
|                                                                              | MHEEP             |
| Freezer Retirements/Replacements                                             | ARet              |
|                                                                              | Home Warming      |
|                                                                              | MHEEP             |
| Room Air Conditioner Retirements                                             | ARet              |
| Dehumidifier Replacements or Retirements/ENERGY STAR Certified Dehumidifiers | ARet              |
|                                                                              | Instant Savings   |
| ENERGY STAR Certified Clothes Dryers                                         | Instant Savings   |
| Efficient Clothes Washers                                                    | Instant Savings   |
| Efficient Washer-Dryer Combination Units                                     | Instant Savings   |
| ENERGY STAR Certified Room Air Purifiers                                     | Instant Savings   |
| ENERGY STAR Certified Dishwashers                                            | Instant Savings   |
| Humidity Sensors for Bathroom Exhaust Fans                                   | EPI               |
| <b>Plug Load Controls</b>                                                    |                   |
| Smart Power Controllers for Audiovisual Equipment                            | EPI               |
|                                                                              | Instant Savings   |
| Power Bars with Integrated Timer                                             | Instant Savings   |
| Heavy-duty Outdoor Timers                                                    | Instant Savings   |
| ENERGY STAR® Certified Pool Pumps                                            | Instant Savings   |

| Measure                             | Program Component |
|-------------------------------------|-------------------|
| <b>Demand Reduction</b>             |                   |
| Three-element Water Heaters         | Green Heat        |
| Domestic Water Heater Timers        | Green Heat        |
| Electric Thermal Storage            | Green Heat        |
| Domestic Water Heater Load Controls | Demand Response   |
| <b>Renewables</b>                   |                   |
| Solar Photovoltaic Systems          | SolarHomes        |
|                                     | HEA               |

## 2 Residential Measure Gross Savings Parameters

The following sections outline all necessary parameters to calculate gross energy savings for prescriptive residential measures.

### 2.1 Lighting

#### 2.1.1 Interactive Effects

In a home, the implementation of energy efficient lighting products interacts with the energy consumption of other elements such as heating and cooling.

The interactive effects factors for residential lighting products listed in Table 3 below are based on a study conducted by ADS Groupe-Conseil Inc. in 1992 for Hydro-Québec. As presented in Appendix I, the climate data of Nova Scotia and Quebec for the duration of the heating and cooling seasons were analyzed as part of the 2015 evaluation and found to be comparable and thus the study results are applicable for EfficiencyOne (E1) lighting measures.

Table 3 presents the interactive effects factors for five different types of home based on the presence of electrical space heating and air conditioning. For measures offered through Instant Savings where no participant-specific data on heating and cooling systems are available, the interactive effects are based on the weighted average calculated in Table 3.

**Table 3: Interactive Effects Factors for Residential Lighting Products Installed Indoors**

| Type of Home                                         | % of Homes <sup>2</sup> | Energy Interactive Effects Factor <sup>3</sup> | Peak Demand Interactive Effects Factor <sup>4</sup> |
|------------------------------------------------------|-------------------------|------------------------------------------------|-----------------------------------------------------|
| Heat Pump Heating and Air Conditioning               | 38%                     | $-58\% / 1.8 + 6.4\% = -25.8\%$                | -90%                                                |
| Electrical Heating with Air Conditioning             | 2%                      | $-58\% + 3.1\% = -54.9\%$                      | -90%                                                |
| Electrical Heating Without Air Conditioning          | 12%                     | -58%                                           | -90%                                                |
| No Electrical Heating with Air Conditioning          | 5%                      | 3.1%                                           | 0%                                                  |
| With Neither Electrical Heating nor Air Conditioning | 43%                     | 0%                                             | 0%                                                  |
| Weighted Average                                     | 100%                    | -17.7%                                         | -46.8%                                              |

#### Type of Homes

The detailed rationale for interactive effects for heating and cooling follows.

#### Interactive Effects on Electrical Heating

The Hydro-Québec study found that efficient lighting installed in electrically heated single-family homes without air conditioning results in an interactive effects factor for heating of -58%.

<sup>2</sup> Based on 2022-2023 EPI participants. 2021 data were excluded because the separation of electrical and non-electrical savings generated that year skewed the results.

<sup>3</sup> ADS ASSOCIÉS, *Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale*, report presented to Hydro-Québec, 1992.

<sup>4</sup> Based on the ADS report, it is assumed that 10% of the heat is released through exterior walls and ceilings and does not contribute to interactive effects.



## Interactive Effects on Heat Pump Heating

Since the interactive effects factors for electrical heating are based on a heating system efficiency of 100%, some adjustments are necessary for homes that use a heat pump as a primary heating system since the efficiency of this system is superior to 100%.

The interactive effects factor for heating (-58.0%) is divided by 1.8, the COP of a standard mini-split heat pump based on an HSPF2 Region V of 6.0, which is the value for a standard split heat pump as defined by the Federal Energy Efficiency Regulations.<sup>5</sup> This yields an interactive effects factor of -32.2% for heating.

## Interactive Effects on Air Conditioning

The Hydro-Québec study found that efficient lighting installed in homes with air-conditioning units results in an interactive effects factor for cooling of 3.6%. By analyzing the Hydro-Québec study, the Evaluator deduced that the 3.6% was obtained using the following formula.

$$IE_{cooling} = 22\%/COP \times \% \text{ Conditioned Home Area}$$

The value of 22% corresponds to the proportion of the energy savings that occurs during the cooling period and affects the cooling load. It was not possible to extract the exact values used by Hydro-Québec for the COP and the percentage of conditioned home area, but the Evaluator found that a COP for cooling of 2.5 (corresponding to an EER of 8.5) and a percentage of conditioned home area of 40% would be reasonable values. Since the efficiency level of air-conditioning units has increased since the Hydro-Québec study, the Evaluator made an adjustment to increase the COP of 2.5 (EER of 8.5) to a COP of 2.9 (EER of 10), which results in an interactive effects factor for air conditioning of 3.1%.

## Interactive Effects on Heat Pump Cooling

As for cases where cooling is provided by a heat pump, the Evaluator adjusted the cooling interactive effects by dividing the 22% value by the efficiency ratio of mini-split heat pumps and AC units (COP 3.5/2.5). The cooling factor is also multiplied by the ratio of conditioned home area (100%/40%) to account for whole-home conditioning, which is typical of heat pumps. This yields an interactive effects factor of 6.4% for cooling.

## Peak Demand

The Hydro-Québec report assumes that 10% of the heat is released through exterior walls and ceilings and does not contribute to interactive effects. Since the peak demand period occurs during the heating period when lighting and heating systems are assumed to be on, the interactive effects factor for peak demand savings in electrically heated homes is -90%. This factor also applies to homes with heat pumps based on the assumption that heat pumps have a 100% efficiency when operating in very cold conditions, which is typical during peak period conditions.

## Indoor Usage

Lighting products cause interactive effects only if installed indoors. To account for this and obtain an overall interactive effects factor for all lighting products, the percentage of products installed indoors, listed in Table 4, is multiplied by the corresponding interactive effects factor.

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<sup>5</sup> Minister of Justice, Canada, *Energy Efficiency Regulations*, 2016, <http://laws-lois.justice.gc.ca/PDF/SOR-2016-311.pdf> (last accessed December 5, 2019).

**Table 4: Proportion of Lighting Products Used Indoors**

| Type of Product                                                | Program Component | % Indoor | Source                                                         |
|----------------------------------------------------------------|-------------------|----------|----------------------------------------------------------------|
| A-type LED Lamps <sup>6</sup>                                  | EPI               | 97%      | 2021, 2022 and 2023 EPI Tracking Sheets                        |
| Reflector and Decorative LED Lamps <sup>7</sup> (Except PAR38) |                   | 100%     | 2024 EPI Evaluation (on-site visits)                           |
| PAR38 LED Lamps                                                |                   | 0%       |                                                                |
| LED Nightlights                                                |                   | 100%     | Assumption                                                     |
| Dimmer Switches                                                |                   | 100%     |                                                                |
| Indoor Motion Sensors                                          |                   | 100%     |                                                                |
| Outdoor Motion Sensors                                         |                   | 0%       |                                                                |
| Solar Fixtures                                                 |                   | 0%       |                                                                |
| Reflector and Decorative LED Lamps <sup>8</sup>                | Instant Savings   | 92%      | 2016 Nova Scotia Socket Study <sup>9</sup>                     |
| ENERGY STAR Certified LED Recessed Downlight Fixtures          |                   | 100%     | Assumption                                                     |
| ENERGY STAR Certified LED Fixtures                             |                   | 100%     | 2024 Instant Savings tracking sheet (10 most popular products) |
| ENERGY STAR Certified LED Fixtures with Motion Sensors         |                   | 3%       | 2024 Instant Savings tracking sheet (10 most popular products) |
| Dimmer Switches                                                |                   | 100%     | Assumption                                                     |
| Indoor Motion Sensors                                          |                   | 100%     |                                                                |
| Outdoor Motion Sensors                                         |                   | 0%       |                                                                |
| Solar Fixtures                                                 |                   | 0%       |                                                                |

## Summary

Combining the values presented in Table 3 and Table 4, Table 5 summarizes the interactive effects factor established for each lighting measure.

<sup>6</sup> Including 9 W, 9.5 W, 10 W, 18 W, and 7 W black-out bulb LED lamps installed through EPI.

<sup>7</sup> Including PAR20, PAR30, GU10, G25, and chandelier E12 LED lamps installed through EPI.

<sup>8</sup> Including ENERGY STAR certified non-A-type lamps rebated through Instant Savings.

<sup>9</sup> Corporate Research Associates Inc., *2016 Socket Study*, Final Report prepared for Efficiency Nova Scotia, December 2016.

**Table 5: Overall Interactive Effects Factors for Residential Lighting Measures**

| Measure                                                                                                                     | Type of Home                                         | Interactive Effects Factors |                        |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|-----------------------------|------------------------|
|                                                                                                                             |                                                      | Energy Savings              | Peak Demand Savings    |
| EPI                                                                                                                         |                                                      |                             |                        |
| LED A-type Lamps <sup>10</sup>                                                                                              | Heat Pump Heating and Air Conditioning               | -25.8% x 97% = -25.0%       | -90% x 97% = -87.3%    |
|                                                                                                                             | Electrical Heating with Air Conditioning             | -54.9% x 97% = -53.3%       | -90% x 97% = -87.3%    |
|                                                                                                                             | Electrical Heating Without Air Conditioning          | -58% x 97% = -56.3%         | -90% x 97% = -87.3%    |
|                                                                                                                             | No Electrical Heating with Air Conditioning          | 3.1% x 97% = 3.0%           | 0% x 97% = 0%          |
|                                                                                                                             | With Neither Electrical Heating nor Air Conditioning | 0% x 97% = 0%               | 0% x 97% = 0%          |
| Reflector and Decorative LED Lamps, LED Nightlights <sup>11</sup> (Except PAR38), Dimmer Switches and Indoor Motion Sensors | Heat Pump Heating and Air Conditioning               | -25.8% x 100% = -25.8%      | -90% x 100% = -90.0%   |
|                                                                                                                             | Electrical Heating with Air Conditioning             | -54.9% x 100% = -54.9%      | -90% x 100% = -90.0%   |
|                                                                                                                             | Electrical Heating Without Air Conditioning          | -58% x 100% = -58.0%        | -90% x 100% = -90.0%   |
|                                                                                                                             | No Electrical Heating with Air Conditioning          | 3.1% x 100% = 3.1%          | 0% x 100% = 0%         |
|                                                                                                                             | With Neither Electrical Heating nor Air Conditioning | 0% x 100% = 0%              | 0% x 100% = 0%         |
| PAR38 LED Lamps, Outdoor Motion Sensors and Solar Fixtures                                                                  | Outdoor                                              | 0% x 0% = 0%                | 0% x 100% = 0%         |
| Instant Savings                                                                                                             |                                                      |                             |                        |
| Reflector and Decorative LED Lamps and LED Nightlights <sup>12</sup>                                                        | Weighted Average                                     | -17.7% x 92% = -16.3%       | -46.8% x 92% = -43.1%  |
| ENERGY STAR Certified LED Recessed Downlight Fixtures                                                                       | Weighted Average                                     | -17.7% x 100% = -17.7%      | -46.8% x 100% = -46.8% |
| ENERGY STAR Certified LED Fixtures                                                                                          | Weighted Average                                     | -17.7% x 100% = -17.7%      | -46.8% x 100% = -46.8% |
| ENERGY STAR Certified LED Fixtures with Motion Sensors                                                                      | Weighted Average                                     | -17.7% x 3% = -0.5%         | -46.8% x 3% = -1.4%    |
| Dimmer Switches                                                                                                             | Weighted Average                                     | -17.7% x 100% = -17.7%      | -46.8% x 100% = -46.8% |
| Indoor Motion Sensors                                                                                                       | Weighted Average                                     | -17.7% x 100% = -17.7%      | -46.8% x 100% = -46.8% |
| Outdoor Motion Sensors                                                                                                      | Outdoor                                              | 0% x 0% = 0%                | 0% x 0% = 0%           |
| Solar Fixtures                                                                                                              | Outdoor                                              | 0% x 0% = 0%                | 0% x 0% = 0%           |

<sup>10</sup> Including 9 W, 9.5 W, 10 W, 18 W, and 7 W black-out bulb LED lamps installed through EPI.

<sup>11</sup> Including PAR20, PAR30, GU10, G25, chandelier E12 LED lamps, and LED nightlights installed through EPI.

<sup>12</sup> Including ENERGY STAR certified non-A-type lamps rebated through Instant Savings.



## 2.1.2 Peak Demand Savings Factors

For all indoor and outdoor LED lamps, nightlights, and fixtures, the peak demand-to-energy ratio is based on the Northeast Residential Lighting Hours-of-Use (NERHOU)<sup>13</sup> study, which established a peak-demand-to-energy ratio of 0.162 W/kWh with a peak coincidence factor (PCF) of 16% and 2.7 hours of use per day. The former value is very close to the 0.161 W/kWh established by the EPI Residential Lighting Metering Study,<sup>14</sup> which consisted of a metering study conducted in 2016 and 2017 among 75 households in Nova Scotia to assess the daily hours of operation. Since the margin of error in the NERHOU study was lower and included outdoor lamps in its sample, the Evaluator recommends using 0.162 W/kWh. This value was also used for dimmer switches and solar fixtures.

For motion sensors, peak demand savings were calculated using the peak demand-to-energy ratios developed by Navigant in the 2016-2018 DSM Plan. These ratios were established for various product categories based on modelled system-coincident peak demand savings and energy savings for a projected deployment of products. Navigant used local data to establish the ratios applicable for 2016-2018. The Evaluator recommends using the same ratios during the 2020-2023 DSM cycle.

Table 6 summarizes the peak demand-to-energy ratios established for each lighting measure.

**Table 6: Peak Demand-to-energy Ratios for Residential Lighting Measures**

| Measure         | Peak Demand-to-energy Ratio (W/kWh) | Source                                                       |
|-----------------|-------------------------------------|--------------------------------------------------------------|
| LED Lamps       | 0.162                               | Northeast Residential Lighting Hours-of-Use Study            |
| LED Fixtures    |                                     |                                                              |
| LED Nightlights |                                     |                                                              |
| Dimmer Switches |                                     |                                                              |
| Solar Fixtures  |                                     |                                                              |
| Motion Sensors  | 0.000                               | RES-Lighting-Control-OccSensors, Navigant 2016-2018 DSM Plan |

<sup>13</sup> NMR Group Inc. and DNV GL, *Northeast Residential Lighting Hours-of-Use Study*, May 5, 2014, p. 69.

<sup>14</sup> Econoler, *Residential Lighting Metering Study*, December 14, 2017.

## 2.1.3 Lighting Measures

### (1) LED Lamps

#### Summary

Table 7 presents a summary of the values used to calculate A-type, reflector, and decorative LED lamp savings. The detailed methodology follows.

**Table 7: LED Lamp Measure Summary**

| Parameter                                          | EPI                                                                                    | Instant Savings                                                                                           |                                                                                                | Reference                                                                              |
|----------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                        |                                                                                                           |                                                                                                |                                                                                        |
| Measure                                            | LED lamps (A-type, Reflector, and Decorative) with direct installation                 | ENERGY STAR Certified LED non-A-type Lamps (R, BR, and Decorative), rebated in store                      | ENERGY STAR Certified LED non-A-type Lamps (excluding R, BR, and Decorative), rebated in store | -                                                                                      |
| Baseline                                           | Existing lamps being replaced                                                          | A mix of new standard lamps (replace on burnout baseline) and existing lamps (early replacement baseline) |                                                                                                |                                                                                        |
| General Parameters                                 |                                                                                        |                                                                                                           |                                                                                                |                                                                                        |
| Installation Rate                                  | 94%                                                                                    | 100%                                                                                                      |                                                                                                | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | Varies depending on replaced and installed wattages as well as lamp type               | 1.0                                                                                                       | 1.0                                                                                            | See Subsection 3.1                                                                     |
| Electrical Savings Parameters                      |                                                                                        |                                                                                                           |                                                                                                |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | Varies depending on replaced and installed wattages. See Table 8 below                 | 43.2                                                                                                      | 41.3                                                                                           | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                                  |                                                                                                           |                                                                                                | See Subsection 2.1.2                                                                   |
| Unitary Peak Demand Savings [W]                    | Varies depending on replaced and installed wattages. See Table 9 below                 | 7.00                                                                                                      | 6.69                                                                                           | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | Calculation based on home heating and air-conditioning systems for each installed unit | -16.3%                                                                                                    | -16.3%                                                                                         | See Subsection 2.1.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                                        | -43.1%                                                                                                    | -43.1%                                                                                         |                                                                                        |

## Electrical Unitary Energy Savings

The equation below determines the unitary savings values of LED lamps for each pairing of old and new wattages. Table 8 lists the parameters and corresponding values used in the equation and the resulting unitary savings values.

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \frac{(\text{Old Wattage} - \text{New Wattage})[W] \times HOU \left[ \frac{h}{day} \right] \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

**Table 8: Electrical Unitary Energy Savings Values for LED Lamps**

| Type of LED                                                                  | Old Wattage (W) | New Wattage (W) | Displaced Wattage (W) | Operating Hours (hrs/day) | Unitary Savings Value (kWh/year) |
|------------------------------------------------------------------------------|-----------------|-----------------|-----------------------|---------------------------|----------------------------------|
| EPI                                                                          |                 |                 |                       |                           |                                  |
| 9 W Replacing 25 W                                                           | 25              | 9               | 16                    | 2.6                       | 15.2                             |
| 9 W Replacing 29 W                                                           | 29              | 9               | 20                    |                           | 19.0                             |
| 9 W Replacing 40 W                                                           | 40              | 9               | 31                    |                           | 29.4                             |
| 9 W Replacing 43 W                                                           | 43              | 9               | 34                    |                           | 32.3                             |
| 9 W Replacing 60 W                                                           | 60              | 9               | 51                    |                           | 48.4                             |
| 9 W Replacing 72 W                                                           | 72              | 9               | 63                    |                           | 59.8                             |
| 9 W Replacing 100 W                                                          | 100             | 9               | 91                    |                           | 86.4                             |
| 9 W Replacing 150 W                                                          | 150             | 9               | 141                   |                           | 134                              |
| 9.5 W Replacing 25 W                                                         | 25              | 9.5             | 15.5                  |                           | 14.7                             |
| 9.5 W Replacing 29 W                                                         | 29              | 9.5             | 19.5                  |                           | 18.5                             |
| 9.5 W Replacing 40 W                                                         | 40              | 9.5             | 30.5                  |                           | 28.9                             |
| 9.5 W Replacing 43 W                                                         | 43              | 9.5             | 33.5                  |                           | 31.8                             |
| 9.5 W Replacing 60 W                                                         | 60              | 9.5             | 50.5                  |                           | 47.9                             |
| 9.5 W Replacing 72 W                                                         | 72              | 9.5             | 62.5                  |                           | 59.3                             |
| 9.5 W Replacing 100 W                                                        | 100             | 9.5             | 90.5                  |                           | 85.9                             |
| 9.5 W Replacing 150 W                                                        | 150             | 9.5             | 140.5                 |                           | 133                              |
| 18 W Replacing 75 W                                                          | 75              | 18              | 57                    |                           | 54.1                             |
| 18 W Replacing 100 W                                                         | 100             | 18              | 82                    |                           | 77.8                             |
| 7 W Black-out Bulbs Replacing 60 W                                           | 60              | 7               | 53                    |                           | 50.3                             |
| 9 W Installed Through the Mail-out Pilot                                     | 57.3            | 9               | 48.3                  |                           | 45.8                             |
| PAR20 7 W Replacing 50 W                                                     | 50              | 7               | 43                    |                           | 40.8                             |
| PAR30 8 W Replacing 53 W                                                     | 53              | 8               | 45                    |                           | 42.7                             |
| PAR30 8 W Replacing 75 W                                                     | 75              | 8               | 67                    |                           | 63.6                             |
| PAR38 15 W Replacing 90 W                                                    | 90              | 15              | 75                    |                           | 71.2                             |
| PAR38 15 W Replacing 120 W                                                   | 120             | 15              | 105                   |                           | 99.6                             |
| PAR38 15 W Replacing 150 W                                                   | 150             | 15              | 135                   |                           | 128                              |
| 7 W GU10 Replacing 35 W                                                      | 35              | 7               | 28                    |                           | 26.6                             |
| 7 W GU10 Replacing 50 W                                                      | 50              | 7               | 43                    |                           | 40.8                             |
| 4.5 W G25 Replacing 40 W <sup>15</sup>                                       | 40              | 4.5             | 35.5                  |                           | 33.7                             |
| 5 W Chandelier E12 Replacing 40 W                                            | 40              | 5               | 35                    |                           | 33.2                             |
| Instant Savings                                                              |                 |                 |                       |                           |                                  |
| ENERGY STAR Certified LED Non-A-type Lamps (R, BR, and Decorative)           | 47.2            | 4.9             | 42.3                  | 2.8                       | 43.2                             |
| ENERGY STAR Certified LED Non-A-type Lamps (excluding R, BR, and Decorative) | 47.0            | 6.6             | 40.3                  | 2.8                       | 41.3                             |

<sup>15</sup> E1 confirmed during the 2024 DSM evaluation that G25 lamps offered through EPI were now 4.5 W and not 7 W.



## Displaced Wattage

For Efficient Product Installation (EPI), displaced wattage is defined as the difference between the real wattage value of the old lamp and that of the new LED lamp. Both these values are available in the EPI tracking sheet. Previous evaluations confirmed that installed LED lamps had a light output wattage equivalent to that of the replaced lamps for almost all replacements. In other cases, the savings calculations are still based on the difference in real wattage values. For Instant Savings, the average displaced wattage values for the two product categories were established for two types of baselines, namely early replacement, and replace-on-burn-out baselines. For the early replacement scenario, the lamps being replaced are the baseline, while the replace-on-burn-out scenario uses the energy efficiency regulation requirements as the baseline. This methodology is recommended in the principles of the Uniform Methods Project (UMP)<sup>16</sup> to better represent the real baseline wattages for LED lamps.

Since R, BR, and decorative lamps are only available in incandescent and LED, it was assumed that all LED R, BR, and decorative lamps replaced incandescent lamps. It should, however, be noted that the most popular lamp types in that category (ST19 lamps) are required to meet the Energy Efficiency Regulations on general service lamps,<sup>17</sup> which set maximum wattage at 43 W for a 60 W equivalent ST19 lamp for instance. In reality, 43 W ST19 lamps are not available on the market, which explains why this baseline is not used in the unitary savings calculations. Therefore, like previous years, the Evaluator selected to use incandescent decorative lamps as the baseline. The Evaluator noted, as part of the 2023 evaluation, that incandescent decorative lamps were very difficult to find on major retailers' websites. While there might still be participants that replace incandescent lamps early, it is likely at this point that most incandescent lamps have already been replaced (since the standard has been in effect for 9 years). Since 2024 is the last year for the measure, E1 maintained it in the Instant Savings offering.

Other non-A-type lamps are primarily reflector lamps, for which some product types (primarily PAR20 and PAR30) are impacted by the Energy Efficiency Regulations on general service incandescent reflector lamps.<sup>18</sup> For those products, the regulation requires that halogen lamps be more efficient than traditional lamps; effectively, 50 W PAR20 lamps must now consume 39 W or less. The Evaluator assumed that all LED PAR20 lamps replaced standard compliant halogen lamps. Other popular product types include GU10 and PAR16 lamps, which are excluded from this regulation and for which the baseline wattage is the regular halogen wattage.

The equivalent incandescent and halogen wattage values were obtained by researching the recommended equivalencies for the 10 most popular products for each category of LED lamps.

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<sup>16</sup> National Renewable Energy Laboratory, *Uniform Methods Protocol Chapter 6: Residential Lighting Evaluation Protocol*, February 2014, pp. 6-20.

<sup>17</sup> NRCan, *General service lamps and modified spectrum incandescent lamps*, <https://natural-resources.canada.ca/energy/regulations-codes-standards/products/6869> (last accessed January 25, 2024).

<sup>18</sup> NRCan, *General service incandescent reflector lamps*, <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/general-service-incandescent-reflector-lamps/6957> (last accessed January 25, 2024).



## Hours of Operation

The daily hours of operation value is based on the 2020 Residential Lighting Hours-of-Use Quick Hit Study (RLHOU)<sup>19</sup> in which the data collected through the 2014 Northeast Residential Lighting Hours-of-Use (NERHOU)<sup>20</sup> study is reanalyzed to take into account the effects of efficient lamp saturation on hours of use (HOU). The Evaluator had previously determined that the NERHOU study was the most appropriate for E1 since its findings fell within the margin of error of the metering study conducted by the Evaluator in Nova Scotia, and because the NERHOU sample size was significantly larger than the Nova Scotia study. The newer RLHOU study found that the average runtime is 2.6 hours per day for all types of bulbs and 2.8 hours per day for efficient bulbs given the absence of a snapback effect, compared to respectively 2.7 and 2.9 hours in the NERHOU study.<sup>21</sup>

The NERHOU Study concluded that the daily HOU for all bulb types were 0.3 hours lower than those for high efficiency bulbs. Three theories have been put forward to explain why efficient bulbs are used over a greater number of hours, as follows.

- › Differential socket selection: The assumption is that the most used sockets in a household are selected to install efficient bulbs.
- › Shifting usage: The assumption is that once an efficient bulb is installed, it is favoured over other sockets containing inefficient bulbs.
- › Snapback effect: The assumption is that there is a tendency to use an efficient product more than a replaced inefficient product.

Since there is no indication that one theory overrides the others, each theory is assumed to represent an additional usage of 0.1 hours per day.

Two theories, differential socket selection and shifting usage, apply to bulbs purchased as part of Instant Savings since participants are likely to buy only a limited quantity of bulbs rather than changing every bulb in the house. As for the snapback effect, it is not taken into account in the HOU assessment since this usage would not have occurred if an incandescent or halogen (base case) had been installed in the absence of the program. To avoid overestimating savings by making calculations based on higher operating hours than those of the base case, the Evaluator included an additional usage of 0.2 hours in the daily HOU value determined in the RLHOU Study for all bulb types, thereby increasing the HOU from 2.6 hours to 2.8 hours per day.

For EPI, the HOU are 2.6 hours per day since none of the theories explains a higher HOU for efficient bulbs. Differential socket selection and shifting usage do not apply to EPI since all eligible bulbs are replaced in participants' homes. As in Instant Savings, the snapback effect is not considered to avoid overestimating savings by making calculations based on higher operating hours than those of the base case. The NERHOU study concluded that there was no difference in HOU between single-family homes and apartments. Thus, the HOU applied to obtain unitary savings for both dwelling types are identical.

## Unitary Peak Demand Savings

Unitary peak demand savings are calculated by multiplying the unitary savings value by the peak demand-to-energy ratio.

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<sup>19</sup> NMR Group Inc. and DNV GL, *Residential Lighting Hours-of-Use Quick Hit Study*, March 31, 2020.

<sup>20</sup> NMR Group Inc. and DNV GL, *Northeast Residential Lighting Hours-of-Use Study*, May 5, 2014, p. 69.

<sup>21</sup> The snapback effect is an increase in usage following the installation of an efficient product because the operating cost is lower.

**Table 9: Electrical Unitary Peak Demand Savings Values for LED Lamps**

| Type of LED                                                                  | Unitary Energy Savings Value (kWh/year) | Peak Demand-to-energy Ratio (W/kWh) | Unitary Peak Demand Savings Value (W/year) |
|------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------|--------------------------------------------|
| EPI                                                                          |                                         |                                     |                                            |
| 9 W Replacing 25 W                                                           | 15.2                                    | 0.162                               | 2.46                                       |
| 9 W Replacing 29 W                                                           | 19.0                                    |                                     | 3.07                                       |
| 9 W Replacing 40 W                                                           | 29.4                                    |                                     | 4.77                                       |
| 9 W Replacing 43 W                                                           | 32.3                                    |                                     | 5.23                                       |
| 9 W Replacing 60 W                                                           | 48.4                                    |                                     | 7.84                                       |
| 9 W Replacing 72 W                                                           | 59.8                                    |                                     | 9.69                                       |
| 9 W Replacing 100 W                                                          | 86.4                                    |                                     | 14.0                                       |
| 9 W Replacing 150 W                                                          | 134                                     |                                     | 21.7                                       |
| 9.5 W Replacing 25 W                                                         | 14.7                                    |                                     | 2.38                                       |
| 9.5 W Replacing 29 W                                                         | 18.5                                    |                                     | 3.00                                       |
| 9.5 W Replacing 40 W                                                         | 28.9                                    |                                     | 4.69                                       |
| 9.5 W Replacing 43 W                                                         | 31.8                                    |                                     | 5.15                                       |
| 9.5 W Replacing 60 W                                                         | 47.9                                    |                                     | 7.76                                       |
| 9.5 W Replacing 72 W                                                         | 59.3                                    |                                     | 9.61                                       |
| 9.5 W Replacing 100 W                                                        | 85.9                                    |                                     | 13.9                                       |
| 9.5 W Replacing 150 W                                                        | 133                                     |                                     | 21.6                                       |
| 18 W Replacing 75 W                                                          | 54.1                                    |                                     | 8.76                                       |
| 18 W Replacing 100 W                                                         | 77.8                                    |                                     | 12.6                                       |
| 7 W Black-out Bulbs Replacing 60 W                                           | 50.3                                    |                                     | 8.15                                       |
| 9 W Installed Through the Mail-out Pilot                                     | 45.8                                    |                                     | 7.43                                       |
| PAR20 7 W Replacing 50 W                                                     | 40.8                                    |                                     | 6.61                                       |
| PAR30 8 W Replacing 53 W                                                     | 42.7                                    |                                     | 6.92                                       |
| PAR30 8 W Replacing 75 W                                                     | 63.6                                    |                                     | 10.3                                       |
| PAR38 15 W Replacing 90 W                                                    | 71.2                                    |                                     | 11.5                                       |
| PAR38 15 W Replacing 120 W                                                   | 99.6                                    |                                     | 16.1                                       |
| PAR38 15 W Replacing 150 W                                                   | 128                                     |                                     | 20.8                                       |
| 7 W GU10 Replacing 35 W                                                      | 26.6                                    |                                     | 4.30                                       |
| 7 W GU10 Replacing 50 W                                                      | 40.8                                    |                                     | 6.61                                       |
| 4.5 W G25 Replacing 40 W                                                     | 33.7                                    |                                     | 5.46                                       |
| 5 W Chandelier E12 Replacing 40 W                                            | 33.2                                    |                                     | 5.38                                       |
| Instant Savings                                                              |                                         |                                     |                                            |
| ENERGY STAR Certified LED Non-A-type Lamps (R, BR, and Decorative)           | 43.2                                    | 0.162                               | 7.00                                       |
| ENERGY STAR Certified LED Non-A-type Lamps (excluding R, BR, and Decorative) | 41.2                                    |                                     | 6.69                                       |

## Installation Rates

Table 10 lists the installation rate for EPI LED Lamps.

**Table 10: EPI LED Lamp Installation Rate**

| Installation Rate | Margin of Error | Reference                            |
|-------------------|-----------------|--------------------------------------|
| 94%               | 3.0%            | 2024 EPI evaluation (on-site visits) |

For upstream programs like Instant Savings, the UMP makes the following recommendation:

“In-service rates should be calculated through an in-home audit. Since program bulbs cannot be easily identified, the in-service rate can be calculated as the number of installed bulbs purchased in a recent 12-month period divided by the total number of bulbs purchased in the same 12-month period. If the sample size of homes with bulbs purchased in the recent 12-month period is insufficient to provide the necessary levels of confidence and precision, a long-term in-service rate can be used for all bulbs regardless of the time of purchase.”

The UMP provides examples from five recent studies that applied first-year in-service rates to LED upstream programs in the United States. These in-service rates varied between 84% and 99%, with four in-service rates being 95% or higher.

The UMP also mentions three main factors that cause in-service rates below 100%, notably: (1) deeply discounted prices; (2) program inclusion of LED multipacks; and (3) consumers waiting for bulbs to burn out before replacing them. Despite the rebate offered and the large majority (85%) of LED lamps purchased through Instant Savings since 2020 being in packs of two or more, the Evaluator considers it unlikely that most purchased LED lamps are left unused since more than 48% of participants interviewed during the fall online survey mentioned that they purchased lamps to replace functional lamps. The Evaluator also believes that it would not be accurate to use an in-service rate from a program that has a different context and design than Instant Savings.

First-year in-service rates measure the proportion of LED lamps installed within the first year after they are purchased although in-service rates do not capture LED lamps that are installed after that first year. Therefore, if an in-service rate were applied to LED lamp savings, some adjustment would need to be made to account for LED lamps installed after the first year, and the Evaluator believes that the savings deduction would be too low to be considered.

For the abovementioned reasons, in-service rates are not applied to LED lamps and all savings are claimed in the year during which LED lamps were purchased.

## (2) LED Fixtures

### Summary

Table 11 presents a summary of the values used to calculate the savings for motion sensors. The detailed methodology follows.

**Table 11: LED Fixture Measure Summary**

| Parameter                                          | Instant Savings                                                   |                                          |                                                                    | Reference                                                                              |
|----------------------------------------------------|-------------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------|
|                                                    | ENERGY STAR<br>Certified LED<br>Recessed<br>Downlight<br>Fixtures | ENERGY STAR<br>Certified LED<br>Fixtures | ENERGY STAR<br>Certified LED<br>Fixtures with<br>Motion<br>Sensors |                                                                                        |
| Measure Description and Identification             |                                                                   |                                          |                                                                    |                                                                                        |
| Measure                                            | LED fixtures rebated in store                                     |                                          |                                                                    | -                                                                                      |
| Baseline                                           | Standard-compliant new fixtures                                   |                                          |                                                                    |                                                                                        |
| General Parameters                                 |                                                                   |                                          |                                                                    |                                                                                        |
| Installation Rate                                  | 100%                                                              |                                          |                                                                    | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 1.0                                                               | 1.0                                      | 1.6                                                                | See Subsection 3.1                                                                     |
| Electrical Savings Parameters                      |                                                                   |                                          |                                                                    |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 52.8                                                              | 83.8                                     | 201                                                                | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio (W/kWh)                | 0.162                                                             |                                          |                                                                    | See Subsection 2.1.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 8.55                                                              | 13.6                                     | 32.6                                                               | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | -17.7%                                                            | -17.7%                                   | -0.5%                                                              | See Subsection 2.1.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | -46.8%                                                            | -46.8%                                   | -1.4%                                                              | See Subsection 2.1.1                                                                   |

### Electrical Unitary Energy Savings

The equation below determines the unitary savings values of LED fixtures. Table 12 lists the parameters and corresponding values used in the equation and the resulting unitary savings values.

$$\begin{aligned}
 & \text{Energy Savings} \left[ \frac{kWh}{yr} \right] \\
 &= \frac{\left( \text{Wattage}_{average\ equivalent} [W] \times HOU_{old} \left[ \frac{hrs}{day} \right] - \text{Wattage}_{average} [W] \times HOU_{new} \left[ \frac{hrs}{day} \right] \right) \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}
 \end{aligned}$$



**Table 12: Electrical Unitary Savings Values for LED Fixtures**

| Type of LED Fixture                                    | Average Wattage (W) | Average Equivalent Wattage (W) | Displaced Wattage (W) | Old Operating Hours (hrs/day) | New Operating Hours (hrs/day) | Unitary Savings Value (kWh/year) |
|--------------------------------------------------------|---------------------|--------------------------------|-----------------------|-------------------------------|-------------------------------|----------------------------------|
| ENERGY STAR Certified LED Recessed Downlight Fixtures  | 12.5                | 64.2                           | 51.7                  | 2.8                           | 2.8                           | 52.8                             |
| ENERGY STAR Certified LED Fixtures                     | 27.0                | 109                            | 82.0                  |                               |                               | 83.8                             |
| ENERGY STAR Certified LED Fixtures with Motion Sensors | 22.4                | 131                            | 109                   | 4.69                          | 2.90                          | 201                              |

### Displaced Wattage

To establish the displaced wattage of each category of lighting fixture offered under Instant Savings, the Evaluator identified the best-selling models listed in the 2024 tracking sheet for each type of LED fixture.

The 10 best-selling models of LED recessed downlight fixtures represent over 93% of all recessed LED lamps sold through Instant Savings. All of these fixtures replaced fixtures that would have housed small halogen reflector lamps, typically MR16 or PAR16. All fixtures were found to have lumen outputs well above that of standard 50 W MR15 (which is around 400-450 lm). However, since fixtures are likely to be replaced one for one, the Evaluator selected a baseline wattage corresponding to the brightest reflector lamps typically used indoor, a 60 W MR16.

The Evaluator selected the 10 most popular models that represent 79% of all 2024 sales for ENERGY STAR Certified LED Fixtures without motion sensors. Most of these fixtures replace fixtures that would have housed incandescent A19 lamps. The Evaluator used the light output measured in lumens found on ENERGY STAR and manufacturer websites and used a table from the ENERGY STAR website to establish equivalent incandescent wattages (see Table 13 below).

**Table 13: 2022 ENERGY STAR Certified Lamp Light Output Equivalency to Incandescent Lamp Wattage<sup>22</sup>**

| Old Incandescent Lamps (W) | ENERGY STAR Certified Lamp Light Output (Lumens) |
|----------------------------|--------------------------------------------------|
| 40                         | 450                                              |
| 60                         | 800                                              |
| 75                         | 1,100                                            |
| 100                        | 1,600                                            |
| 150                        | 2,600                                            |

The Evaluator analyzed the eleven best-selling models of ENERGY STAR certified LED fixtures with a motion sensor, which represent 89% (excluding solar fixtures) of all 2024 sales for this product category. The Evaluator found that 97% of those fixtures housed lamps that replaced halogen lamps, while 3% of them replaced incandescent lamps.<sup>23</sup>

<sup>22</sup> ENERGY STAR, *Learn About Brightness*, [https://www.energystar.gov/products/lighting\\_fans/light\\_bulbs/learn\\_about\\_brightness](https://www.energystar.gov/products/lighting_fans/light_bulbs/learn_about_brightness) (last accessed December 21, 2018).

<sup>23</sup> NRCAN, *General service incandescent reflector lamps*, <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/general-service-incandescent-reflector-lamps/6957> (Last accessed January 25, 2024).



## Hours of Operation

The daily hours of operation value is based on the 2020 Residential Lighting Hours-of-Use Quick Hit Study (RLHOU)<sup>24</sup> in which the data collected through the 2014 Northeast Residential Lighting Hours-of-Use (NERHOU)<sup>25</sup> study is reanalyzed. This newer study established an average use of 2.8 hours per day for efficient bulbs given the absence of a snapback effect.<sup>26</sup>

The UMP Residential Lighting Evaluation Protocol recommends that each jurisdiction conduct a metering study to determine specific hours of use (HOU). In 2016 and 2017, the Evaluator conducted a metering study among 75 households to assess daily hours of operation. The overall average daily HOU was established at 2.48 hours/day with a margin of error of  $\pm 0.24$  hours/day. Since the NERHOU Study was conducted on a much larger scale with 848 households and the study data and findings are closely aligned with the Evaluator's metering study margin of error, the Evaluator decided that the values established by the NERHOU Study are still the most appropriate for LED lamps installed through Instant Savings. For 2024, Evaluator used the updated average hours of operation value for efficient lamps without a snapback value, which is 2.8 hours per day.

For 2024, the Evaluator found that 97% of the LED fixtures equipped with a motion sensor are designed for outdoor usage. For LED fixtures installed outdoors, the old and new hours of operation used are 4.75 and 2.95 hours per day respectively.<sup>27</sup> For LED fixtures installed indoors, the old and new hours of operation used are 2.6 and 1.2 hours per day respectively (where 1.2 hours is calculated based on the 54% reduction in operating time).<sup>28</sup> When accounting for the weight of indoor and outdoor fixtures, the average old and new hours of operation were established at 4.69 and 2.90 respectively.

## Installation Rates

The installation rate is assumed to be 100%.

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<sup>24</sup> NMR Group Inc. and DNV GL, *Residential Lighting Hours-of-Use Quick Hit Study*, March 31, 2020, p. 22.

<sup>25</sup> NMR Group Inc. and DNV GL, *Northeast Residential Lighting Hours-of-Use Study*, May 5, 2014, p. 69.

<sup>26</sup> The snapback effect is an increase in usage following the installation of an efficient product because the operating cost is lower.

<sup>27</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>28</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

### (3) Dimmer Switches

#### Summary

Table 14 presents a summary of the values used to calculate dimmer switch savings. The detailed methodology follows.

**Table 14: Dimmer Switch Measure Summary**

| Parameter                                          | Instant Savings                                                                             | EPI                                                                                    | Reference                                                                              |
|----------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                             |                                                                                        |                                                                                        |
| Measure                                            | Indoor dimmer switches rebated in store (Instant Savings) or with direct installation (EPI) |                                                                                        | -                                                                                      |
| Baseline                                           | Existing indoor fixture without dimmer controls                                             | Existing indoor LED fixture without dimmer controls                                    |                                                                                        |
| General Parameters                                 |                                                                                             |                                                                                        |                                                                                        |
| Installation Rate                                  | 100%                                                                                        |                                                                                        | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                                                          | See Subsection 3.2                                                                     |                                                                                        |
| Electrical Savings Parameters                      |                                                                                             |                                                                                        |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 8.20                                                                                        | 3.42                                                                                   | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                                       |                                                                                        | See Subsection 2.1.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 1.33                                                                                        | 0.554                                                                                  | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | -17.7%                                                                                      | Calculation based on home heating and air-conditioning systems for each installed unit | See Subsection 2.1.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | -46.8%                                                                                      |                                                                                        | See Subsection 2.1.1                                                                   |

#### Electrical Unitary Energy Savings

The unitary savings value for dimmer switches is based on the general lighting equation adapted as follows to consider the effect of dimming on energy consumption.

$$Energy\ Savings\ \left[ \frac{kWh}{yr} \right] = \frac{(Average\ Wattage)[W] \times \%Dimmed \times HOU \left[ \frac{h}{day} \right] \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

The value for each parameter and resulting unitary savings value are summarized in Table 15.

**Table 15: Electrical Unitary Savings Values for Dimmer Switches**

| Parameter                         | Instant Savings     | EPI              | Reference                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------|---------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average Wattage [W]               | 2 x 21.6 W = 43.2 W | 2 x 9 W = 18.0 W | Assumed two controlled lamps per motion sensor<br><u>Instant Savings</u> : Weighted average wattage per installed lamp of different lighting technologies observed in residences by the United States Department of Energy <sup>29</sup><br><u>EPI</u> : Standard indoor LED wattage (A-type) assuming the dimmer controls lamps were LED or replaced by LED through EPI |
| Dimmed Wattage [%]                | 20%                 |                  | 2011 OPA Prescriptive Measures and Assumptions List <sup>30</sup>                                                                                                                                                                                                                                                                                                        |
| Daily Hours of Operation          | 2.6                 |                  | RLHOU, 2020 <sup>31</sup>                                                                                                                                                                                                                                                                                                                                                |
| Unitary Energy Savings [kWh/year] | 8.20                | 3.42             | Calculation                                                                                                                                                                                                                                                                                                                                                              |

## Installation Rates

The installation rate is assumed to be 100%.

<sup>29</sup> U.S. Department of Energy, 2020 U.S. Lighting Market Characterization, April 2024, p. 37.

<sup>30</sup> Ontario Power Authority (OPA), 2011 Prescriptive Measures and Assumptions Version 1, March 2011.

<sup>31</sup> NMR Group Inc. and DNV GL, Residential Lighting Hours-of-Use Quick Hit Study, March 31, 2020, p. 22.

## (4) Motion Sensors

### Summary

Table 16 presents a summary of the values used to calculate the savings for motion sensors. The detailed methodology follows.

**Table 16: Motion Sensor Measure Summary**

| Parameter                                          | Instant Savings                                                                                        |                                         |                       | EPI                                                                                    |                       | Reference                                                                              |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------|----------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------|
|                                                    | Indoor Motion Sensor                                                                                   | Indoor Motion Sensor with Dimmer Switch | Outdoor Motion Sensor | Indoor Motion Sensor                                                                   | Outdoor Motion Sensor |                                                                                        |
| Measure Description and Identification             |                                                                                                        |                                         |                       |                                                                                        |                       |                                                                                        |
| Measure                                            | Indoor and outdoor motion sensors rebated in store (Instant Savings) or with direct installation (EPI) |                                         |                       |                                                                                        |                       | -                                                                                      |
| Baseline                                           | Existing indoor or outdoor fixtures without motion sensors                                             |                                         |                       | LED indoor or outdoor fixtures without motion sensors                                  |                       |                                                                                        |
| General Parameters                                 |                                                                                                        |                                         |                       |                                                                                        |                       |                                                                                        |
| Installation Rate                                  | 100%                                                                                                   |                                         |                       |                                                                                        |                       | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                                                                     |                                         |                       |                                                                                        |                       | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                                                        |                                         |                       |                                                                                        |                       |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 22.1                                                                                                   | 25.9                                    | 54.1                  | 9.22                                                                                   | 19.7                  | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                                                                                  |                                         |                       |                                                                                        |                       | See Subsection 2.1.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0.00                                                                                                   |                                         |                       |                                                                                        |                       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | -17.7%                                                                                                 |                                         | 0%                    | Calculation based on home heating and air-conditioning systems for each installed unit | 0%                    | See Subsection 2.1.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | -46.8%                                                                                                 |                                         | 0%                    |                                                                                        | 0%                    | See Subsection 2.1.1                                                                   |

### Electrical Unitary Energy Savings

Different unitary savings values apply according to the location of the motion sensor and additional devices.

## Indoor Motion Sensors

The unitary savings value for indoor motion sensors is based on the general lighting equation adapted as follows to consider the effect of motion sensing on energy consumption.

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \frac{(\text{Average Wattage})[W] \times HOU \left[ \frac{h}{day} \right] \times \%HOU \text{ Reduction} \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

The value for each parameter and resulting unitary savings value are summarized in Table 17.

**Table 17: Electrical Unitary Savings Values for Indoor Motion Sensors**

| Parameter                                 | Instant Savings     | EPI              | Reference                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------|---------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average Wattage [W]                       | 2 x 21.6 W = 43.2 W | 2 x 9 W = 18.0 W | Assumed two controlled lamps per motion sensor<br><u>Instant Savings</u> : Weighted average wattage per installed lamp of different lighting technologies observed in residences by the United States Department of Energy <sup>32</sup><br><u>EPI</u> : Standard indoor LED wattage (A-type) assuming the motion sensor controls lamps were LED or replaced by LED through EPI |
| Daily Hours of Operation [h/day]          | 2.6                 |                  | RLHOU, 2020 <sup>33</sup>                                                                                                                                                                                                                                                                                                                                                       |
| Daily Reduction of Hours of Operation [%] | 54%                 |                  | 2011 OPA Prescriptive Measures and Assumptions List <sup>34</sup>                                                                                                                                                                                                                                                                                                               |
| <b>Unitary Energy Savings [kWh/year]</b>  | <b>22.1</b>         | <b>9.22</b>      | <b>Calculation</b>                                                                                                                                                                                                                                                                                                                                                              |

## Indoor Motion Sensors with Dimmer Switch

The unitary savings value for indoor motion sensors is based on the general lighting equation adapted as follows to consider the effects of motion sensing and dimming on energy consumption. The annual energy savings corresponds to the difference between the base consumption and the reduced consumption occurring with the motion sensor and dimmer switch.

$$\text{Energy Savings [kWh/yr]} = \text{Base Consumption} - \text{Reduced Consumption}$$

$$\begin{aligned} \text{Base Consumption [kWh/yr]} \\ = ((\text{Average Wattage})[W] \times HOU[h/day] \times 365[day/yr]) / 1,000[W/kW] \end{aligned}$$

$$\begin{aligned} \text{Reduced Consumption [kWh/yr]} \\ = ((\text{Average Wattage})[W] \times (1 - \%Dimmed) \times HOU[h/day] \\ \times (1 - \%HOU \text{ Reduction}) \times 365[day/yr]) / 1,000[W/kW] \end{aligned}$$

The value for each parameter and resulting unitary savings value are summarized in Table 18 below.

<sup>32</sup> U.S. Department of Energy, 2020 U.S. Lighting Market Characterization, April 2024, p. 37.

<sup>33</sup> NMR Group Inc. and DNV GL, Residential Lighting Hours-of-Use Quick Hit Study, March 31, 2020, p. 22.

<sup>34</sup> Ontario Power Authority (OPA), 2011 Prescriptive Measures and Assumptions Version 1, March 2011.

**Table 18: Unitary Savings Values for Indoor Motion Sensors with Dimmer Switch**

| Parameter                                 | Value               | Reference                                                                                                                                                     |
|-------------------------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average Wattage [W]                       | 2 x 21.6 W = 43.2 W | Weighted average wattage per installed lamp of different lighting technologies observed in residences by the United States Department of Energy <sup>35</sup> |
| Dimmed Wattage [%]                        | 20%                 | 2011 OPA Prescriptive Measures and Assumptions List <sup>36</sup>                                                                                             |
| Daily Hours of Operation [h/day]          | 2.6                 | RLHOU, 2020 <sup>37</sup>                                                                                                                                     |
| Daily Reduction of Hours of Operation [%] | 54%                 | 2011 OPA Prescriptive Measures and Assumptions List <sup>38</sup>                                                                                             |
| <b>Unitary Energy Savings [kWh/year]</b>  | <b>25.9</b>         | <b>Calculation</b>                                                                                                                                            |

## Outdoor Motion Sensors

The unitary savings value for outdoor motion sensors is based on the general lighting equation adapted as follows to consider the effect of motion sensing on energy consumption.

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \frac{(\text{Average Wattage})[W] \times (\text{Old HOU} - \text{New HOU}) \left[ \frac{h}{day} \right] \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

The value for each parameter and resulting unitary savings value are summarized in Table 19.

**Table 19: Unitary Savings Values for Outdoor Motion Sensors**

| Parameter                                | Instant Savings                                | EPI               | Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------|------------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Average Wattage [W]                      | (85% x 2 x 44.6 W) + (15% x 2 x 21.6) = 82.3 W | 2 x 15 W = 30.0 W | Assumed two controlled lamps per motion sensor<br><u>Instant Savings</u> : Assumed 85% of outdoor lighting for security spotlights with an average wattage of 44.6 W as indicated through the representative lamp mix calculation in Table 20. Assumed the remaining 15% for porch lighting with the weighted average wattage of 21.6 W as observed by the United States Department of Energy <sup>39</sup><br><u>EPI</u> : Standard outdoor LED wattage (PAR38) <sup>40</sup> assuming the motion sensor controls lamps were LED or replaced by LED through EPI |
| Old Operating Time [hrs/day]             | 4.75                                           |                   | 2011 OPA Prescriptive Measures and Assumptions List <sup>41</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| New Operating Time [hrs/day]             | 2.95                                           |                   | 2011 OPA Prescriptive Measures and Assumptions List <sup>42</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Unitary Energy Savings [kWh/year]</b> | <b>54.1</b>                                    | <b>19.7</b>       | <b>Calculation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

<sup>35</sup> U.S. Department of Energy, 2020 U.S. Lighting Market Characterization, April 2024, p. 37.

<sup>36</sup> Ontario Power Authority (OPA), 2011 Prescriptive Measures and Assumptions Version 1, March 2011.

<sup>37</sup> NMR Group Inc. and DNV GL, Residential Lighting Hours-of-Use Quick Hit Study, March 31, 2020, p. 22.

<sup>38</sup> Ontario Power Authority (OPA), 2011 Prescriptive Measures and Assumptions Version 1, March 2011.

<sup>39</sup> U.S. Department of Energy, 2020 U.S. Lighting Market Characterization, April 2024, p. 37.

<sup>40</sup> Given that 15 W PAR38 LED lamps are the only outdoor lamps installed through EPI, the Evaluator only considered them in the baseline assumption.

<sup>41</sup> Ontario Power Authority (OPA), 2011 Prescriptive Measures and Assumptions Version 1, March 2011.

<sup>42</sup> Ibid.

**Table 20: Representative Lamp Mix Calculation for Outdoor Motion Sensor Security Lighting Lamp Wattage**

| Parameter                           | Value                                                                                           | Reference                                                                                                                                                      |
|-------------------------------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Representative lamp mix wattage [W] | 150 W x 16% [incandescent] + 90 W x 7% [halogen] + 23 W x 33% [CFL] + 15 W x 44% [LED] = 44.6 W | Assumed a representative lamp mix using the United States Department of Energy residential lighting technology distribution for outdoor lighting <sup>43</sup> |

## Installation Rates

The installation rate is assumed to be 100%.

<sup>43</sup> U.S. Department of Energy, Table 3.10 Lighting Technology Distribution of Residences by Room Type in 2020, *2020 U.S. Lighting Market Characterization*, April 2024, p. 44.



## (5) LED Nightlights

### Summary

Table 21 presents a summary of the values used to calculate savings for LED nightlights. The detailed methodology follows.

**Table 21: LED Nightlight Measure Summary**

| Parameter                                          | EPI                                                                                    | Reference                                                                              |
|----------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                        |                                                                                        |
| Measure                                            | LED nightlights with direct installation                                               | -                                                                                      |
| Baseline                                           | Existing nightlight being replaced, which must be incandescent                         |                                                                                        |
| General Parameters                                 |                                                                                        |                                                                                        |
| Installation Rate                                  | 94%                                                                                    | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 1.0                                                                                    | See Subsection 3.1                                                                     |
| Electrical Savings Parameters                      |                                                                                        |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 29.3                                                                                   | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                                  | See Subsection 2.1.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 4.75                                                                                   | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | Calculation based on home heating and air-conditioning systems for each installed unit | See Subsection 2.1.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                                        |                                                                                        |

### Electrical Unitary Energy Savings

Table 22 lists the parameters and corresponding values used in the equation below for LED nightlights and the resulting unitary values. The values for displaced wattages and hours of operation are consistent with the values used by other jurisdictions such as the State of Pennsylvania.<sup>44</sup>

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \frac{(\text{Old Wattage} - \text{New Wattage})[W] \times HOU \left[ \frac{h}{day} \right] \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

<sup>44</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, August 2019 (revised February 2021), p. 8.

**Table 22: Electrical Unitary Savings Values for LED Nightlights**

| Parameter                         | Value | Reference                                                                   |
|-----------------------------------|-------|-----------------------------------------------------------------------------|
| Old Wattage [W]                   | 7.0   | Assumption based on the typical wattage value of an incandescent nightlight |
| New Wattage [W]                   | 0.3   | Wattage value of the LED nightlight installed through EPI (E1)              |
| Average Displaced Wattage [W]     | 6.7   | Calculation                                                                 |
| Hours of Operation [hrs/day]      | 12    | Assumption based on the average length of night                             |
| Unitary Energy Savings [kWh/year] | 29.3  | Calculation                                                                 |

## Installation Rates

Table 23 lists the installation rate for EPI LED nightlights.

**Table 23: EPI LED Nightlight Installation Rate**

| Installation Rate | Margin of Error | Reference                            |
|-------------------|-----------------|--------------------------------------|
| 94%               | 3.0%            | 2024 EPI evaluation (on-site visits) |

## (6) Solar Fixtures

### Summary

Table 24 presents a summary of the values used to calculate the savings for solar fixtures. The detailed methodology follows.

**Table 24: Solar Fixture Measure Summary**

| Parameter                                          | Instant Savings                                                                         | EPI                                                  | Reference                                                                              |
|----------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                         |                                                      |                                                                                        |
| Measure                                            | LED solar fixtures rebated in store (Instant Savings) or with direct installation (EPI) |                                                      | -                                                                                      |
| Baseline                                           | Standard-compliant fixtures connected to the grid                                       | Non-LED fixtures connected to the grid <sup>45</sup> |                                                                                        |
| <b>General Parameters</b>                          |                                                                                         |                                                      |                                                                                        |
| Installation Rate                                  | 100%                                                                                    |                                                      | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 1.9                                                                                     | 10                                                   | See Subsection 3.1                                                                     |
| <b>Electrical Savings Parameters</b>               |                                                                                         |                                                      |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 81.0                                                                                    | 92.6                                                 | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio (W/kWh)                | 0.162                                                                                   |                                                      | See Subsection 2.1.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 13.1                                                                                    | 15.0                                                 | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0.0%                                                                                    |                                                      | See Subsection 2.1.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0.0%                                                                                    |                                                      | See Subsection 2.1.1                                                                   |

## Electrical Unitary Energy Savings

Since solar fixtures consume no electricity from the grid, all the electrical energy consumed by the baseline fixture is saved. The only solar fixtures currently offered are outdoor security fixtures with motion sensors.

The unitary savings value for solar fixtures with motion sensors is based on the outdoor motion sensor equation adapted as follows to consider the nil consumption of the new fixtures.

$$Energy\ Savings\ \left[\frac{kWh}{yr}\right] = \frac{Baseline\ Wattage\ [W] \times Old\ HOU\ \left[\frac{h}{day}\right] \times 365\ \left[\frac{day}{yr}\right]}{1,000\ \left[\frac{W}{kW}\right]}$$

The value for each parameter and resulting unitary savings value are summarized in Table 25.

<sup>45</sup> For solar fixtures, E1 requires electricians to replace non-LED outdoor fixtures only.

**Table 25: Unitary Savings Values for Solar Fixtures**

| Parameter                         | Instant Savings | EPI  | Reference                                                                                                                                                                               |
|-----------------------------------|-----------------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Baseline Wattage [W]              | 46.7            | 53.4 | <u>Instant Savings</u> : Standard-compliant lamps providing the same lighting output as the rebated solar fixtures<br><u>EPI</u> : See Table 26 for representative lamp mix calculation |
| Old Operating Time [hrs/day]      | 4.75            |      | Used the old operating time for outdoor motion sensors in Table 19 as indicated in 2011 OPA Prescriptive Measures and Assumptions List <sup>46</sup>                                    |
| Unitary Energy Savings [kWh/year] | 81.0            | 92.6 | Calculation                                                                                                                                                                             |

**Table 26: Representative Lamp Mix Calculation for Solar Fixtures through EPI**

| Parameter                           | Value                                                                                                                                                                         | Reference                                                                                                                                                                                                                                                                              |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Representative lamp mix wattage [W] | $(100 \text{ W} \times 16\% [\text{incandescent}] + 90 \text{ W} \times 7\% [\text{halogen}] + 23 \text{ W} \times 33\% [\text{CFL}]) / (16\% + 7\% + 33\%) = 53.4 \text{ W}$ | Assumed a representative lamp mix while excluding LED lighting using the United States Department of Energy residential lighting technology distribution for outdoor lighting <sup>47</sup><br>Wattages in this calculation are baseline technology equivalent values for 1,500 lumens |

## Installation Rates

The installation rate is assumed to be 100%.

<sup>46</sup> Ontario Power Authority (OPA), 2011 Prescriptive Measures and Assumptions Version 1, March 2011.

<sup>47</sup> U.S. Department of Energy, 2020 U.S. Lighting Market Characterization, April 2024, p. 44.



## 2.2 Water Heating

### 2.2.1 Interactive Effects

#### Hot Water Insulation Measures

For hot water insulation measures, namely pipe insulation and hot water tank wraps, the interactive effects factors are based on engineering calculations to account for the duration of the heating and cooling seasons, cooling and heating system efficiency, and the percentage of heat generated inside the heated portion of the building envelope.

This section contains the detailed methodology for calculating interactive effects as well as the rationale for interactive effects for single-family homes and apartments. The distinction between interactive effects for these two types of dwellings comes from the assumption that domestic hot water (DHW) insulation measures are more likely to be installed in conditioned spaces in apartments than in single-family homes.

#### Single-family Homes

Based on site visit results from the 2015 evaluation<sup>48</sup> and accounting for the proportion of DHW insulation measures installed in conditioned spaces, the average number of months during which heating interactive effects occur in a single-family home is 3.8 months. It is assumed that the impact of DHW on cooling loads is negligible since most measures were installed in basements or garages, which might be heated but are rarely air-conditioned. Similar to lighting measures, it is assumed that 10% of the heat released by the pipes and DHW is lost through exterior walls and ceilings and does not contribute to the interactive effects.

For single-family homes with heat pump heating, since the interactive effects factors are based on a heating system efficiency of 100%, some adjustments are necessary for homes that use a heat pump as a primary heating system because the efficiency of such systems is superior to 100%. To do so, the interactive effects factor for heating (-28.5%) is divided by 1.8, the COP of a standard mini-split heat pump based on an HSPF2 Region V of 6.0, which is the value for a standard split heat pump as defined by the Federal Energy Efficiency Regulations.<sup>49</sup>

#### Apartments

Based on the assumption that DHW insulation measures are installed in conditioned spaces, a heating period of eight months was used as the average number of months during which heating interactive effects occur in an apartment. Similarly, cooling interactive effects occur for the duration of the cooling period, which is two months.

To adjust the potential interactive effects on air-conditioning systems, the Evaluator used an average COP of 3.5 for apartments with heat pumps and a COP of 2.9 for apartments with air conditioning, which are consistent with the assumptions outlined in Subsection 2.1.1.

#### Peak Demand

As for the impact on peak demand savings, it is assumed that all the DHW tanks in a conditioned or semi-conditioned space create interactive effects. Therefore, similar to lighting products, the interactive effects factor for peak demand savings in electrically heated homes is -90%.

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<sup>48</sup> Econoler, *Residential Direct Install 2015 Evaluation*, March 3, 2016.

<sup>49</sup> Minister of Justice, Canada, *Energy Efficiency Regulations*, 2016, <http://laws-lois.justice.gc.ca/PDF/SOR-2016-311.pdf> (last accessed December 5, 2019).

Table 27 summarizes the interactive effects factors for DHW insulation measures.

**Table 27: Interactive Effects Factors for Pipe Insulation and Hot Water Tank Wraps**

| Parameter           |                                                      | Energy Interactive Effects During Heating Period | Energy Interactive Effects During Cooling Period | Total Energy Interactive Effects | Peak Demand Interactive Effects |
|---------------------|------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|----------------------------------|---------------------------------|
| Single-family Homes | Heat Pump Heating                                    | $-90\% \times 3.8 / 12 / 1.8 = -15.8\%$          | 0.0%                                             | -15.8%                           | -90.0%                          |
|                     | Electrical Heating                                   | $-90\% \times 3.8 / 12 = -28.5\%$                | 0.0%                                             | -28.5%                           | -90.0%                          |
|                     | No Electrical Heating                                | 0.0%                                             | 0.0%                                             | 0.0%                             | 0%                              |
| Apartments          | Heat Pump Heating and Cooling                        | $-90\% \times 8 / 12 / 1.8 = -33.3\%$            | $90\% / 3.5 \times 2 / 12 = +4.3\%$              | -29.0%                           | -90.0%                          |
|                     | Electrical Heating with Air Conditioning             | $-90\% \times 8 / 12 = -60.0\%$                  | $90\% / 2.9 \times 2 / 12 = +5.2\%$              | -54.8%                           | -90.0%                          |
|                     | Electrical Heating Without Air Conditioning          | $-90\% \times 8 / 12 = -60.0\%$                  | 0.0%                                             | -60.0%                           | -90%                            |
|                     | No Electrical Heating with Air Conditioning          | 0.0%                                             | $90\% / 2.9 \times 2 / 12 = +5.2\%$              | +5.2%                            | 0%                              |
|                     | With Neither Electrical Heating nor Air Conditioning | 0.0%                                             | 0.0%                                             | 0.0%                             | 0%                              |

## Other DHW Measures

For the remaining DHW measures, interactive effects are nil, with the exception of HPWHs. For HPWH measures, interactive effects are already included in the engineering equation used to calculate the unitary savings value. Therefore, no additional interactive effects factor is applied to those savings.

## Summary

Table 28 summarizes the interactive effects factors established for each water heating measure.

**Table 28: Interactive Effects Factors for Water Heating Measures**

| Measure                                | Type of Home                                                    | Interactive Effects Factors for Energy Savings | Interactive Effects Factors for Peak Demand Savings | Source                                                          |
|----------------------------------------|-----------------------------------------------------------------|------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------------|
| Drain Water Heat Recovery              | N/A                                                             | 0%                                             | 0%                                                  | Assumption                                                      |
| Solar Domestic Hot Water               |                                                                 |                                                |                                                     |                                                                 |
| Heat Pump Water Heater                 |                                                                 | 0%                                             | 0%                                                  | Included in engineering equation – refer to Subsection 1.1.1(3) |
| Low-flow Showerhead                    |                                                                 | 0%                                             | 0%                                                  | Assumption                                                      |
| Faucet Aerator                         |                                                                 |                                                |                                                     |                                                                 |
| Thermostatic Shower Valve              |                                                                 |                                                |                                                     |                                                                 |
| Pipe Insulation<br>Hot Water Tank Wrap | Single-family Homes, Heat Pump Heating                          | -15.8%                                         | -90%                                                | Calculation                                                     |
|                                        | Single-family Homes, Electrical Heating                         | -28.5%                                         | -90%                                                |                                                                 |
|                                        | Single-family Homes, no Electrical Heating                      | 0%                                             | 0%                                                  |                                                                 |
|                                        | Apartments, Heat Pump Heating with Air Conditioning             | -29.0%                                         | -90%                                                |                                                                 |
|                                        | Apartments, Electrical Heating with Air Conditioning            | -54.8%                                         | -90%                                                |                                                                 |
|                                        | Apartments, Electrical Heating Without Air Conditioning         | -60.0%                                         | -90%                                                |                                                                 |
|                                        | Apartments, no Electrical Heating with Air Conditioning         | +5.2%                                          | 0%                                                  |                                                                 |
|                                        | Apartments with Neither Electrical Heating nor Air Conditioning | 0%                                             | 0%                                                  |                                                                 |

## 2.2.2 Peak Demand Savings Factors

For most water heating measures, peak demand savings are calculated using the peak demand-to-energy ratios developed by Navigant in the 2016-2018 DSM Plan. These ratios were established for various product categories based on modelled system-coincident peak demand savings and electrical energy savings for a projected deployment of products. Navigant used local data to establish the ratios applicable for the 2016-2018 period. The Evaluator recommends using the same ratios during the 2023-2025 DSM cycle, since this end-use load shape is unlikely to have changed significantly since 2026.

For solar domestic hot water (DHW), the peak demand-to-energy ratio is nil. Solar DHW systems provide no peak demand savings because the sun has set during the peak demand period.

Table 29 summarizes the peak demand-to-energy ratios established for each water heating measure.

**Table 29: Peak Demand-to-energy Ratios for Water Heating Measures**

| Measure                   | Peak Demand-to-energy Ratio (W/kWh) | Source                                                                                                 |
|---------------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------|
| Drain Water Heat Recovery | 0.162                               | RES-Water Heat, Navigant 2016-2018 DSM Plan                                                            |
| Heat Pump Water Heater    |                                     |                                                                                                        |
| Low-flow Showerhead       |                                     |                                                                                                        |
| Faucet Aerator            |                                     |                                                                                                        |
| Thermostatic Shower Valve |                                     |                                                                                                        |
| Pipe Insulation           |                                     |                                                                                                        |
| Hot Water Tank Wrap       | 0.000                               | Solar DHW systems provide no peak demand savings because the sun has set during the peak demand period |
| Solar Domestic Hot Water  |                                     |                                                                                                        |

## 2.2.3 Water Heating Measures

### (1) Drain Water Heat Recovery

#### Summary

Table 30 presents a summary of the values used to calculate drain water heat recovery (DWHR) savings. The detailed methodology follows.

**Table 30: Drain Water Heat Recovery Measure Summary**

| Parameter                                          | MHEEP                                                                       | Reference                                                                              |
|----------------------------------------------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                             |                                                                                        |
| Measure                                            | Drain water heat recovery for electric DHW heating with direct installation | -                                                                                      |
| Baseline                                           | Shower drains without drain water heat recovery                             |                                                                                        |
| General Parameters                                 |                                                                             |                                                                                        |
| Installation Rate                                  | 100%                                                                        | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 20                                                                          | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                             |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 599                                                                         | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                       | See Subsection 2.2.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 97.0                                                                        | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                          | See Subsection 2.2.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                          | See subsection 2.2.1                                                                   |



## Electrical Unitary Energy Savings

The DWHR unitary savings values were determined using the HOT2000 simulation tool since it includes DWHR as an option. Although a typical single-family home and multifamily building were modelled, the savings for DWHR were the same regardless of the building type when looking at savings per occupant. The unitary savings values were obtained using the equation below and the values presented in Table 31 afterwards.

$$\text{Energy Savings}_{kWh} = \text{Savings per Occupant} \times \text{Number of Persons per Household}$$

**Table 31: Electrical Unitary Energy Savings Values for Drain Water Heat Recovery Systems**

| Parameter                                       | MHEEP | Reference                          |
|-------------------------------------------------|-------|------------------------------------|
| <b>Inputs to the HOT2000 Simulation</b>         |       |                                    |
| Number of Showers per Person per Day [shower]   | 0.67  | Mayer, Oreo et al. <sup>50</sup>   |
| Average Shower Duration <sup>51</sup> [minutes] | 8     | DeOreo et al. <sup>52</sup>        |
| Shower Flow Rate [litres/minute]                | 9.5   | 2019 Connecticut TRM <sup>53</sup> |
| <b>Energy Savings Calculation</b>               |       |                                    |
| Number of Persons per Household [person]        | 3.6   | 2022 MHEEP tracking sheet          |
| Energy Savings per Occupant [kWh/person]        | 166.4 | HOT2000 simulations                |
| Unitary Energy Savings [kWh/year]               | 599   | Calculated                         |

## Installation Rates

Installation rates for drain water heat recovery systems are estimated at 100% because they are installed by MHEEP contractors.

<sup>50</sup> Mayer, P. W., DeOreo W. B. and al., *Residential End Uses of Water*, published by the AWWA Research Foundation, 1999, pp. 99-102.

<sup>51</sup> Ibid.

<sup>52</sup> Mayer, P. W., DeOreo W. B. and al., *Residential End Uses of Water*, Version 2: Executive Report, published by Water Research Foundation, April 2016. pp. 5-8.

<sup>53</sup> United Illuminating Company and Connecticut Light & Power Company, *Connecticut Program Savings Document, 15<sup>th</sup> Edition for 2019 Program Year*, March 2019.

## (2) Solar Domestic Hot Water

### Summary

Table 32 presents a summary of the values used to calculate solar domestic hot water (DHW) savings. The detailed methodology follows.

**Table 32: Solar Domestic Hot Water Measure Summary**

| Parameter                                          | Green Heat                                              | Reference                                                                              |
|----------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                         |                                                                                        |
| Measure                                            | Solar domestic hot water heating rebated after purchase | -                                                                                      |
| Baseline                                           | Existing conventional electric water heater             |                                                                                        |
| General Parameters                                 |                                                         |                                                                                        |
| Installation Rate                                  | 100%                                                    | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 20                                                      | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                         |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | N/A (Calculated using RETScreen)                        | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0                                                       | See Subsection 2.2.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0                                                       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                      | See Subsection 2.2.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                      | See Subsection 2.2.1                                                                   |

### Electrical Unitary Energy Savings

The unitary savings value for solar DHW systems installed through Green Heat is calculated for each system using a custom RETScreen model.

### Unitary Peak Demand Savings

Solar DHW systems provide no peak demand savings because the sun has set during the peak demand period.

### Installation Rates

Installation rates for solar DHW systems are estimated at 100% due to their relatively high cost.

### (3) Heat Pump Water Heaters

#### Summary

Table 33 presents a summary of the values used to calculate heat pump water heater (HPWH) savings. Savings are included for a market transformation HPWH program, in addition to other resource acquisition program components. The detailed methodology follows.

**Table 33: Heat Pump Water Heater Measure Summary**

| Parameter                                          | HEA, MHEEP                                                                                                                                                                                                                    |                                             |                                   | Instant Savings, HPWH                                                              |                                                                                        | Reference |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------|
| Measure Description and Identification             |                                                                                                                                                                                                                               |                                             |                                   |                                                                                    |                                                                                        |           |
| Measure                                            | Heat pump water heaters for electric DHW heating with direct installation (MHEEP), rebated after installation (HEA), rebated in store (Instant Savings) or installed as a result of a market transformation initiative (HPWH) |                                             |                                   |                                                                                    | -                                                                                      |           |
| Baseline                                           | Electric resistance water heating                                                                                                                                                                                             |                                             |                                   |                                                                                    |                                                                                        |           |
| Application                                        | Value for non-electric space heating                                                                                                                                                                                          | Value for electric resistance space heating | Value for heat pump space heating | Average value for non-electrical, electric resistance, and heat pump space heating |                                                                                        |           |
| General Parameters                                 |                                                                                                                                                                                                                               |                                             |                                   |                                                                                    |                                                                                        |           |
| Installation Rate                                  | 100%                                                                                                                                                                                                                          |                                             |                                   |                                                                                    | See details below under Installation Rates                                             |           |
| Effective Useful Life [years]                      | 15                                                                                                                                                                                                                            |                                             |                                   |                                                                                    | See Subsection 3.2                                                                     |           |
| Electrical Savings Parameters                      |                                                                                                                                                                                                                               |                                             |                                   |                                                                                    |                                                                                        |           |
| Unitary Energy Savings [kWh/year]                  | 1,611                                                                                                                                                                                                                         | 1,179                                       | 1,280                             | 1,007                                                                              | See details below under Electrical Unitary Energy Savings                              |           |
| Peak Demand-to-energy Ratio (W/kWh)                | 0.162                                                                                                                                                                                                                         |                                             |                                   |                                                                                    | See Subsection 2.2.2                                                                   |           |
| Unitary Peak Demand Savings [W]                    | 261                                                                                                                                                                                                                           | 191                                         | 207                               | 163                                                                                | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |           |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                                                                                                                            |                                             |                                   |                                                                                    | Included in engineering equation. See details under Electrical Unitary Savings         |           |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                                                                                                                            |                                             |                                   |                                                                                    |                                                                                        |           |

## Electrical Unitary Energy Savings

The unitary savings for HPWHs are taken from a metering study conducted for NEEA.<sup>54</sup> They include interactive effects. Instant Savings Average Unitary Energy Savings is a weighted average based on the share of space heating systems in Nova Scotia; it calculates the electric energy savings only, by taking into account the proportion of replaced water heaters that electric water heaters among households that have non-electric, electric resistance and heat pump space heating.

Table 34 below lists the equation parameters and corresponding values, as well as the resulting unitary savings values.

---

<sup>54</sup> Ecotope inc., *NEEA Heat Pump Water Heater Model Validation Study*, March 2, 2015.

**Table 34: Electrical Unitary Savings Values for Heat Pump Water Heaters**

| Parameter                                        | Symbol   | HEA, MHEEP                 |                                   |                         | Instant Savings, HPWH      |                                   |                         | Source                                                      |
|--------------------------------------------------|----------|----------------------------|-----------------------------------|-------------------------|----------------------------|-----------------------------------|-------------------------|-------------------------------------------------------------|
|                                                  |          | Non-electric Space Heating | Electric Resistance Space Heating | Heat Pump Space Heating | Non-electric Space Heating | Electric Resistance Space Heating | Heat Pump Space Heating |                                                             |
| Savings Including Interactive Effects [kWh/year] |          | 1,611                      | 1,179                             | 1,280                   | 1,611                      | 1,179                             | 1,280                   | 2015 Ecotope inc. <sup>55</sup>                             |
| Share of Electric Water Heaters in Nova Scotia   | -        | N/A                        |                                   |                         | 57%                        | 97%                               | 83%                     | Based on 2022 and 2023 EPI tracking sheets <sup>56,57</sup> |
| Unitary Energy Savings [kWh/year]                | -        | 1,611                      | 1,179                             | 1,280                   | 918                        | 1,144                             | 1,062                   | Calculation                                                 |
| Share of Space Heating Systems in Nova Scotia    | -        | N/A                        |                                   |                         | 53%                        | 26%                               | 21%                     | Statistics Canada <sup>58</sup>                             |
| <b>Average Unitary Energy Savings [kWh/year]</b> | <b>-</b> | <b>1,611</b>               | <b>1,179</b>                      | <b>1,280</b>            | <b>1,007</b>               |                                   |                         | <b>Calculation</b>                                          |

## Installation Rates

Installation rates for heat pump water heaters are estimated at 100% due to their relatively high cost.

<sup>55</sup> Ecotope inc., *NEEA Heat Pump Water Heater Model Validation Study*, 2015, p. 72.

Average of 3 non-ducted models in heating zone 3 (most comparable to Nova Scotia). All water heaters are assumed to be in heated spaces since HEA tracking sheet shows that is the case for more than 98% of homes. Used Interior "EFAF" for electric resistance space heating, "interior HP" for heat pumps space heating and "interior gas" for non-electrical space heating.

<sup>56</sup> The proportions of electric water heating published by NRCAN are not consistent and significantly lower than the value obtained from EPI participants. Therefore, the proportion of electrical water heating is based on EPI tracking sheet data.

<sup>57</sup> Given the change in the EPI program in 2021, the data for the proportion of electric water heating didn't reflect what was previously observed. Therefore, data from only the 2022 and 2023 EPI tracking sheets were used.

<sup>58</sup> Statistics Canada, *Table 38-10-0286-01 (formerly CANSIM 153-0145) Primary heating systems and type of energy*, 2021, December 12, 2022.

<https://www150.statcan.gc.ca/t1/tbl1/en/cv/recreate.action?pid=3810028601&selectedNodeIds=1D4&checkedLevels=1D1&refPeriods=20170101,20210101&dimensionLayouts=layout3,layout3,layout2&vectorDisplay=false> (last accessed September 13, 2024).

## (4) Low-flow Showerheads

### Summary

Table 35 presents a summary of the values used to calculate low-flow showerhead savings. The detailed methodology follows.

**Table 35: Low-flow Showerhead Measure Summary**

| Parameter                                          |                                                                        | EPI                             |                              |                                |                                 |                                            | Reference                                                                              |
|----------------------------------------------------|------------------------------------------------------------------------|---------------------------------|------------------------------|--------------------------------|---------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                        |                                 |                              |                                |                                 |                                            |                                                                                        |
| Measure                                            | Low-flow showerheads for electric DHW heating with direct installation |                                 |                              |                                |                                 | -                                          |                                                                                        |
| Baseline                                           | Standard showerhead with a flow rate of at least 2 gpm                 |                                 |                              |                                |                                 | -                                          |                                                                                        |
| Measure Subcategory                                | Single-family homes                                                    |                                 |                              | Apartments                     |                                 |                                            | -                                                                                      |
|                                                    | Flow rate reduction of 0.5 gpm                                         | Flow rate reduction of 0.75 gpm | Flow rate reduction of 1 gpm | Flow rate reduction of 0.5 gpm | Flow rate reduction of 0.75 gpm | Flow rate reduction of 1 gpm               |                                                                                        |
| General Parameters                                 |                                                                        |                                 |                              |                                |                                 |                                            |                                                                                        |
| Installation Rate                                  | 95%                                                                    |                                 |                              |                                |                                 | See details below under Installation Rates |                                                                                        |
| Effective Useful Life [years]                      | 10                                                                     |                                 |                              |                                |                                 | See Subsection 3.2                         |                                                                                        |
| Electrical Savings Parameters                      |                                                                        |                                 |                              |                                |                                 |                                            |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 197                                                                    | 296                             | 395                          | 225                            | 338                             | 450                                        | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                  |                                 |                              |                                |                                 | See Subsection 2.2.2                       |                                                                                        |
| Unitary Peak Demand Savings [W]                    | 31.9                                                                   | 48.0                            | 64.0                         | 36.5                           | 54.8                            | 72.9                                       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                     |                                 |                              |                                |                                 | See Subsection 2.2.1                       |                                                                                        |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                     |                                 |                              |                                |                                 | See Subsection 2.2.1                       |                                                                                        |

## Electrical Unitary Energy Savings

The equations below are used to determine the annual unitary savings values for low-flow showerheads. The reduction in domestic hot water consumption is established by the difference between the base and efficient domestic hot water consumption levels, as presented in the second equation.

$$\begin{aligned} \text{Energy Savings} \left[ \frac{kWh}{year} \right] &= \text{DHW Reduction} \left[ \frac{gal}{day} \right] \times \frac{1}{\eta} \times Cp_{H2O} \left[ \frac{Btu}{lb \cdot ^\circ F} \right] \times \rho_{H2O} \left[ \frac{lb}{ft^3} \right] \times \Delta T_{H2O} [^\circ F] \times n_{days} \left[ \frac{days}{year} \right] \\ &\times UC1 \left[ \frac{kWh}{Btu} \right] \times UC2 \left[ \frac{ft^3}{gal} \right] \times \%DWH_{elec} \\ \text{DHW Reduction} \left[ \frac{gal}{day} \right] &= (q_{base} - q_{low}) [gpm] \times \frac{n_{people} [person]}{n_{showerheads}} \times \%DHW \times t_{shower} \left[ \frac{min}{shower} \right] \\ &\times n_{shower} \left[ \frac{shower}{day \cdot person} \right] \end{aligned}$$

Table 36 below lists the parameters and corresponding values applied in the equations above for low-flow showerheads and the resulting unitary savings values.

**Table 36: Electrical Unitary Energy Savings Values for Low-flow Showerheads**

| Parameter                                                        | Symbol            | EPI                                      |                                          | Reference                                                                           |
|------------------------------------------------------------------|-------------------|------------------------------------------|------------------------------------------|-------------------------------------------------------------------------------------|
|                                                                  |                   | Single-family Homes                      | Apartments                               |                                                                                     |
| Baseline Flow Rate [gpm]                                         | $q_{base}$        | Variable (2.0 gpm, 2.25 gpm, or 2.5 gpm) | Variable (2.0 gpm, 2.25 gpm, or 2.5 gpm) | Measure specific - use information in TS                                            |
| Low-flow Rate [gpm]                                              | $q_{low}$         | 1.5                                      |                                          | 2021 EPI Program Manual                                                             |
| Number of People per Household [person]                          | $n_{people}$      | 2.5                                      | 1.9                                      | 2020 EPI November tracking sheet                                                    |
| Average Number of Showers per Day per Person [shower/day/person] | $n_{shower}$      | 0.67                                     |                                          | Mayer and Oreo <sup>59</sup>                                                        |
| Number of Showerheads per Household [showers]                    | $n_{showerheads}$ | 1.50                                     | 1                                        | Single-family homes: 2024 EPI Evaluation (on-site visits)<br>Apartments: Assumption |
| Average Shower Time per Person [min/shower]                      | $t_{shower}$      | 7.8                                      |                                          | DeOreo et al. <sup>60</sup>                                                         |
| Percentage of Hot Water Used in Showers                          | $\%_{DHW}$        | 63%                                      |                                          | DeOreo et al. <sup>61</sup>                                                         |
| Number of Days per Year [days/year]                              | $n_{days}$        | 365                                      |                                          | Convention                                                                          |
| Specific Heat of Water [Btu/lb°F]                                | $C_{pH_2O}$       | 1                                        |                                          | Convention                                                                          |
| Density of Water [lb/ft <sup>3</sup> ]                           | $\rho_{H_2O}$     | 62.43                                    |                                          | Convention                                                                          |
| Temperature Rise in Electrical Water Heater [°F]                 | $\Delta T_{H_2O}$ | 79                                       |                                          | 2011 OPA <sup>62</sup>                                                              |
| Electrical Water Heater Efficiency                               | $\eta$            | 98%                                      |                                          | Pennsylvania Public Utility Commission TRM <sup>63</sup>                            |
| Unit Conversion #1 [kWh/Btu]                                     | UC1               | 0.000293083                              |                                          | Convention                                                                          |

<sup>59</sup> Mayer, P. W., Oreo W. B. et al., *Residential End Uses of Water*, published by the AWWA Research Foundation, 1999, pp. 99-102.

<sup>60</sup> DeOreo et al. (2016). *Residential End Uses of Water*, Version 2: Executive Report, published by Water Research Foundation, <http://www.waterrf.org/PublicReportLibrary/4309A.pdf> (March 16, 2017), pp. 5-8.

<sup>61</sup> Obtained based on the total domestic water consumption level in showers per household (28.1 gpd) and the hot water use for showers (17.8 gpd) in DeOreo et al. (2016). *Residential End Uses of Water*, Version 2: Executive Report, published by Water Research Foundation, <http://www.waterrf.org/PublicReportLibrary/4309A.pdf> (March 16, 2017), p. 5.

<sup>62</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>63</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82.



**Table 37: Electrical Unitary Energy Savings Values for Low-flow Showerheads (Continued)**

| Parameter                                           | Symbol                          | EPI                 |            | Reference                                                                              |
|-----------------------------------------------------|---------------------------------|---------------------|------------|----------------------------------------------------------------------------------------|
|                                                     |                                 | Single-family Homes | Apartments |                                                                                        |
| Unit Conversion #2 [ft <sup>3</sup> /gal]           | UC2                             | 0.1337              |            | Convention                                                                             |
| Share of Participants with Electrical Water Heaters | %DHWelec                        | 100%                |            | EPI: Units claimed in DSM savings are installed in homes with electrical water heaters |
| Unitary Energy Savings [kWh/year]                   | Flow rate reduction of 0.5 gpm  | 197                 | 225        | Calculation                                                                            |
|                                                     | Flow rate reduction of 0.75 gpm | 296                 | 338        | Calculation                                                                            |
|                                                     | Flow rate reduction of 1 gpm    | 395                 | 450        | Calculation                                                                            |

## Installation Rates

Table 38 lists the installation rate for EPI low-flow showerheads.

**Table 38: EPI Low-flow Showerhead Installation Rate**

| Installation Rate | Margin of Error | Source                               |
|-------------------|-----------------|--------------------------------------|
| 95%               | 4.7%            | 2024 EPI evaluation (on-site visits) |

## (5) Faucet Aerators

### Summary

Table 39 presents a summary of the values used to calculate faucet aerator savings. The detailed methodology follows.

**Table 39: Faucet Aerator Measure Summary**

| Parameter                                          | EPI                                                               |            | Reference                                                                              |
|----------------------------------------------------|-------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                   |            |                                                                                        |
| Measure                                            | Faucet aerators for electric DHW heating with direct installation |            | -                                                                                      |
| Baseline                                           | Standard faucet with no aerator                                   |            |                                                                                        |
| Application                                        | Single-family homes                                               | Apartments |                                                                                        |
| General Parameters                                 |                                                                   |            |                                                                                        |
| Installation Rate                                  | 92%                                                               |            | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                                |            | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                   |            |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 118                                                               | 128        | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                             |            | See Subsection 2.2.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 19.1                                                              | 20.7       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                |            | See Subsection 2.2.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                |            | See Subsection 2.2.1                                                                   |

### Electrical Unitary Energy Savings

The equation below is used to calculate the annual unitary savings value for faucet aerators.

$$\begin{aligned}
 & \text{Energy Savings} \left[ \frac{kWh}{yr} \right] \\
 &= \frac{(DHW_{base} - DHW_{efficient}) \left[ \frac{gal}{day} \right] \times Cp_{H_2O} \left[ \frac{BTU}{lb^{\circ}F} \right] \times \rho_{H_2O} \left[ \frac{lb}{ft^3} \right] \times \Delta T_{H_2O} [^{\circ}F] \times n_{days} \left[ \frac{days}{yr} \right] \times UC1 \left[ \frac{kWh}{BTU} \right] \times UC2 \left[ \frac{ft^3}{gal} \right]}{\eta}
 \end{aligned}$$

The base domestic hot water consumption value ( $DHW_{base}$ ) is calculated with the equation below:

$$DHW_{base} \left[ \frac{gal}{day} \right] = \frac{DW_{person} \left[ \frac{gal}{day \cdot person} \right] \times n_{people} [person] \times \%_{DHW}}{n_{faucets}}$$

The efficient domestic hot water consumption value ( $DHW_{efficient}$ ) is calculated by using the baseline flow rate ( $q_{base}$ ), low-flow rate ( $q_{low}$ ), and base domestic hot water consumption value, as illustrated in the equation below:

$$DHW_{efficient} \left[ \frac{gal}{day} \right] = DHW_{base} \left[ \frac{gal}{day} \right] \times \left( 1 - \frac{q_{base} - q_{low}}{q_{base}} \right)$$

Table 40 lists the parameters and values applied in the three equations above for faucet aerators and the resulting unitary savings values.

**Table 40: Electrical Unitary Savings Values for Faucet Aerators**

| Parameter                                        | Symbol            | Value for Single-family Homes | Value for Apartments | Source                                                                                                                             |
|--------------------------------------------------|-------------------|-------------------------------|----------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Baseline Flow Rate [gpm]                         | $q_{base}$        | 1.39                          | 1.39                 | DeOreo et al. in <i>Residential End Uses of Water Study Update</i> , as cited in Illinois Commerce Commission (2016) <sup>64</sup> |
| Low-flow Rate [gpm]                              | $q_{low}$         | 0.94                          | 0.94                 | DeOreo et al. in <i>Residential End Uses of Water Study Update</i> , as cited in Illinois Commerce Commission (2016) <sup>65</sup> |
| Number of People per Household [person]          | $n_{people}$      | 2.5                           | 1.9                  | 2020 EPI November tracking sheet                                                                                                   |
| DW Used per Person [gpd]                         | $DW_{person}$     | 9.9                           |                      | DeOreo et al. <sup>66</sup>                                                                                                        |
| Percentage of Hot Water Used by Faucet Aerator   | $\%_{DHW}$        | 59%                           |                      | DeOreo et al. <sup>67</sup>                                                                                                        |
| Number of Faucets per Household                  | $n_{faucets}$     | 2.85                          | 2                    | Single-family homes: EPI 2024 on-site visits<br>Apartments: Assumption                                                             |
| Specific Heat of Water [Btu/lb°F]                | $C_{pH_2O}$       | 1                             |                      | Convention                                                                                                                         |
| Density of Water [lb/ft³]                        | $\rho_{H_2O}$     | 62.43                         |                      | Convention                                                                                                                         |
| Temperature Rise in Electrical Water Heater [°F] | $\Delta T_{H_2O}$ | 79                            |                      | OPA Prescriptive Measures and Assumptions 2011 <sup>68</sup>                                                                       |
| Electrical Water Heater Efficiency               | $\eta$            | 98%                           |                      | Pennsylvania TRM <sup>69</sup>                                                                                                     |
| Number of Days per Year [days/year]              | $n_{days}$        | 365                           |                      | Convention                                                                                                                         |
| Unit Conversion #1 [kWh/Btu]                     | UC1               | 0.000293083                   |                      | Convention                                                                                                                         |
| Unit Conversion #2 [ft³/gal]                     | UC2               | 0.1337                        |                      | Convention                                                                                                                         |
| <b>Unitary Energy Savings [kWh/year]</b>         | -                 | <b>118</b>                    | <b>128</b>           | <b>Calculation</b>                                                                                                                 |

<sup>64</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 5.0 – Volume 3: Residential Measures*, February 11, 2016, p. 175.

<sup>65</sup> Ibid.

<sup>66</sup> Obtained based on the total domestic water consumption through faucets per household (26.3 gpd) and the average number of people per participating household (2.65) in DeOreo et al. *Residential End Uses of Water, Version 2: Executive Report*, published by Water Research Foundation, 2016, pp. 5-8.

<sup>67</sup> Obtained based on the total domestic water consumption through faucets per household (26.3 gpd) and the hot water use through faucets (15.4 gpd) in DeOreo et al. *Residential End Uses of Water, Version 2: Executive Report*, published by Water Research Foundation, 2016, p. 5.

<sup>68</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>69</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82.



## Installation Rates

Table 41 lists the installation rate for EPI faucet aerators.

**Table 41: EPI Faucet Aerator Installation Rate**

| Installation Rate | Margin of Error | Reference                            |
|-------------------|-----------------|--------------------------------------|
| 92%               | 7.0%            | 2024 EPI evaluation (on-site visits) |

## (6) Thermostatic Shower Valves

### Summary

Table 42 presents a summary of the values used to calculate thermostatic shower valve savings. The detailed methodology follows.

**Table 42: Thermostatic Shower Valve Measure Summary**

| Parameter                                          |                                                                              | EPI        |                                                                                        | Reference |
|----------------------------------------------------|------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------|-----------|
| Measure Description and Identification             |                                                                              |            |                                                                                        |           |
| Measure                                            | Thermostatic shower valves for electric DHW heating with direct installation |            | -                                                                                      |           |
| Baseline                                           | Showerheads with a flow rate of 2.5 gpm with no thermostatic shower valve    |            |                                                                                        |           |
| Application                                        | Single-family homes                                                          | Apartments |                                                                                        |           |
| General Parameters                                 |                                                                              |            |                                                                                        |           |
| Installation Rate                                  | 89%                                                                          |            | See details below under Installation Rates                                             |           |
| Effective Useful Life [years]                      | 10                                                                           |            | See Subsection 3.2                                                                     |           |
| Electrical Savings Parameters                      |                                                                              |            |                                                                                        |           |
| Unitary Energy Savings [kWh/year]                  | 124                                                                          | 141        | See details below under Electrical Unitary Energy Savings                              |           |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                        |            | See Subsection 2.2.2                                                                   |           |
| Unitary Peak Demand Savings [W]                    | 20.1                                                                         | 22.8       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |           |
| Interactive Effects Factor for Energy Savings      | 0%                                                                           |            | See Subsection 2.2.1                                                                   |           |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                           |            | See Subsection 2.2.1                                                                   |           |

## Electrical Unitary Energy Savings

The equation below is used to determine the annual unitary savings values for thermostatic shower valves. Energy savings are established by calculating the reduction in domestic hot water usage, as presented in the second equation below.

$$DHW \text{ Reduction } \left[ \frac{gal}{year} \right] = q \left[ \frac{gal}{min} \right] \times n_{people} [person] \times \%_{DHW} \times t_w \left[ \frac{min}{shower} \right] \times n_{shower} \left[ \frac{shower}{day \cdot person} \right] \times \frac{1}{n_{showerhead}}$$

Table 43 below lists the parameters and corresponding values applied to the two equations above and the resulting unitary savings values for thermostatic shower valves.

**Table 43: Electrical Unitary Energy Savings Values for Thermostatic Shower Valves**

| Parameter                                                        | Symbol               | Value for Single-family Homes | Value for Apartments | Reference                                                              |
|------------------------------------------------------------------|----------------------|-------------------------------|----------------------|------------------------------------------------------------------------|
| Flow Rate [gpm]                                                  | q                    | 2.5 gpm                       |                      | EPI 2024 Program Manual                                                |
| Number of People per Household [person]                          | $\eta_{people}$      | 2.5                           | 1.9                  | 2020 EPI November tracking sheet                                       |
| Average Number of Showers per Day per Person [shower/day/person] | $\eta_{shower}$      | 0.67                          |                      | Mayer and Oreo <sup>70</sup>                                           |
| Average Number of Showerheads per Household [showerhead]         | $\eta_{showerheads}$ | 1.50                          | 1                    | Single-family homes: 2024 EPI on-site visits<br>Apartments: Assumption |
| Behavioural Waste Time [min/shower]                              | $t_w$                | 0.98                          |                      | Pennsylvania Public Utility Commission TRM <sup>71</sup>               |
| Percentage of Hot Water Used in Showers                          | $\%_{DHW}$           | 63%                           |                      | DeOreo et al. <sup>72</sup>                                            |
| Number of Days per Year [days/year]                              | $n_{days}$           | 365                           |                      | Convention                                                             |
| Specific Heat of Water [Btu/lb·°F]                               | $C_{pH_2O}$          | 1                             |                      | Convention                                                             |
| Density of Water [lb/ft³]                                        | $\rho_{H_2O}$        | 62.43                         |                      | Convention                                                             |
| Temperature Rise in Electrical Water Heater [°F]                 | $\Delta T_{H_2O}$    | 79                            |                      | OPA Prescriptive Measures and Assumptions 2011 <sup>73</sup>           |
| Unit Conversion #1 [kWh/Btu]                                     | UC1                  | 1 / 3,412                     |                      | Convention                                                             |
| Unit Conversion #2 [ft³/gal]                                     | UC2                  | 0.1337                        |                      | Convention                                                             |
| Electrical Water Heater Efficiency                               | $\eta$               | 98%                           |                      | Pennsylvania Public Utility Commission TRM <sup>74</sup>               |
| Unitary Energy Savings [kWh/year]                                | -                    | 124                           | 141                  | Calculation                                                            |

## Installation Rates

Table 44 lists the installation rate for thermostatic shower valves.

<sup>70</sup> Mayer, P. W., W. B. Oreo et al., *Residential End Uses of Water*, published by the AWWA Research Foundation, 1999, pp. 99-102.

<sup>71</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, August 2019 (revised February 2021), p. 93.

<sup>72</sup> Obtained based on the total domestic water consumption level in showers per household (28.1 gpd) and the hot water use for showers (17.8 gpd) in DeOreo et al. (2016). *Residential End Uses of Water, Version 2: Executive Report*, published by Water Research Foundation, <http://www.waterrf.org/PublicReportLibrary/4309A.pdf> (March 16, 2017), p. 5.

<sup>73</sup> Ontario Power Authority (OPA), *OPA Prescriptive Measures and Assumptions List*, December 2010.

<sup>74</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82.

**Table 44: Thermostatic Shower Valve Installation Rate**

| Installation Rate | Margin of Error | Reference                            |
|-------------------|-----------------|--------------------------------------|
| 89%               | 17.6%           | 2024 EPI evaluation (on-site visits) |

## (7) Pipe Insulation

### Summary

Table 45 presents a summary of the values used to calculate pipe insulation savings. The detailed methodology follows.

**Table 45: Pipe Insulation Measure Summary**

| Parameter                                          | EPI                                                                                        | Reference                                                                              |
|----------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                            |                                                                                        |
| Measure                                            | Pipe insulation of 0.75 in. in thickness for electric DHW heating with direct installation | -                                                                                      |
| Baseline                                           | Pipes with no insulation                                                                   |                                                                                        |
| Installation Rate                                  |                                                                                            |                                                                                        |
| Installation Rate                                  | 100%                                                                                       | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 13                                                                                         | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                                            |                                                                                        |
| Unitary Energy Savings (per ft) [kWh/year]         | 12.7                                                                                       | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                                      | See Subsection 2.2.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 2.06                                                                                       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | Calculation based on home heating and air-conditioning systems for each installed unit     | See Subsection 2.2.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                                            |                                                                                        |

### Electrical Unitary Energy Savings

As presented in Table 46, the annual unitary savings value for pipe insulation was identified through Ontario Power Authority (OPA) 2011<sup>75</sup> values and amounts, established at 12.7 kWh per linear foot.

**Table 46: Unitary Savings Value for Pipe Insulation**

| Parameter                                  | EPI  |
|--------------------------------------------|------|
| Unitary Energy Savings (per ft) [kWh/year] | 12.7 |

<sup>75</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011, p. 542.

## Installation Rates

Table 47 lists the installation rate for EPI pipe insulation.

**Table 47: EPI Pipe Insulation Installation Rate**

| Installation Rate | Margin of Error | Reference                            |
|-------------------|-----------------|--------------------------------------|
| 100%              | 0.0%            | 2024 EPI evaluation (on-site visits) |

## (8) Hot Water Tank Wraps

### Summary

Table 48 presents a summary of the values used to calculate hot water tank wrap savings. The detailed methodology follows.

**Table 48: Hot Water Tank Wrap Measure Summary**

| Parameter                                          | EPI                                                                                    |            | Reference                                                                              |
|----------------------------------------------------|----------------------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                        |            |                                                                                        |
| Measure                                            | Existing electric DHW heater with added tank wrap with direct installation             |            | -                                                                                      |
| Baseline                                           | Existing hot water tanks without wrap                                                  |            |                                                                                        |
| Application                                        | Single-family homes                                                                    | Apartments |                                                                                        |
| General Parameters                                 |                                                                                        |            |                                                                                        |
| Installation Rate                                  | 100%                                                                                   |            | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 7                                                                                      |            | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                                        |            |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 157                                                                                    | 117        | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.162                                                                                  |            | See Subsection 2.2.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 25.4                                                                                   | 19.0       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | Calculation based on home heating and air-conditioning systems for each installed unit |            | See Subsection 2.2.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                                        |            |                                                                                        |



## Electrical Unitary Energy Savings

The following equations are used to determine the annual unitary savings associated with hot water tank wraps. The energy savings are equal to the difference in heat losses associated with tank circumference ( $Q_{\text{tank}}$ ) before and after adding the tank wrap ( $Q_{\text{tank+RSI 1.21}}$ ). The heat losses are calculated using the following formulas of heat transfer in an insulated cylinder:

$$R_{\text{layer}} = \frac{\ln(r_e/r_i)}{2\pi k}$$

$$R_{\text{cyl}} = R_{\text{layer1}} + R_{\text{layer2}}$$

$$Q_{\text{cyl}} = \frac{T_i - T_e}{R_{\text{cyl}}} L$$

$$Q_{\text{top}} = \frac{A_{\text{top}} \times (T_i - T_e)}{R_{\text{top}}}$$

$$Q_{\text{total}} = Q_{\text{cyl}} + Q_{\text{top}}$$

$$\text{Energy Savings}_{\text{kWh}} = \frac{(Q_{\text{total}}) \cdot \text{HOU}}{\eta_{\text{heater}}}$$

The calculation considers a typical domestic tank with a capacity of 60 imperial gallons and a hot water tank wrap with a thermal resistance of 1.21 m<sup>2</sup>·°C/W.

Table 49 lists the values applied in equations presented above to obtain the unitary savings for tank wraps.

**Table 49: Electrical Unitary Savings Values for Hot Water Tank Wraps**

| Parameter                                                                                                                              | Symbol              | Value for Single-family Homes | Value for Apartments | Reference                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------------|----------------------|---------------------------------------------------------------------------|
| Layer 1: Interior Insulation of Tank                                                                                                   |                     |                               |                      |                                                                           |
| External Radius of the Layer [m]                                                                                                       | r <sub>e</sub>      | 0.300                         | 0.280                | Giant <sup>76</sup>                                                       |
| Internal Radius of the Layer [m]                                                                                                       | r <sub>i</sub>      | 0.249                         | 0.229                | Ibid                                                                      |
| Thermal Conductivity of the Layer [W/m·°C]                                                                                             | k                   | 0.024                         |                      | Ibid                                                                      |
| Thermal Resistance of the Layer of Material in the Cylinder (e.g. insulation inside the tank and tank wrap) [m <sup>2</sup> ·°C/W]     | R <sub>layer</sub>  | 1.228                         | 1.333                | Calculation                                                               |
| Thermal Resistance of the Top of the Tank [m <sup>2</sup> ·°C/W]                                                                       | R <sub>Top</sub>    | 2.113                         |                      | Giant <sup>77</sup>                                                       |
| Layer 2: Tank Wrap                                                                                                                     |                     |                               |                      |                                                                           |
| External Radius of the Layer [m]                                                                                                       | r <sub>e</sub>      | 0.351                         | 0.331                | Estimated from Frost King Insulation Blanket Specifications <sup>78</sup> |
| Internal Radius of the Layer [m]                                                                                                       | r <sub>i</sub>      | 0.300                         | 0.280                | Giant <sup>79</sup>                                                       |
| Thermal Conductivity of the Layer [W/m·°C]                                                                                             | k                   | 0.042                         |                      | Estimated from Frost King Insulation Blanket Specifications               |
| Thermal Resistance of the Layer of Material Inside the Cylinder (e.g. insulation inside the tank and tank wrap) [m <sup>2</sup> ·°C/W] | R <sub>layer</sub>  | 1.823                         | 1.965                | Calculation                                                               |
| Thermal Resistance of the Top of the Tank [m <sup>2</sup> ·°C/W]                                                                       | R <sub>Top</sub>    | 3.323                         |                      | Sum of R-values of the insulation inside the tank and tank wrap           |
| Heat Transfer                                                                                                                          |                     |                               |                      |                                                                           |
| Length of the Cylinder [m]                                                                                                             | L                   | 1.52                          | 1.22                 | Giant <sup>80</sup>                                                       |
| Area of the Top of the Tank [m²]                                                                                                       | A <sub>top</sub>    | 0.283                         | 0.246                | Calculated from Giant tank dimensions                                     |
| Temperature at the External Radius of the Cylinder [°C]                                                                                | T <sub>e</sub>      | 21                            |                      | Assumption for standard ambient indoor temperature                        |
| Temperature at the Internal Radius of the Cylinder [°C]                                                                                | T <sub>i</sub>      | 60                            |                      | OPA Prescriptive Measures and Assumptions 2011 <sup>81</sup>              |
| Hours of Use [h/year]                                                                                                                  | HOU                 | 8,760                         |                      | Assumption                                                                |
| Thermal Efficiency of Heating Element                                                                                                  | η <sub>heater</sub> | 98%                           |                      | Pennsylvania Public Utility Commission <sup>82</sup>                      |
| Heat Transfer Through the Tank [W]                                                                                                     | Q <sub>total</sub>  | 53.4                          | 40.2                 | Calculation                                                               |
| Heat Transfer Through the Insulated Tank [W]                                                                                           | Q <sub>total</sub>  | 35.8                          | 27.1                 | Calculation                                                               |
| Unitary Energy Savings for Tank Wrap [kWh/year]                                                                                        | -                   | 157                           | 117                  | Calculation                                                               |

<sup>76</sup> Giant Inc., *Engineering Submittal Data Sheet 172ETE Models*, <http://www.giantinc.com/tech-data/FT-172E-An.pdf> (last accessed February 18, 2015).

<sup>77</sup> Ibid.

<sup>78</sup> Frost King Weatherization Products, *Water Heater Insulation Blanket*, <http://www.frostking.com/water-heater-insulation-blanket/> (last accessed January 4, 2014).

## Installation Rates

Table 50 lists the installation rate for EPI hot water tank wraps.

**Table 50: EPI Hot Water Tank Wrap Installation Rate**

| Installation Rate | Margin of Error | Source                               |
|-------------------|-----------------|--------------------------------------|
| 100%              | 0.0%            | 2024 EPI evaluation (on-site visits) |

## 2.3 Space Heating

### 2.3.1 Interactive Effects

Since space heating measures target heating and cooling loads directly, the impact of these measures on heating and cooling is considered in the unitary savings. Therefore, as presented in Table 51, the interactive effects factors for each space heating measure are assumed to be nil.

**Table 51: Interactive Effects Factors for Space Heating Measures**

| Measure                                                   | Interactive Effects Factor for Energy Savings | Interactive Effects Factor for Peak Demand Savings | Source                                                                                                               |
|-----------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| Mini-split Heat Pump                                      | 0%                                            | 0%                                                 | No interactive effects for space heating measures since impact on heating and cooling is included in unitary savings |
| Central Air-source Heat Pump                              |                                               |                                                    |                                                                                                                      |
| Ground-source Heat Pump                                   |                                               |                                                    |                                                                                                                      |
| Wood and Pellet Stove/Fireplace Inserts                   |                                               |                                                    |                                                                                                                      |
| Wood and Pellet Boilers and Furnaces                      |                                               |                                                    |                                                                                                                      |
| Solar Air Heating                                         |                                               |                                                    |                                                                                                                      |
| Air Sealing Products                                      |                                               |                                                    |                                                                                                                      |
| Window Film Kits                                          |                                               |                                                    |                                                                                                                      |
| Programmable Thermostat                                   |                                               |                                                    |                                                                                                                      |
| Smart Thermostat for Electrical Heating Systems           |                                               |                                                    |                                                                                                                      |
| Advanced Learning Thermostats for Central Heating Systems |                                               |                                                    |                                                                                                                      |

<sup>79</sup> Giant Inc., *Engineering Submittal Data Sheet 172ETE Models*, <http://www.giantinc.com/tech-data/FT-172E-An.pdf> (last accessed February 18, 2015).

<sup>80</sup> Ibid.

<sup>81</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>82</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82.

## 2.3.2 Peak Demand Savings Factors

For most space heating measures, peak demand savings are not calculated using a peak demand-to-energy ratio. For more details, refer to Subsection 1.1.1(1) for mini-split heat pumps, Subsection 1.1.1(2) for central-air-source heat pumps, Subsection 1.1.1(3) for ground-source heat pumps, Subsection 1.1.1(4) for wood and pellet stoves and fireplace inserts, and Subsection 1.1.1(5) for wood and pellet boilers and furnaces.

For air sealing products, peak demand savings are calculated using a peak demand-to-energy ratio developed by Navigant in the 2016-2018 DSM Plan. These ratios were established for various product categories based on modelled system-coincident peak demand savings and electrical energy savings for a projected deployment of products. Navigant used local data to establish the ratios applicable for the 2016-2018 period. The Evaluator recommends using the same ratios during the 2020-2023 DSM cycle.

For programmable thermostats, several studies demonstrate peak demand savings when there are specific interventions to adjust heating operating times to minimize redundancy with the system peak. However, when there is no specific intervention related to the installation of programmable thermostats, the impact on the system peak is often assumed to be nil. Only one study was referenced with winter peak demand savings, but these demand savings were very low and difficult to replicate to the Nova Scotia market. Therefore, the peak demand-to-energy ratio for programmable thermostats is established at 0 kW/kWh.

For solar air heating, the peak demand-to-energy ratio is nil. Solar systems provide no peak demand savings because the sun has set during the peak demand period.

For smart thermostats, similar to programmable thermostats, the impact on the system peak is assumed to be nil since no specific intervention to minimize redundancy of operation with the system peak is in place. Therefore, the peak demand-to-energy ratio for smart thermostats is established at 0 W/kWh.

A literature review of programmable and smart thermostat peak demand savings found that nil peak demand savings is the most common assumption among other jurisdictions when thermostats are installed with no specific demand response intervention. In other words, peak demand savings for thermostats are assumed to be nil unless participants are taking part in a demand response program.

Table 52 summarizes the peak demand-to-energy ratios established for each space heating measure.

**Table 52: Peak Demand-to-energy Ratios for Space Heating Measures**

| Measure                                      | Peak Demand-to-energy Ratio (W/kWh) | Reference                                               |
|----------------------------------------------|-------------------------------------|---------------------------------------------------------|
| Mini-split Heat Pumps (MSHPs)                | -                                   | -                                                       |
| Central Air-source Heat Pumps                |                                     |                                                         |
| Ground-source Heat Pumps                     |                                     |                                                         |
| Wood and Pellet Stoves/Fireplace Inserts     |                                     |                                                         |
| Wood and Pellet Furnaces/Boilers             |                                     |                                                         |
| Solar Air Heating                            | 0.000                               | Assumption                                              |
| Air Sealing Products                         | 0.283                               | RES-Elec-Space Heat & Cool, Navigant 2016-2018 DSM Plan |
| Programmable Thermostats                     | 0.000                               | Assumption based on literature review findings          |
| Smart Thermostats                            |                                     |                                                         |
| Modelled Space Heating and Building Envelope | 0.283                               | RES-Elec-Space Heat & Cool, Navigant 2016-2018 DSM Plan |

## 2.3.3 Space Heating Measures

### (1) Mini-split Heat Pumps

#### Summary

Table 53 presents a summary of the values used to calculate mini-split heat pump (MSHP) savings. The detailed methodology follows.

**Table 53: Mini-split Heat Pump Measure Summary**

| Parameter                                          | Green Heat, ASFH                                                                                                                     |                                                                             | HEA                                                         | MHEEP                                                                     | Reference                                                 |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                      |                                                                             |                                                             |                                                                           |                                                           |
| Measure                                            | Mini-split heat pumps for high-efficiency space heating with direct installation (HEA, MHEEP) or rebated after purchase (Green Heat) |                                                                             |                                                             |                                                                           | -                                                         |
| Baseline                                           | Electric resistance space heating                                                                                                    |                                                                             |                                                             |                                                                           |                                                           |
| Application                                        | Fully electrically heated households                                                                                                 | Mainly electrically heated households                                       | -                                                           |                                                                           |                                                           |
| General Parameters                                 |                                                                                                                                      |                                                                             |                                                             |                                                                           |                                                           |
| Installation Rate                                  | 100%                                                                                                                                 |                                                                             |                                                             |                                                                           | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 18                                                                                                                                   |                                                                             |                                                             |                                                                           | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                                                                                                      |                                                                             |                                                             |                                                                           |                                                           |
| Unitary Energy Savings [kWh/year]                  | 0.0855 kWh/Btu/h multiplied by the heating capacity of each installed system                                                         | 0.000 kWh/Btu/h multiplied by the heating capacity of each installed system | Calculated using HOT2000 modelling with an adjustment ratio |                                                                           | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | N/A                                                                                                                                  |                                                                             |                                                             |                                                                           |                                                           |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each installed system                                                                    |                                                                             |                                                             | 0.148 W/Btu/h multiplied by the heating capacity of each installed system | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                                   |                                                                             |                                                             |                                                                           | See Subsection 2.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                                   |                                                                             |                                                             |                                                                           | See Subsection 2.3.1                                      |

## Electrical Unitary Energy Savings

For Green Heat, the electrical unitary energy savings for MSHPs are based on the billing analysis results of the 2024 Green Heat evaluation, which yielded savings per unit of capacity for both homes that were fully electrically heated and homes that were only mainly electrically heated (e.g. that had secondary non-electrical heating systems such as wood stoves. Note that fireplaces are not considered as non-electrical secondary heating systems for the purpose of the billing analyses, and households with such systems still fall in the fully electrically heated category). The billing analysis results yield unitary savings values of 0.0855 kWh/Btu/h for fully electrically heated households and nil savings for mainly electrically heated homes. The appropriate unitary savings value is then multiplied by the heating capacity of the MSHP (found in the tracking sheet) and is used to calculate an energy savings value specific to each MSHP. Further details on the billing analysis methodology and results are found in the appendices of the 2024 DSM Existing Residential Evaluation Report.

For HEA and MHEEP, the electrical energy savings are based on HOT2000 simulation outputs that are multiplied by adjustment ratios obtained through a billing analysis conducted for the 2024 DSM evaluation of HEA, as listed in Table 54 below. These adjustment ratios apply to all HOT2000 modelled savings (i.e. including savings from measures other than heat pumps).

**Table 54: Adjustment Ratios for HEA and MHEEP Modelled Savings**

| Scenario                                                                            | Adjustment Ratio |
|-------------------------------------------------------------------------------------|------------------|
| A participant who registered <b>with</b> a heat pump                                | 1.24             |
| A participant who registered <b>without</b> a heat pump and who did not install one | 0.58             |
| A participant who registered <b>without</b> a heat pump and then had one installed  | 0.43             |

## Unitary Peak Demand Savings

For Green Heat and HEA, the unitary peak demand unitary savings for MSHPs are calculated using the variables defined and listed in the equation and Table 55 below.

$$Peak\ Demand\ Savings_W = \frac{1,000}{3.412} \times HC_{min} \times \left( \frac{1}{COP_{base\_min}} - \frac{1}{COP_{ee\_min}} \right)$$

**Table 55: Unitary Peak Demand Savings Values for Mini-split Heat Pumps**

| Variable                                                                                            | Symbol            | Green Heat                                   | Reference                           |
|-----------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------|-------------------------------------|
| Rated heating capacity of the new heat pump at outdoor air temperature of -15°C [kBtu/h]            | $HC_{min}$        | Specification data for each installed system | AHRI certified value                |
| Coefficient of performance of the assumed baseline equipment (electric resistance) at -15°C [kW/kW] | $COP_{base\_min}$ | 1                                            | Assumed COP for electric resistance |
| Coefficient of performance of the new heat pump at -15°C [kW/kW]                                    | $COP_{ee\_min}$   | Specification data for each installed system | AHRI certified value                |
| Conversion factor [Btu/W·h]                                                                         | 3.412             | 3.412                                        | Convention                          |
| Conversion factor [W/kW]                                                                            | 1,000             | 1,000                                        | Convention                          |

For Green Heat, peak demand savings are only claimed for households with a fully electrically heated baseline and are nil for mainly electrically heated baselines since the billing analysis resulted in nil electrical energy savings for those homes.

For some models, the availability of a heating capacity and COP at -15°C is limited. For those models, peak demand savings are considered nil if the specification sheets indicate a cut-off temperature above -15°C, otherwise ratios are applied to the rated COP and heating capacity at 47°F to obtain values considering average performance reductions as per simulation software (DOE- 2) performance curves shared by NRCan. The two following equations are used to obtain the adjusted values.

$$COP_{ee\_min} = 53.78\% \times \text{Rated COP at } 47^{\circ}\text{F}$$

$$HC_{min} = 37.46\% \times \text{Rated Capacity at } 47^{\circ}\text{F}$$

For MHEEP, unitary peak demand savings are established by multiplying the average unitary peak demand savings per capacity obtained from the mini-split heat pump measures installed under HEA by the capacity of each system installed under MHEEP and the percentage of electrical space heating.

## Installation Rates

Installation rates for MSHPs are estimated at 100% due to their relatively high cost.

## (2) Central Air-source Heat Pumps

### Summary

Table 56 presents a summary of the values used to calculate central air-source heat pump (CASHP) savings. The detailed methodology follows.

**Table 56: Central Air-source Heat Pump Measure Summary**

| Parameter                                          | Green Heat                                                                         | HEA                                                                             | Reference                                                 |
|----------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                    |                                                                                 |                                                           |
| Measure                                            | Central air-source (air-to-air and air-to-water) heat pumps rebated after purchase |                                                                                 | -                                                         |
| Baseline                                           | Electric resistance space heating                                                  |                                                                                 |                                                           |
| General Parameters                                 |                                                                                    |                                                                                 |                                                           |
| Installation Rate                                  | 100%                                                                               |                                                                                 | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 18                                                                                 |                                                                                 | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                                                    |                                                                                 |                                                           |
| Unitary Energy Savings [kWh/year]                  | 0.101 kWh/Btu/h multiplied by the heating capacity of each installed system        | Calculated using HOT2000 modelling                                              | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | N/A                                                                                | 0.283                                                                           | N/A                                                       |
| Unitary Peak Demand Savings [W]                    | 3,989                                                                              | Calculated by multiplying the energy savings by the peak demand-to-energy ratio | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                 | 0%                                                                              | See Subsection 2.2.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                 | 0%                                                                              | See Subsection 2.2.1                                      |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for CASHPs are based on the billing analysis results of the 2017 Green Heat evaluation, which yielded savings per units of capacity of 0.101 kWh/Btu/h. The unitary savings value is then multiplied by the heating capacity of the CASHP (found in the tracking sheet) and is used to calculate an energy savings value specific to each CASHP.

## Unitary Peak Demand Savings

For CASHPs installed under Green Heat, rated heating capacity and COP at -15°C are not always available. The Evaluator looked into the specification details of CASHPs installed through Green Heat in 2022 and was able to identify those parameters for up to nine models. The average unitary peak demand savings for CASHPs were then calculated using the variables defined and listed in the equation and Table 57 below.

$$Peak\ Demand\ Savings_W = \frac{HC_{min}}{3.412} \times \left( \frac{1}{COP_{base\_min}} - \frac{1}{COP_{ee\_min}} \right)$$

**Table 57: Unitary Peak Demand Savings Values for Central Air-source Heat Pumps**

| Variable                                                                                            | Symbol                    | Green Heat | Reference                                                                                   |
|-----------------------------------------------------------------------------------------------------|---------------------------|------------|---------------------------------------------------------------------------------------------|
| Rated heating capacity of the new heat pump at outdoor air temperature of -15°C [Btu/h]             | $HC_{min}$                | 26,261     | Average specification data for 7 models in the 2022 Green Heat tracking sheet <sup>83</sup> |
| Coefficient of performance of the assumed baseline equipment (electric resistance) at -15°C [kW/kW] | $COP_{base\_min}$         | 1          | Assumed COP for electric resistance                                                         |
| Coefficient of performance of the new heat pump at -15°C [kW/kW]                                    | $COP_{ee\_min}$           | 2.076      | Average specification data for 9 models in the 2022 Green Heat tracking sheet               |
| Conversion factor [Btu/W·h]                                                                         | 3.412                     | 3.412      | Convention                                                                                  |
| Unitary Peak Demand Savings [W]                                                                     | $Peak\ Demand\ Savings_W$ | 3,989      | Calculation                                                                                 |

## Installation Rates

Installation rates for CASHPs are estimated at 100% due to their relatively high cost.

<sup>83</sup> CASHP characteristics were not updated since 2022 due to the low number of CASHPs installed in subsequent years.



### (3) Ground-source Heat Pumps

#### Summary

Table 58 presents a summary of the values used to calculate ground-source heat pump (GSHP) savings. The detailed methodology follows.

**Table 58: Ground-source Heat Pump Measure Summary**

| Parameter                                          | Green Heat                                                                                                                 | HEA                                                                                    | Reference                                                 |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                            |                                                                                        |                                                           |
| Measure                                            | Ground-source heat pumps for high-efficiency space rebated after installation (HEA) or rebated after purchase (Green Heat) |                                                                                        | -                                                         |
| Baseline                                           | Electric heating resistance, CASHP, or MSHP                                                                                |                                                                                        |                                                           |
| General Parameters                                 |                                                                                                                            |                                                                                        |                                                           |
| Installation Rate                                  | 100%                                                                                                                       |                                                                                        | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 25                                                                                                                         |                                                                                        | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                                                                                            |                                                                                        |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each installed system                                                          | Calculated using HOT2000 modelling                                                     | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | N/A                                                                                                                        | 0.283                                                                                  | N/A                                                       |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each installed system                                                          | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                         | 0%                                                                                     | See Subsection 2.2.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                         | 0%                                                                                     | See Subsection 2.2.1                                      |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for GSHPs in Green Heat are calculated using the variables defined and listed in the equation and Table 59 below.

$$\begin{aligned}
 \text{Energy Savings}_{kWh} &= \text{Heating Savings} + \text{Cooling Savings or Penalty} \\
 &= \left( \frac{HC}{1,000} \times \left( \frac{1}{HSPF2_{base}} - \frac{1}{COP_{ee} \times DRF \times 3.412} \right) \times FLH_{heat} \right) \\
 &\quad + \left( \frac{CC}{1,000} \times \left( \frac{1}{SEER2_{base}} \times AC - \frac{1}{EER2_{ee} \times DRF \times GSER} \right) \times FLH_{cool} \right)
 \end{aligned}$$

**Table 59: Electrical Unitary Savings Values for Ground-source Heat Pumps in Green Heat**

| Parameter                                                                        | Symbol         | Value                                                          | Reference                                                                                                                                                                       |
|----------------------------------------------------------------------------------|----------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rated heating capacity of the new heat pump [Btu/h]                              | $HC$           | Specification data for each installed system                   | AHRI certified value                                                                                                                                                            |
| Rated cooling capacity of the new heat pump [Btu/h]                              | $CC$           | Specification data for each installed system                   | AHRI certified value                                                                                                                                                            |
| Heating seasonal performance factor of the baseline equipment [HSPF2 in Btu/W·h] | $HSPF2_{base}$ | Elec. resistance: 3.412<br>MSHP and CASHP: 6.0                 | Assumptions <sup>84</sup>                                                                                                                                                       |
| Coefficient of performance of the new heat pump [kW/kW]                          | $COP_{ee}$     | Specification data for each installed system                   | AHRI certified value                                                                                                                                                            |
| Derating factor of the new heat pump                                             | $DRF$          | 0.885                                                          | 2019 PUC TRM <sup>85</sup>                                                                                                                                                      |
| Factor used to determine the SEER of a GSHP based on its EER [Btu/W·h]           | $GSEER$        | 1.02                                                           | 2019 PUC TRM                                                                                                                                                                    |
| Energy efficiency ratio of the existing AC system [SEER2 in Btu/W·h]             | $SEER2_{base}$ | Room AC: 10.9<br>Central AC: 13.4<br>MSHP: 14.3<br>CASHP: 14.3 | Assumptions <sup>86</sup>                                                                                                                                                       |
| Energy efficiency ratio of the new heat pump [Btu/h]                             | $EER2_{ee}$    | Specification data for each installed system                   | AHRI certified value                                                                                                                                                            |
| Full heating load hours [h/year]                                                 | $FLH_{heat}$   | 1,603                                                          | Estimate based on the number of hours that a GSHP needs to operate to meet a heating load of 16,915 kWh, with a capacity of 3 tonnes based on the 2018 evaluation <sup>87</sup> |
| Full cooling load hours [h/year]                                                 | $FLH_{cool}$   | 213                                                            | 2020 Minnesota TRM <sup>88</sup>                                                                                                                                                |
| Cooling penalty modifier                                                         | $AC$           | AC in baseline = 1<br>No AC in baseline = 0                    | Assumptions                                                                                                                                                                     |
| Conversion factor [Btu/W·h]                                                      | 3.412          | 3.412                                                          | Convention                                                                                                                                                                      |
| Conversion factor [W/kW]                                                         | 1,000          | 1,000                                                          | Convention                                                                                                                                                                      |

<sup>84</sup> Assuming a HSPF of 3.412 for electric resistance and an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for “Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained” as per the NRCAN regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

<sup>85</sup> Pennsylvania Public Utility Commission (PUC), *Technical Reference Manual*, August 2019, Subsection 2.2 – HVAC.

<sup>86</sup> Assumptions based on the average efficiency values cited by NRCAN for room air conditioners (average EER of 10 divided by 0.875 and by 1.05 to convert to SEER 2), <https://www.nrcan.gc.ca/energy/publications/efficiency/residential/air-conditioning/6051> and on SEER 2 for “Split-system central air conditioners, other than those that are space-constrained or small-duct and high-velocity” for central AC, for “Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained” for heat pumps as per NRCAN regulation <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

<sup>87</sup> Based on the average modelled heating energy consumption of HEA participants before and after their home retrofit, including 100% electrically heated participants with no heat pumps and adjusted to take into account HOT2000 overestimation ratios from the 2018 billing analysis. The averages of each year were weighted according to the number of projects.

<sup>88</sup> Minnesota Department of Commerce Division of Energy Resources, *State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 3.1*, January 2020.

## Unitary Peak Demand Savings

The unitary peak demand savings for GSHPs installed under **Green Heat** are established using the equation below. All variables from this equation are defined in Table 59. Since standard MSHPs and CASHPs are assumed to operate exclusively on the electric resistance backup in the air handler during peak periods, the value of the  $COP_{base}$  variable in the formula below is the electrical baseline value of 1 regardless of the actual baseline equipment.

$$Peak\ Demand\ Savings_W = \left( 1,000 \times HC \times \left( \frac{1}{COP_{base}} - \frac{1}{COP_{ee} \times DRF} \right) \right)$$

## Installation Rates

Installation rates for GSHPs are estimated at 100% due to their relatively high cost.

## (4) Wood and Pellet Stoves/Fireplace Inserts

### Summary

Table 60 presents a summary of the values used to calculate wood and pellet stove and fireplace insert savings. The detailed methodology follows.

**Table 60: Wood and Pellet Stove and Fireplace Insert Measure Summary**

| Parameter                                          | Green Heat                                                                                                           |                  | HEA                       | Reference                                                 |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------|---------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                      |                  |                           |                                                           |
| Measure                                            | Wood and pellet stoves and fireplace inserts rebated after installation (HEA) or rebated after purchase (Green Heat) |                  |                           | -                                                         |
| Baseline                                           | Electrical heating or heat pump                                                                                      |                  |                           |                                                           |
| Measure Subcategory                                | Stove                                                                                                                | Fireplace insert | Stove or fireplace insert |                                                           |
| General Parameters                                 |                                                                                                                      |                  |                           |                                                           |
| Installation Rate                                  | 100%                                                                                                                 |                  |                           | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 18                                                                                                                   |                  |                           | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                                                                                      |                  |                           |                                                           |
| Unitary Energy Savings [kWh/year]                  | 1,461                                                                                                                | 232              | 1,461                     | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | -                                                                                                                    |                  |                           | -                                                         |
| Unitary Peak Demand Savings [W]                    | 828                                                                                                                  | 132              | 828                       | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                   |                  |                           | See Subsection 2.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                   |                  |                           | See Subsection 2.3.1                                      |

## Electrical Unitary Energy Savings

The electrical unitary energy savings values for wood and pellet stoves and fireplace inserts are based on the billing analysis results of the 2024 Green Heat evaluation. The values obtained are valid for homes that have an existing electric resistance system or a heat pump heating system.

Measured savings were significantly lower for fireplace inserts than for stoves in the Green Heat participant population used for the billing analysis. As a result, separate unitary energy savings for Green Heat are provided for stoves and fireplace inserts. For HEA, since the tracking sheet does not allow to make the distinction between stove and fireplace insert installations, unitary energy savings for stoves are used for both stoves and fireplace inserts.

## Unitary Peak Demand Savings

Unitary peak demand savings for wood and pellet stoves and fireplace inserts installed under Green Heat and HEA were previously based on program design data.<sup>89</sup> It was assumed that, during the peak demand period, existing ASHPs operated exclusively on the electric resistance backup in the air handler. Thus, the peak demand savings for wood and pellet stoves and fireplace inserts with ASHP baselines were identical to the peak demand savings of wood and pellet stoves and fireplace inserts with electric resistance baselines.

In light of the significant reduction in unitary energy savings resulting from the billing analysis, the assumption that the existing ASHP or electric resistance assumed the heating load during peak demand periods no longer seemed valid. The Evaluator also adjusted peak demand savings. Therefore, the peak demand savings were reduced by the ratio of electrical energy savings to the previous electrical energy savings.

For Green Heat, this was done separately for stoves and fireplace inserts. For HEA, the reduction calculated for stoves is applied to both stoves and fireplace inserts since the tracking sheet does not allow to make the distinction between stove and fireplace insert installations. These calculations are presented in the equation and Table 61 below.

$$\text{Peak Demand Savings}_W = \text{Previous Peak Demand Savings}_W \times \frac{\text{Energy Savings}_{kWh}}{\text{Previous Energy Savings}_{kWh}}$$

**Table 61: Unitary Peak Demand Savings Values for Wood or Pellet Stoves and Fireplace Inserts**

| Parameter                                                                                                                                                                                                                               | Green Heat            |                                  | HEA                                        | Reference          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------|--------------------------------------------|--------------------|
|                                                                                                                                                                                                                                         | Wood or Pellet Stoves | Wood or Pellet Fireplace Inserts | Wood or Pellet Stoves or Fireplace Inserts |                    |
| Previous Peak Demand Savings [W]                                                                                                                                                                                                        | 4,000                 |                                  |                                            | 2020-2023 DSM MA   |
| Energy Savings [kWh]                                                                                                                                                                                                                    | 1,461                 | 232                              | 1,461                                      | 2024 DSM MA        |
| Previous Energy Savings [kWh]*                                                                                                                                                                                                          | 7,055*                |                                  |                                            | 2020-2023 DSM MA   |
| <b>Peak Demand Savings [W]</b>                                                                                                                                                                                                          | <b>828</b>            | <b>132</b>                       | <b>828</b>                                 | <b>Calculation</b> |
| *The values presented correspond to the arithmetic mean of the tracked unitary electrical energy savings for wood or pellet stoves with a heat pump or electric resistance baseline since these measures have all been merged into one. |                       |                                  |                                            |                    |

## Installation Rates

Installation rates for wood and pellet stoves are estimated at 100% due to their relatively high cost.

<sup>89</sup> Dunsy Energy Consulting, *Residential Fuel Substitution Pilot Program*, Final Report, December 2010.

## (5) Wood and Pellet Boilers and Furnaces

### Summary

Table 62 presents a summary of the values used to calculate wood and pellet boiler and furnace savings. The detailed methodology follows.

**Table 62: Wood and Pellet Boiler and Furnace Measure Summary**

| Parameter                                          | Green Heat                                                                                                   |        |           |        | HEA        |        |                                 |                                 | Reference                                                 |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------|-----------|--------|------------|--------|---------------------------------|---------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                              |        |           |        |            |        |                                 |                                 |                                                           |
| Measure                                            | Wood and pellet boilers and furnaces rebated after installation (HEA) or rebated after purchase (Green Heat) |        |           |        |            |        |                                 |                                 | -                                                         |
| Baseline                                           | Electrical heating or heat pump                                                                              |        |           |        |            |        |                                 |                                 |                                                           |
| Application                                        | Electrical                                                                                                   |        | Heat pump |        | Electrical |        | Heat pump                       |                                 |                                                           |
| Measure Subcategory                                | Wood                                                                                                         | Pellet | Wood      | Pellet | Wood       | Pellet | Wood                            | Pellet                          |                                                           |
| General Parameters                                 |                                                                                                              |        |           |        |            |        |                                 |                                 |                                                           |
| Installation Rate                                  | 100%                                                                                                         |        |           |        |            |        |                                 |                                 | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 18                                                                                                           |        |           |        |            |        |                                 |                                 | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                                                                              |        |           |        |            |        |                                 |                                 |                                                           |
| Unitary Energy Savings [kWh/year]                  | 13,804                                                                                                       | 13,765 | 7,669     | 7,647  | 13,804     | 13,765 | $\frac{13,804}{COP_{base\_hp}}$ | $\frac{13,765}{COP_{base\_hp}}$ | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | -                                                                                                            |        |           |        |            |        |                                 |                                 | -                                                         |
| Unitary Peak Demand Savings [W]                    | 7,660                                                                                                        | 7,750  | 7,660     | 7,750  | 7,660      | 7,750  | 7,660                           | 7,750                           | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                           |        |           |        |            |        |                                 |                                 | See Subsection 2.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                           |        |           |        |            |        |                                 |                                 | See Subsection 2.3.1                                      |

## Electrical Unitary Energy Savings

The electrical unitary savings values for wood and pellet boilers and furnaces are based on HOT2000 energy models.<sup>90</sup> The baseline of the models used electric resistance heating as the primary heat source and was calibrated to account for the historical electrical consumption of participants.

For participants who have ASHPs, as their primary heating system instead of electric resistance heating, unitary savings values are calculated using the equation below.

$$Energy\ Savings_{kWh\ (base\_hp)} = Energy\ Savings_{kWh\ (base\_elec)} \times \frac{COP_{base\_elec}}{COP_{base\_hp}}$$

For HEA, the baseline heat pump COP value specified in the tracking sheet is used, while for Green Heat, the COP of a standard mini-split heat pump based on a HSPF2 Region V of 6.0 is used.<sup>91</sup> The unitary energy savings values are presented in Table 63 below.

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<sup>90</sup> The HOT2000 energy models were developed as part of the 2013 evaluation.

<sup>91</sup> Assuming an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for “Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained” as per the NRCan regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

**Table 63: Electrical Unitary Energy Savings Values for Wood and Pellet Boilers and Furnaces**

| Parameter                                                              | Symbol                                | Green Heat             |                          | HEA                                          |                                 | Reference                                           |
|------------------------------------------------------------------------|---------------------------------------|------------------------|--------------------------|----------------------------------------------|---------------------------------|-----------------------------------------------------|
|                                                                        |                                       | Wood Furnace or Boiler | Pellet Furnace or Boiler | Wood Furnace or Boiler                       | Pellet Furnace or Boiler        |                                                     |
| Coefficient of Performance of the Baseline Electric Resistance [kW/kW] | $COP_{base\_elec}$                    | 1                      |                          |                                              |                                 | Convention                                          |
| Coefficient of Performance of the Baseline Heat Pump [kW/kW]           | $COP_{base\_hp}$                      | 1.8                    |                          | Specification data for each installed system |                                 | Green Heat: Assumption<br>HEA: AHRI certified value |
| Unitary Energy Savings with Electrical Baseline [kWh/year]             | $Energy\ Savings_{kWh\ (base\_elec)}$ | 13,804                 | 13,765                   | 13,804                                       | 13,765                          | 2013 Evaluation HOT2000 Energy Models               |
| Unitary Energy Savings with Heat Pump Baseline [kWh/year]              | $Energy\ Savings_{kWh\ (base\_hp)}$   | 7,669                  | 7,647                    | $\frac{13,804}{COP_{base\_hp}}$              | $\frac{13,765}{COP_{base\_hp}}$ | Calculation                                         |



## Unitary Peak Demand Savings

For Green Heat, unitary peak demand savings are based on program design data.<sup>92</sup> It is assumed that during the peak demand period, existing ASHPs operate exclusively on the electric resistance backup in the air handler. Thus, the peak demand savings for wood and pellet boiler and furnace measures with an ASHP baseline are identical to the peak demand savings with an electric resistance baseline.

The unitary peak demand savings values are presented in Table 64 below.

**Table 64: Unitary Peak Demand Savings Values for Wood and Pellet Boilers and Furnaces**

| Parameter                       | Green Heat                                      |                                                   |                                           |                                             |
|---------------------------------|-------------------------------------------------|---------------------------------------------------|-------------------------------------------|---------------------------------------------|
|                                 | Wood Furnace or Boiler with Electrical Baseline | Pellet Furnace or Boiler with Electrical Baseline | Wood Furnace or Boiler with ASHP Baseline | Pellet Furnace or Boiler with ASHP Baseline |
| Unitary Peak Demand Savings [W] | 7,660                                           | 7,750                                             | 7,660                                     | 7,750                                       |

## Installation Rates

Installation rates for wood and pellet boilers and furnaces are estimated at 100% due to their relatively high cost.

## (6) Solar Air Heating

### Summary

Table 65 presents a summary of the values used to calculate solar air heating savings. The detailed methodology follows.

<sup>92</sup> Dunskey Energy Consulting, *Residential Fuel Substitution Pilot Program*, Final Report, December 2010.

**Table 65: Solar Air Heating Measure Summary**

| Parameter                                          | Green Heat                                           | Reference                                                                              |
|----------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                      |                                                                                        |
| Measure                                            | Solar air heating systems rebated after installation | -                                                                                      |
| Baseline                                           | Electric space heating (resistance or heat pump)     |                                                                                        |
| General Parameters                                 |                                                      |                                                                                        |
| Installation Rate                                  | 100%                                                 | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 20                                                   | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                      |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | Calculated using RETScreen                           | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                                | See Subsection 2.3.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0                                                    | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                   | See Subsection 2.2.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                   | See Subsection 2.2.1                                                                   |

## Electrical Unitary Energy Savings

The unitary savings value for solar air heating systems installed through Green Heat is calculated for each system.

## Installation Rates

Installation rates for solar air heating are estimated at 100% due to their relatively high cost.

## (7) Air Sealing Products

### Summary

Table 66 presents a summary of the values used to calculate air sealing product savings. The detailed methodology follows.

**Table 66: Air Sealing Product Measure Summary**

| Parameter                                          |                                                                            | EPI        |                            |                                |                        |            |                            |                                |                                                                                        | Reference |
|----------------------------------------------------|----------------------------------------------------------------------------|------------|----------------------------|--------------------------------|------------------------|------------|----------------------------|--------------------------------|----------------------------------------------------------------------------------------|-----------|
| Measure Description and Identification             |                                                                            |            |                            |                                |                        |            |                            |                                |                                                                                        |           |
| Measure                                            | Air sealing products in electrically heated homes with direct installation |            |                            |                                |                        |            |                            |                                | -                                                                                      |           |
| Baseline                                           | Door and/or windows without added air sealing products                     |            |                            |                                |                        |            |                            |                                |                                                                                        |           |
| Measure Subcategory                                | Electrical resistance heated homes                                         |            |                            |                                | Heat pump heated homes |            |                            |                                |                                                                                        |           |
|                                                    | Foam gasket                                                                | Door sweep | Foot of window air sealing | Foot of door weather stripping | Foam gasket            | Door sweep | Foot of window air sealing | Foot of door weather stripping |                                                                                        |           |
| General Parameters                                 |                                                                            |            |                            |                                |                        |            |                            |                                |                                                                                        |           |
| Installation Rate                                  | 29%                                                                        | 100%       | 84%                        | 84%                            | 29%                    | 100%       | 84%                        | 84%                            | See details below under Installation Rates                                             |           |
| Effective Useful Life [years]                      | 15                                                                         |            |                            |                                |                        |            |                            |                                | See Subsection 3.2                                                                     |           |
| Electrical Savings Parameters                      |                                                                            |            |                            |                                |                        |            |                            |                                |                                                                                        |           |
| Unitary Energy Savings [kWh/year]                  | 9                                                                          | 173        | 9.9                        | 11.5                           | 5.00                   | 96.1       | 5.50                       | 6.39                           | See details below under Installation Rates                                             |           |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.283                                                                      |            |                            |                                |                        |            |                            |                                | See Subsection 2.3.2                                                                   |           |
| Unitary Peak Demand Savings [W]                    | 2.55                                                                       | 49.0       | 2.80                       | 3.25                           | 1.42                   | 27.2       | 1.56                       | 1.81                           | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |           |
| Interactive Effects Factor for Energy Savings      | 0%                                                                         |            |                            |                                |                        |            |                            |                                | See Subsection 2.3.1                                                                   |           |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                         |            |                            |                                |                        |            |                            |                                | See Subsection 2.3.1                                                                   |           |

## Electrical Unitary Energy Savings

The electrical unitary energy savings values are based on the results of an evaluation of a residential weatherization program conducted in Connecticut by KEMA in 2010.<sup>93</sup> Based on post-retrofit blower door tests on sampled homes, which included single-family homes as well as apartments, the KEMA evaluation report provides per-foot unitary savings values for window air sealing and door weather stripping, as well as per-unit unitary savings for foam gaskets and door sweeps. For heat pump heating systems, the savings from electric resistance are divided by 1.8, the COP of a standard mini-split heat pump based on a HSPF2 Region V of 6.0.<sup>94</sup>

Table 67 summarizes the savings for each measure included in air sealing products for electric resistance.

**Table 67: Savings Values for Air Sealing Products in Electric Resistance and Heat Pump Heated Homes**

| Measure                                                      | Electric Resistance Heated Homes | Heat Pump Heated Homes | Reference                                                    |
|--------------------------------------------------------------|----------------------------------|------------------------|--------------------------------------------------------------|
| Annual Energy Savings from Foam Gaskets [kWh/gasket]         | 9                                | 5.00                   | <u>Electric Resistance:</u><br>Connecticut TRM <sup>95</sup> |
| Annual Energy Savings from Door Sweeps [kWh/door]            | 173                              | 96.1                   |                                                              |
| Annual Energy Savings from Window Air Sealing [kWh/foot]     | 9.9                              | 5.50                   |                                                              |
| Annual Energy Savings from Door Weather Stripping [kWh/foot] | 11.5                             | 6.39                   | <u>Heat Pump:</u><br>Calculation                             |

<sup>93</sup> United Illuminating Company and Connecticut Light & Power Company, *Connecticut Program Savings Document, 15<sup>th</sup> Edition for 2019 Program Year*, March 2019.

<sup>94</sup> Assuming an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for “Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained” as per the NRCan regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

<sup>95</sup> Ibid.

## Installation Rates

Table 68 lists the installation rate for EPI air sealing products.

**Table 68: EPI Air Sealing Product Installation Rate**

| Measure Description    | Installation Rate | Margin of Error | Reference                            |
|------------------------|-------------------|-----------------|--------------------------------------|
| Foam Gasket            | 29%               | -               | 2024 EPI evaluation                  |
| Door Sweep             | 100%              | -               | Assumption                           |
| Window Air Sealing     | 84%               | 11.2%           | 2021 EPI evaluation (on-site visits) |
| Door Weather Stripping | 84%               | 11.2%           | 2021 EPI evaluation (on-site visits) |

## (8) Window Film Kits

### Summary

Table 69 presents a summary of the values used to calculate window film kit savings. The detailed methodology follows.

**Table 69: Window Film Kit Measure Summary**

| Parameter                                          |                                                                                                                 | EPI                    |                                                                                        | Reference |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------------|-----------|
| Measure Description and Identification             |                                                                                                                 |                        |                                                                                        |           |
| Measure                                            | Window film kits installed by the participant (left behind by the delivery agent), in electrically heated homes |                        | -                                                                                      |           |
| Baseline                                           | Windows without film kits                                                                                       |                        |                                                                                        |           |
| Measure Subcategory                                | Electrical Resistance Heated Homes                                                                              | Heat Pump Heated Homes |                                                                                        |           |
| General Parameters                                 |                                                                                                                 |                        |                                                                                        |           |
| Installation Rate                                  | 57%                                                                                                             |                        | 2024 Illinois TRM <sup>96</sup>                                                        |           |
| Effective Useful Life [years]                      | 1                                                                                                               |                        | See Subsection 3.2                                                                     |           |
| Electrical Savings Parameters                      |                                                                                                                 |                        |                                                                                        |           |
| Unitary Energy Savings [kWh/year]                  | 334                                                                                                             | 185                    | See details below under Electrical Unitary Energy Savings                              |           |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.283                                                                                                           |                        | See Subsection 2.3.2                                                                   |           |
| Unitary Peak Demand Savings [W]                    | 94.5                                                                                                            | 52.4                   | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |           |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                              |                        | See Subsection 2.3.1                                                                   |           |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                              |                        | See Subsection 2.3.1                                                                   |           |

### Electrical Unitary Energy Savings

The electrical unitary energy savings values of the window kit measure are calculated using the equations below.

$$\begin{aligned}
 \text{Energy Savings (kWh)} &= ES_{\text{sealing}} + ES_{\text{insulation}} \\
 ES_{\text{sealing}} &= \frac{n_{\text{window}} \times p_{\text{window}} \times ESPF_{\text{tape}}}{COP} \times \frac{HDD_{NS}}{HDD_{CT}} \\
 ES_{\text{insulation}} &= \frac{HDD_{NS} \times n_{\text{window}} \times A_{\text{window}} \times 24 \times ADJ}{COP \times 3,413} \times \left( \frac{1}{R_{\text{window}}} - \frac{1}{R_{\text{window}} + R_{\text{air}}} \right)
 \end{aligned}$$

<sup>96</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 12.0, Volume 3*, September 22, 2023, p. 384.

Total energy savings for this measure were calculated by combining savings from insulation and sealing; for the number of units, it was assumed that each kit could be used to cover two two-foot by three-foot windows.

The energy savings per foot of tape (ESPF) used in the second equation for sealing was taken from Connecticut's 2021 Program Savings Document;<sup>97</sup> the value was adjusted to the Nova Scotia context by using a heating degree days (HDD) ratio between Connecticut and Nova Scotia.

For the savings generated by insulation, the resistance values of the window and the added air layer due to film shrinkage ( $R_{\text{window}} + R_{\text{air}}$ ) were based on specific values provided by the 2022 Iowa Energy Efficiency Statewide Technical Reference Manual.<sup>98</sup> That TRM also provides an adjustment factor of 0.63 for wall insulation, used to account for overclaiming savings due to prescriptive engineering algorithms.

Table 70 presents the parameters used to calculate unitary energy savings for window film kits installed through EPI.

**Table 70: Electrical Unitary Savings Calculations for Window Film Kits**

| Parameter                                                  | Symbol                   | Value for Electrical Resistance Heated Homes |      | Value for Heat Pump Heated Homes                                                                  |
|------------------------------------------------------------|--------------------------|----------------------------------------------|------|---------------------------------------------------------------------------------------------------|
| Number of Windows Insulated                                | $n_{\text{window}}$      | 2                                            |      | Assumption that one window kit can typically cover two 2'x3' windows                              |
| Perimeter of Insulated Window [ft]                         | $p_{\text{window}}$      | 10                                           |      |                                                                                                   |
| Net Area of Insulated Window [ft²]                         | $A_{\text{window}}$      | 6                                            |      |                                                                                                   |
| Average Annual Heating Degree Days in Connecticut [°F·day] | HDD <sub>CT</sub>        | 5,885                                        |      | 2021 Connecticut Program Savings Document, 18th Edition, p. 242                                   |
| Average Annual Heating Degree Days in Nova Scotia [°F·day] | HDD <sub>NS</sub>        | 6,765                                        |      | Environment Canada, Halifax Stanfield International Airport, using an 18 °C heating balance point |
| Coefficient of Performance                                 | COP                      | 1                                            | 1.8  |                                                                                                   |
| Energy Savings per Foot of Tape [kWh/ft]                   | EPSF <sub>tape</sub>     | 9.9                                          |      | 2021 Connecticut Program Savings Document, 18th Edition, p. 248                                   |
| R-value of Existing Window [ft²·°F·h/Btu]                  | $R_{\text{window}}$      | 2                                            |      | 2022 Iowa TRM, Volume 2, p. 307                                                                   |
| R-value of existing window [ft²·°F·h/Btu]                  | $R_{\text{air}}$         | 2.85                                         |      |                                                                                                   |
| Adjustment to Account for Overclaiming of Savings [%]      | ADJ                      | 63%                                          |      |                                                                                                   |
| Energy Savings from Air Sealing Provided by the Tape [kWh] | ES <sub>sealing</sub>    | 228                                          | 126  | Calculation                                                                                       |
| Energy Savings from Insulation Provided by the Film [kWh]  | ES <sub>insulation</sub> | 106                                          | 58.7 |                                                                                                   |

<sup>97</sup> Energize Connecticut. *Connecticut's 2021 Program Savings Document*, March 1.

<sup>98</sup> Iowa Utilities Board, *Iowa Energy Efficiency Statewide Technical Reference Manual*, July 23, 2021. Available at: [https://iub.iowa.gov/sites/default/files/documents/2021/09/iowa\\_trm\\_v6\\_vol\\_1\\_overview\\_and\\_user\\_guide\\_2069155\\_210820-161936.pdf](https://iub.iowa.gov/sites/default/files/documents/2021/09/iowa_trm_v6_vol_1_overview_and_user_guide_2069155_210820-161936.pdf).

|                                   |                                     |     |     |             |
|-----------------------------------|-------------------------------------|-----|-----|-------------|
| Unitary Energy Savings [kWh/year] | <i>Energy Savings<sub>kWh</sub></i> | 334 | 185 | Calculation |
|-----------------------------------|-------------------------------------|-----|-----|-------------|

## Installation Rates

The installation rate of 57% was drawn from the 2024 Illinois TRM<sup>99</sup> value for window kits.

## (9) Programmable Thermostats

### Summary

Table 71 presents a summary of the values used to calculate programmable thermostat savings. The detailed methodology follows.

**Table 71: Programmable Thermostat Measure Summary**

| Parameter                                          | Instant Savings                                                               | MHEEP                                                                                 | Reference                                                                              |
|----------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                               |                                                                                       |                                                                                        |
| Measure                                            | Programmable thermostats rebated in store for controlling electric baseboards | Programmable thermostats with direct installation for controlling electric baseboards | -                                                                                      |
| Baseline                                           | Non-programmable electronic thermostats (50% analog and 50% electronic)       | Existing analog thermostats                                                           |                                                                                        |
| General Parameters                                 |                                                                               |                                                                                       |                                                                                        |
| Installation Rate                                  | 100%                                                                          | 100%                                                                                  | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                                            | 10                                                                                    | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                               |                                                                                       |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 164                                                                           | 221                                                                                   | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0                                                                             | 0                                                                                     | See Subsection 2.3.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0                                                                             | 0                                                                                     | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                            | 0%                                                                                    | See Subsection 2.3.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                            | 0%                                                                                    | See Subsection 2.3.1                                                                   |

<sup>99</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 12.0, Volume 3*, September 22, 2023, p. 384.





## Electrical Unitary Energy Savings

For programmable thermostats, the electrical unitary energy savings are based on the results from a Hydro-Québec 2009 program evaluation of electronic thermostats in residential new construction.<sup>100</sup> In this evaluation, savings values include energy savings generated by the thermostat's accuracy and temperature setback and are established for three types of dwellings: single-family homes, duplex/triplex/ townhouses, and apartments. For MHEEP, the savings values were determined only for single-family homes since that corresponds to most of its participants, and the savings values include energy savings generated by the thermostat's accuracy and temperature setback since MHEEP only replaces analog thermostats. As for Instant Savings, savings values were determined for all three types of dwellings and the baseline was set at 50% analog thermostats and 50% electronic thermostats. As defined by the equation below, the unitary savings values are calculated through a weighted average based on the proportion of each dwelling type in Nova Scotia's residential market, as defined in the 2021 Census Profile of Statistics Canada.<sup>101</sup>

$$Energy\ Savings_{kWh} = \sum (Dwelling\ Proportion \times Total\ Savings)$$

Table 72 presents the parameters used to calculate unitary energy savings for programmable thermostats installed through Instant Savings.

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<sup>100</sup> Econoler, *Évaluation du programme thermostats électroniques – Volet nouvelle construction au marché résidentiel*, Final Report presented to Hydro-Québec, February 9, 2009.

<sup>101</sup> Statistics Canada. (2021). Census Profile, 2021 Census, <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=PR&Code1=12&Geo2=PR&Code2=01&SearchText=Nova%20Scotia&SearchType=Begin&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=12&type=0> (last accessed September 18, 2024).

**Table 72: Electrical Unitary Savings Calculations for Programmable Thermostats**

| Parameters                                               | Symbol                              | Instant Savings |                              |           | MHEEP         | Reference                                    |
|----------------------------------------------------------|-------------------------------------|-----------------|------------------------------|-----------|---------------|----------------------------------------------|
|                                                          |                                     | Single-family   | Duplex/Triplex/<br>Townhouse | Apartment | Single-family |                                              |
| Proportion of Each Dwelling Type                         | <i>Dwelling Proportion</i>          | 67%             | 8%                           | 25%       | 100%          | Statistics Canada 2021 Census <sup>102</sup> |
| <b>Gross Energy Savings per Thermostat</b>               |                                     |                 |                              |           |               |                                              |
| Unitary Savings for Electronic Thermostat Accuracy [kWh] | <i>Thermostat Savings</i>           | 60.3            | 47.0                         | 30.3      | 121           | 2009 Econoler <sup>103</sup>                 |
| Unitary Savings for Temperature Setback [kWh]            | <i>Temp. Setback Savings</i>        | 100             | 201                          | 118       | 100           | 2009 Econoler <sup>104</sup>                 |
| Total Savings per Dwelling Type [kWh]                    | <i>Total Savings</i>                | 160             | 248                          | 148       | 221           | Calculation                                  |
| <b>Average Weighted Unitary Energy Savings [kWh]</b>     | <b>Energy Savings<sub>kWh</sub></b> | <b>164</b>      |                              |           | <b>221</b>    | <b>Calculation</b>                           |

## Installation Rates

For Instant Savings, the installation rate is assumed to be 100%.

<sup>102</sup> Ibid.

<sup>103</sup> Econoler, *Évaluation du programme thermostats électroniques – Volet nouvelle construction au marché résidentiel*, Final Report presented to Hydro-Québec, February 9, 2009.

<sup>104</sup> Ibid.

## (10) Smart Thermostats for Electrical Heating Systems

### Summary

Table 73 presents a summary of the values used to calculate smart thermostat savings. The detailed methodology follows.

**Table 73: Smart Thermostat for Electrical Heating System Measure Summary**

| Parameter                                          | Instant Savings,<br>MHEEP, ASFH                                                      |      | EPI                                             |      |                                                 |      | Reference                                                                              |
|----------------------------------------------------|--------------------------------------------------------------------------------------|------|-------------------------------------------------|------|-------------------------------------------------|------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                      |      |                                                 |      |                                                 |      |                                                                                        |
| Measure                                            | Smart thermostats controlling electric baseboards, MSHP or electric in-floor heating |      |                                                 |      |                                                 |      | -                                                                                      |
| Baseline                                           | Non-programmable thermostat                                                          |      |                                                 |      |                                                 |      |                                                                                        |
| Measure Subcategory                                | -                                                                                    |      | Single-family homes                             |      | Apartments                                      |      | -                                                                                      |
|                                                    | Electric Baseboard or Electric In-floor Heating                                      | MSHP | Electric Baseboard or Electric In-floor Heating | MSHP | Electric Baseboard or Electric In-floor Heating | MSHP |                                                                                        |
| General Parameters                                 |                                                                                      |      |                                                 |      |                                                 |      |                                                                                        |
| Installation Rate                                  | 100%                                                                                 |      | 100%                                            | 84%  | 100%                                            | 84%  | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                                                   |      |                                                 |      |                                                 |      | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                                      |      |                                                 |      |                                                 |      |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 312                                                                                  | 564  | 312                                             | 564  | 241                                             | 535  | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0                                                                                    |      |                                                 |      |                                                 |      | See Subsection 2.3.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0                                                                                    |      |                                                 |      |                                                 |      | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                   |      |                                                 |      |                                                 |      | See Subsection 2.3.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                                      |      |                                                 |      |                                                 |      |                                                                                        |

## Electrical Unitary Energy Savings

Some models of smart thermostats sold through Instant Savings or installed through EPI or MHEEP are compatible with electrical heating systems. They operate by connecting to a single baseboard, MSHP, or in-floor heating system as opposed to a central heating system. The equation below is used to calculate the unitary savings value for smart thermostats compatible with electrical heating systems and installed through Instant Savings, EPI or MHEEP.

$$Energy\ Savings_{kWh} = \frac{Heating\ Energy \times \%Savings \times FMT}{COP}$$

Since no studies specific to smart thermostats connected to electric baseboards, MSHPs, or electric in-floor heating systems were identified, the percentage of the heating load saved by thermostats is based on available studies for smart thermostats compatible with central heating systems, which have essentially the same features. Table 74 presents two billing analyses conducted for Nest smart thermostats installed on central electrical heating systems (rather than natural gas or oil heating systems). Both analyses served to assess the savings for smart thermostats installed to replace both programmable and non-programmable thermostats, which is a reasonable baseline. In both studies, heating consumption savings of 12% were evaluated for central air-source heat pumps, which is the closest heating system to electric baseboards, MSHPs, and electric in-floor heating systems among Nest compatible systems.

**Table 74: Billing Analysis Savings Results for Smart Thermostats for Electrical Heating Systems**

| Jurisdiction                                   | Measure          | Sample Size | Heating Consumption Savings |
|------------------------------------------------|------------------|-------------|-----------------------------|
| Oregon <sup>105</sup>                          | Nest thermostats | 185         | 12% (for ASHPs)             |
| Bonneville Power Administration <sup>106</sup> | Nest thermostats | 176         | 12% (for ASHPs)             |

As previously mentioned, electric baseboards, MSHPs, or electric in-floor heating systems are individually paired to a unique compatible smart thermostat. Therefore, the savings are divided by the average number of electrical heating systems within a dwelling, assuming there is one baseboard per room, one MSHP per floor, and one electric in-floor heating system per room.

<sup>105</sup> Apex Analytics LLC, *Energy Trust of Oregon Nest Thermostat Heat Pump Control Pilot Evaluation*, October 10, 2014, p. 123.

<sup>106</sup> Bonneville Power Administration, *Nest Learning Thermostat Pilot Program Savings Assessment Bonneville Power Administration & Franklin Public Utility District*, November 16, 2016.

Table 75 below presents the variables used for the unitary savings calculation and the resulting value.

**Table 75: Electrical Unitary Energy Savings Calculation for Smart Thermostats for Electrical Heating Systems**

| Parameter                                                             | Symbol         | Instant Savings, MHEEP, ASFH, EPI                         |                | EPI                                                       |                | Reference                                                                                                                                              |
|-----------------------------------------------------------------------|----------------|-----------------------------------------------------------|----------------|-----------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                       |                | Single-family homes                                       |                | Apartments                                                |                |                                                                                                                                                        |
|                                                                       |                | Value for Electric Baseboard or Electric In-floor Heating | Value for MSHP | Value for Electric Baseboard or Electric In-floor Heating | Value for MSHP |                                                                                                                                                        |
| Average heating energy consumption of a home [kWh/year]               | Heating Energy | 16,915                                                    |                | 8,025                                                     |                | Single-family homes: 2021, 2022, and 2023 HEA tracking sheets<br>Apartments 2021, 2022, and 2023 HEA tracking sheets and NRCan 2021 <sup>107,108</sup> |
| Percentage of heating load saved by smart thermostats                 | %Savings       | 12%                                                       |                |                                                           |                | Literature review of billing analyses, see Table 74                                                                                                    |
| Factor to account for multiple thermostats installed in the same home | FMT            | 0.15                                                      | 0.5            | 0.25                                                      | 1              | Single-family homes: Assumption <sup>109</sup><br>Apartments: Assumption <sup>110</sup>                                                                |
| Heating system coefficient of performance                             | COP            | 1                                                         | 1.8            | 1                                                         | 1.8            | Assumption <sup>111</sup>                                                                                                                              |
| Unitary Savings [kWh/year]                                            | -              | 312                                                       | 564            | 241                                                       | 535            | Calculation                                                                                                                                            |

<sup>107</sup> Based on the average modelled heating energy consumption of HEA participants. As for single-family homes, multiplied by the ratio of household energy intensity of Nova Scotia apartments (48.2 GJ/household) to household energy intensity of Nova Scotia single-detached homes (101.6 GJ/household). Values from Table 34: *Single Detached Secondary Energy Use and GHG Emissions by Energy Source* and Table 38: *Apartments Secondary Energy Use and GHG Emissions by Energy Source* for Nova Scotia's residential sector in Natural Resources Canada's 2021 Comprehensive Energy Use Database. Natural Resources Canada, 2021 Comprehensive Energy Use Database, [https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive/trends\\_res\\_ns.cfm](https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/menus/trends/comprehensive/trends_res_ns.cfm).

<sup>108</sup> Based on the average modelled heating energy consumption of HEA participants before and after their home retrofit, including 100% electrically heated participants with no heat pumps and adjusted to take into account HOT2000 overestimation ratios from the 2018 billing analysis. The averages of each year were weighted according to the number of projects.

<sup>109</sup> Assuming 1 thermostat per room for electric baseboards and in-floor heating and 6.5 rooms on average based on Statistics Canada 2016 Census. For MSHP, Assuming 1 thermostat per indoor unit and 2 indoor units per home. Statistics Canada, Census Profile, 2016 Census, <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=PR&Code1=12&Geo2=&Code2=&Data=Count&SearchType=Begin&SearchPR=01&B1=All> (last accessed December 3, 2019).

## Installation Rates

For Instant Savings and MHEEP, the installation rates are assumed to be 100%. For EPI, an installation rate of 84% was measured during the 2024 EPI on-site visits for smart thermostats for MSHPs. For smart thermostats controlling electric baseboards and electric in-floor heating delivered through EPI, the 100% installation rate assumption is maintained since installation rates for these types of smart thermostats were not measured during the on-site visits.

Table 76 lists the installation rate for EPI smart thermostats for MSHPs.

**Table 76: EPI Smart Thermostat for MSHP Installation Rate**

| Measure Description         | Installation Rate | Margin of Error | Reference                            |
|-----------------------------|-------------------|-----------------|--------------------------------------|
| Smart Thermostats for MSHPs | 84%               | 12.3%           | 2024 EPI evaluation (on-site visits) |

## (11) Advanced Learning Thermostat for Central Heating Systems

### Summary

Table 77 presents a summary of the values used to calculate advanced learning thermostat for central heating system savings. The detailed methodology follows.

<sup>110</sup> Assuming 1 thermostat per room for electric baseboards and in-floor heating and 4 rooms on average derived from Statistics Canada 2021 Census given the current distribution of occupied private dwellings and number of rooms. For MSHPs, assuming 1 thermostat for the entire apartment. Statistics Canada, Census Profile, 2021 Census, <https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&DGUIDlist=2021A000212&GENDERlist=1&STATISTIClist=1&HEADERlist=0&form=MG0AV3>.

<sup>111</sup> Assuming a COP of 1 for electric resistance (including baseboard and in-floor) and a COP of 1.8 for heat assuming an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for "Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained" as per the NRCan regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

**Table 77: Advanced Learning Thermostat for Central Heating System Measure Summary**

| Parameter                                          |                                                                                                                                                                                                                                                                                                                           | EPI              | Reference                                                                              |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                                                                                                                                                                                                           |                  |                                                                                        |
| Measure                                            | Wi-Fi enabled advanced thermostats with 7-day or learning-based scheduling and remote access for homes with central electric heating. Thermostats must have built in occupancy sensors or plug-in occupancy sensors packaged with the wall unit as well as heat pump auxiliary heat control and optimization capabilities |                  | -                                                                                      |
| Baseline                                           | Analog or digital non-programmable thermostat                                                                                                                                                                                                                                                                             |                  | -                                                                                      |
| Measure Subcategory                                | Central Heat Pump                                                                                                                                                                                                                                                                                                         | Electric Furnace |                                                                                        |
| General Parameters                                 |                                                                                                                                                                                                                                                                                                                           |                  |                                                                                        |
| Installation Rate                                  | 100%                                                                                                                                                                                                                                                                                                                      |                  | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                                                                                                                                                                                                                                                                                        |                  | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                                                                                                                                                                                                                                                                           |                  |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 1,128                                                                                                                                                                                                                                                                                                                     | 2,030            | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0                                                                                                                                                                                                                                                                                                                         |                  | See Subsection 2.3.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0                                                                                                                                                                                                                                                                                                                         |                  | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                                                                                                                                                                                                                        |                  | See Subsection 2.3.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                                                                                                                                                                                                                                                                           |                  |                                                                                        |

## Electrical Unitary Energy Savings

The equation below is used to calculate the unitary savings value for learning thermostats compatible with central electrical heating systems and installed through EPI.

$$Energy\ Savings_{kWh} = \frac{Heating\ Energy \times \%Savings}{COP}$$

The billing analyses and the 12% savings presented in Table 74 are applicable to this measure. Table 78 below presents the variables used for the unitary savings calculation and the resulting value.

**Table 78: Electrical Unitary Energy Savings Calculation for Smart Thermostats for Electrical Heating Systems**

| Parameter                                               | Symbol                | Value for Central Heat Pump | Value for Electric Furnace | Reference                                               |
|---------------------------------------------------------|-----------------------|-----------------------------|----------------------------|---------------------------------------------------------|
| Average Heating Energy Consumption of a Home [kWh/year] | <i>Heating Energy</i> | 16,915                      |                            | 2021, 2022, and 2023 HEA tracking sheets <sup>112</sup> |
| Percentage of Heating Load Saved by Smart Thermostats   | <i>%Savings</i>       | 12%                         |                            | Literature review of billing analyses, see Table 74     |
| Heating System Coefficient of Performance               | <i>COP</i>            | 1.8                         | 1                          | Assumption <sup>113</sup>                               |
| <b>Unitary Energy Savings [kWh/year]</b>                | -                     | <b>1,128</b>                | <b>2,030</b>               | <b>Calculation</b>                                      |

## Installation Rates

For EPI the installation rate is assumed to be 100%.

<sup>112</sup> Based on the average modelled heating energy consumption of HEA participants before and after their home retrofit, including 100% electrically heated participants with no heat pumps and adjusted to take into account HOT2000 overestimation ratios from the 2018 billing analysis. The averages of each year were weighted according to the number of projects.

<sup>113</sup> Assuming a COP of 1 for electric resistance (electric furnace) and a COP of 1.8 for heat pumps assuming an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for "Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained" as per the NRCAN regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.



## 2.4 Appliances

### 2.4.1 Interactive Effects

Retiring old appliances causes an increase in the heating load in the winter and a decrease in the cooling load in the summer since compressors on old appliances release significantly more waste heat than newer, more efficient models. If an inefficient appliance is retired without being replaced, interactive effects are greater.

The heating load period in Nova Scotia lasts about eight months, while the cooling load period is relatively short, lasting approximately two months. The annual total interactive effects due to the retirement or replacement of old appliances are therefore expected to be negative, pushing the savings generated by such retirements or replacements downward.

Several other factors can also affect the interactive effects of E1 appliance measures:

- › Close to all appliance measures are accounted for in E1 DSM savings and thus the focus is on electricity savings for appliances. In Nova Scotia, 25% of households use electricity as their primary heating source.<sup>114</sup> Therefore, the negative interactive effects on the heating load only affect approximately one-third of participating households.
- › A significant number of appliances targeted through E1 programs, such as refrigerators and freezers, are built into or leaned against an exterior wall. Rather than contributing to building heat loads, this results in more heat loss through the building envelope and through the appliance back wall, thereby reducing interactive effects.
- › In Nova Scotia, over one third of households (38%)<sup>115</sup> use air conditioning. For these households, positive interactive effects occur during the cooling period, which cancel a portion of the negative interactive effects.
- › Most jurisdictions that offer refrigerator and freezer programs do not consider interactive effects for those appliances.<sup>116</sup>

Considering all these factors, the interactive effects for appliances are negligible and, therefore, the interactive effects factors for energy and peak demand savings are 0%.

Table 79 summarizes the interactive effect factors established for appliances.

<sup>114</sup> Statistics Canada, *Residential Sector, Nova Scotia, Table 14: Total Households by Building Type and Energy Source*, <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&year=2020&rn=14&page=0>, (last accessed September 25, 2024).

<sup>115</sup> Statistics Canada, *Table 38-10-0019-01 – Air conditioners*, <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3810001901> (last accessed September 2024).

<sup>116</sup> The TRMs for California Municipal Utilities, Connecticut, Illinois, Maine, Massachusetts, Minnesota, Mid-Atlantic, New York, Northwest Power and Conservation Council, Ohio, Pennsylvania, Vermont, and Wisconsin were consulted. Only Northwest Power and Conservation Council and New York apply interactive effects factors for freezers and refrigerators (although only for new rebated appliances and not for recycled appliances).

**Table 79: Interactive Effects Factors for Appliances**

| Measure                                                                       | Interactive Effects Factor for Energy Savings | Interactive Effects Factor for Peak Demand Savings | Source                                 |
|-------------------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|----------------------------------------|
| Clotheslines and Outdoor Drying Racks                                         | 0%                                            | 0%                                                 | Assumption (see text above this table) |
| Refrigerator Retirements/Replacements                                         |                                               |                                                    |                                        |
| Freezer Retirements/Replacements                                              |                                               |                                                    |                                        |
| Room Air Conditioner Retirements                                              |                                               |                                                    |                                        |
| Dehumidifier Replacements or Retirements/ENERGY STAR® Certified Dehumidifiers |                                               |                                                    |                                        |
| Clothes Dryer Replacements/ENERGY STAR® Certified Clothes Dryers              |                                               |                                                    |                                        |
| Efficient Clothes Washers                                                     |                                               |                                                    |                                        |
| ENERGY STAR® Certified Room Air Purifiers                                     |                                               |                                                    |                                        |
| ENERGY STAR® Certified Dishwashers                                            |                                               |                                                    |                                        |

### 2.4.2 Peak Demand Savings Factors

For most appliances, peak demand savings are calculated using the peak demand-to-energy ratios developed by Navigant in the 2016-2018 DSM Plan. These ratios were established for various product categories based on modelled system-coincident peak demand savings and electrical energy savings for a projected deployment of products. Navigant used local data to establish the ratios applicable for the 2016-2018 period. The Evaluator recommends using the same ratios during the 2020-2023 DSM cycle.

The Evaluator assumes a peak demand-to-energy ratio of zero for clotheslines, outdoor drying racks, and retired air room conditioners since these products are not likely used on cold winter days when peak conditions occur.

Table 80 summarizes the peak demand-to-energy ratios established for appliances.

**Table 80: Peak Demand-to-energy Ratios for Appliances**

| Measure                                                                          | Peak Demand-to-energy Ratio (W/kWh) | Source                                                                                                                                          |
|----------------------------------------------------------------------------------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Clothesline and Outdoor Drying Racks                                             | 0.000                               | Calculated by the Evaluator                                                                                                                     |
| Refrigerator Retirements/Replacements                                            | 0.138                               | RES-Appliance-Fridge, Navigant 2016-2018 DSM Plan                                                                                               |
| Freezer Retirements/Replacements                                                 | 0.138                               | RES-Appliance-Fridge, Navigant 2016-2018 DSM Plan                                                                                               |
| Room Air Conditioner Retirements                                                 | 0.000                               | Calculated by the Evaluator                                                                                                                     |
| Dehumidifier Replacements or Retirements/<br>ENERGY STAR Certified Dehumidifiers | 0.335                               | RES-Appliance-Dehumidifier, Navigant 2016-2018 DSM Plan                                                                                         |
| Clothes Dryer Replacements/ENERGY<br>STAR Certified Clothes Dryers               | 0.138                               | RES-Appliance-CW, Navigant 2016-2018 DSM Plan                                                                                                   |
| Efficient Clothes Washers                                                        | 0.138                               | RES-Appliance-CW, Navigant 2016-2018 DSM Plan                                                                                                   |
| ENERGY STAR Certified Room Air Purifiers                                         | 0.171                               | Calculated by the Evaluator, assuming even distribution of 5840 hours of operation throughout the year                                          |
| ENERGY STAR Certified Dishwashers                                                | 0.341                               | Calculated using NREL ResStock end-use load profile <sup>117</sup> for Maine and “dishwasher” end use and E1’s definition of winter peak period |
| Ventilation Fans for Bathrooms                                                   | 0.1                                 | Calculated by Evaluator                                                                                                                         |

<sup>117</sup> National Renewable Energy Laboratory, *ResStock End-use Load Profiles Data Sets 2022.1 Release*, <https://resstock.nrel.gov/datasets> (last accessed November 6, 2023).

## 2.4.3 Appliance Measures

### (1) Clotheslines and Outdoor Drying Racks

#### Summary

Table 81 presents a summary of the values used to calculate clothesline and outdoor drying rack savings. The detailed methodology follows.

**Table 81: Clothesline and Outdoor Drying Rack Measure Summary**

| Parameter                                          | Instant Savings                                        | Reference                                                                              |
|----------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                        |                                                                                        |
| Measure Description                                | Clotheslines and outdoor drying racks rebated in store | -                                                                                      |
| Baseline                                           | Clothes being dried with a clothes dryer               |                                                                                        |
| General Parameters                                 |                                                        |                                                                                        |
| Installation Rate                                  | 100%                                                   | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                     | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                        |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 70.6                                                   | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                                  | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0                                                      | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                     | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                     | See Subsection 2.4.1                                                                   |

#### Electrical Unitary Energy Savings

The savings from this measure are due to avoided clothes dryer loads. The following equation is used to establish the unitary savings associated with clotheslines and outdoor drying racks.

$$\begin{aligned} \text{Energy Savings} \left[ \frac{kWh}{\text{year}} \right] &= \text{Annual Laundry Loads} \left[ \frac{\text{load}}{\text{year}} \right] \\ &\times \text{Proportion of Loads Dried on Clotheslines or Outdoor Drying Racks} [\%] \\ &\times \text{Energy Consumption per Load} \left[ \frac{kWh}{\text{load}} \right] \end{aligned}$$

Table 82 below lists the parameters and corresponding values applied in the equation above for clotheslines and outdoor drying racks installed and the resulting unitary savings values.

**Table 82: Electrical Unitary Savings Values for Clotheslines and Outdoor Drying Racks**

| Parameter                                     | Value       | Source                                                                                                                          |
|-----------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------|
| Number of Laundry Loads per Year [loads/year] | 197         | Research to update this value showed that it hardly changed, so the one established in 2015 NRCan <sup>118</sup> was maintained |
| Proportion of Loads Dried on Clotheslines [%] | 16.3%       | 2011 OPA Prescriptive Measures and Assumptions List <sup>119</sup>                                                              |
| Energy Consumption per Load [kWh/load]        | 2.2         | 2011 OPA Prescriptive Measures and Assumptions List <sup>120</sup>                                                              |
| <b>Unitary Energy Savings [kWh/year]</b>      | <b>70.6</b> | <b>Calculation</b>                                                                                                              |

## Installation Rates

For Instant Savings, the installation rate is assumed to be 100% since participants have to purchase the product.

<sup>118</sup> NRCan, *2015 Survey of Household Energy Use*, Table 10.6. Calculated average annual dried loads for Atlantic, assuming 100 days of summer and 265 days of winter. Available at: <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=SH&sector=aaa&juris=ca&year=2015&rn=38&page=1>, (last accessed July 12, 2024).

<sup>119</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>120</sup> Ibid.

## (2) Refrigerator Retirements/Replacements

### Summary

Table 83 presents a summary of the values used to calculate refrigerator retirement and replacement savings. The detailed methodology follows.

**Table 83: Refrigerator Retirement/Replacement Measure Summary**

| Parameter                                          | ARet                                          |                                         | HomeWarming / MHEEP                             | Reference                                                                              |
|----------------------------------------------------|-----------------------------------------------|-----------------------------------------|-------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                               |                                         |                                                 |                                                                                        |
| Measure                                            | Retirement and recycling of old refrigerators |                                         | New efficient refrigerators                     | -                                                                                      |
| Baseline                                           | Continued usage of old refrigerators          |                                         | Existing refrigerators manufactured before 1995 |                                                                                        |
| Measure Subcategory                                | Full-sized refrigerators – 10 ft.3 and more   | Small refrigerators – less than 10 ft.3 | -                                               |                                                                                        |
| General Parameters                                 |                                               |                                         |                                                 |                                                                                        |
| Installation Rate                                  | -                                             |                                         | 100%                                            | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 4                                             |                                         | 5                                               | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                               |                                         |                                                 |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 660                                           | 164                                     | 674                                             | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.138                                         |                                         |                                                 | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 91.1                                          | 22.6                                    | 93.0                                            | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                            |                                         |                                                 | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                            |                                         |                                                 | See Subsection 2.4.1                                                                   |

## Electrical Unitary Energy Savings

The following equations are used to determine the electrical unitary energy savings value of retired and replaced refrigerators.

$$\text{Energy Savings}_{kWh} = \text{AvgConsumptionPerSize} \times \text{AvgSize} \times \text{OAR} \times \text{PuF} - \text{NewConsumption}$$

$$\text{AvgConsumptionPerSize} = \sum (\text{ConsumptionPerSize} \times \% \text{ManufactureSplit})$$

For regular and small refrigerators retired through ARet, average annual per-cubic-foot energy consumption is calculated using 2017 metering activity results<sup>121</sup> for appliances manufactured before 2002 and the results of NRCAN data analyses for appliances manufactured in or after 2002.

Since most retired units in the category “manufactured in or after 2002” are now more recent than the most recent units used in the 2017 metering activity, unitary savings values for refrigerators manufactured in 2002 or later were established using data extracted from NRCAN EnerGuide appliance directories from 2001 to 2012.<sup>122</sup> Model numbers in the 2022 and 2023 tracking sheets were matched with EnerGuide data to extract energy consumption values.<sup>123</sup> Given retired appliances manufactured in 2002 or later are on average 15 years old, the Evaluator increased the EnerGuide energy consumption level by 27% to account for the efficiency loss due to aging based on findings from a recently published metering study.<sup>124</sup>

Average annual consumption values by manufacture-year class<sup>125,126,127</sup> were established and a weighted average was calculated based on 2024 tracking sheet proportion of units per manufacture-year class. The occupant adjustment factor is based on the metering protocol of the New York Department of Public Service<sup>128</sup> and the part-use factor is calculated based on 2022 participant survey data.<sup>129</sup>

For refrigerators replaced through HomeWarming and MHEEP, the unitary savings value is based on the average annual per-cubic-foot energy consumption of refrigerators manufactured in 1994 and earlier because eligible refrigerators correspond to this age category. It is assumed that all replaced refrigerators are primary refrigerators since it is a program component criterion and therefore no part-use factor is applied. The average size is based on data from the 2021, 2022 and 2023 tracking sheet for HomeWarming and MHEEP. The energy consumption of installed new refrigerators is calculated based on 2021, 2022 and 2023 HomeWarming and MHEEP tracking sheet data and the energy consumption rating of each model as labeled by EnerGuide retrieved using the ENERGY STAR Product Finder Tool.<sup>130</sup>

<sup>121</sup> Econoler, *Residential Efficient Product Rebates Program – 2017 DSM Evaluation*, Final Report presented to Efficiency Nova Scotia, March 15, 2018.

<sup>122</sup> Natural Resources Canada, *EnerGuide appliance directory*, <https://publications.gc.ca/site/eng/9.500453/publication.html>. (last accessed October 10, 2024).

<sup>123</sup> Only two years of data were used since the exercise of matching NRCAN data began in 2022, yet three years of data will be used in the next update of the Measure Assessment.

<sup>124</sup> Paul A. et al., *Impact of aging on the energy efficiency of household refrigerating appliances*, *Applied Thermal Engineering*, Volume 205(117992), 25 March 2022. <https://doi.org/10.1016/j.applthermaleng.2021.117992> (last accessed November 30, 2022).

<sup>125</sup> U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Energy Conservation: Program for Consumer Products: Energy Conservation Standards for Refrigerators, Refrigerator-Freezers and Freezers*, 10 CFR Part 430, April 28, 1997.

<sup>126</sup> Natural Resources Canada, *Refrigerators, Refrigerator-Freezers and Wine Chillers - Energy Efficiency Regulations*, <http://www.nrcan.gc.ca/energy/regulations-codes-standards/products/6877> (last accessed January 17, 2019).

<sup>127</sup> Natural Resources Canada, *Registration and Publication of Regulations Amending Canada's Energy Efficiency Regulations*, <https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-regulations/regulatory-announcements/amendment-13/18419> (last accessed October 1, 2020).

<sup>128</sup> New York Department of Public Service, *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs - Residential, Multi-Family, and Commercial/Industrial Measures*, April 15, 2019, p. 29.

<sup>129</sup> Econoler, *Residential Efficient Product Rebates Program – 2022 DSM Evaluation*, Final Report presented to Efficiency Nova Scotia, March 2023.

<sup>130</sup> ENERGY STAR, *Product Finder Tool*, <https://www.energystar.gov/productfinder/product/certified-residential-freezers/results?SetLanguage=English&NRCAN=on> (last accessed September 3, 2020).

Table 84 below presents the parameters of the above equations as well as the unitary savings calculations for the refrigerator retirement and replacement measures.

**Table 84: Electrical Unitary Savings Values for Refrigerator Retirements/Replacements**

| Parameter                                                  | Symbol                              | Manufacture-year Class | ARet (Retirement)                                   |      | HomeWarming / MHEEP (Replacement)           | Reference                                                        |
|------------------------------------------------------------|-------------------------------------|------------------------|-----------------------------------------------------|------|---------------------------------------------|------------------------------------------------------------------|
|                                                            |                                     |                        | Full-sized Refrigerators ( $\geq 10 \text{ ft}^3$ ) |      | Small Refrigerators ( $< 10 \text{ ft}^3$ ) |                                                                  |
| Annual Consumption per Size [kWh/ft <sup>3</sup> ]         | <i>ConsumptionPerSize</i>           | 2002 and later         | 34.8                                                |      |                                             | NRCAN data analysis (see text before the table for more details) |
|                                                            |                                     | 1995-2001              | 41.1                                                |      |                                             | 2017 metering activities, 1997 USDE, NRCAN EE Regulations        |
|                                                            |                                     | 1994 and earlier       | 58.9                                                |      |                                             |                                                                  |
| Proportion of Refrigerators                                | %ManufactureSplit                   | 2002 and later         | 81%                                                 | 81%  | 0%                                          | ARet: 2024 tracking sheet<br>Replacement: Assumption             |
|                                                            |                                     | 1995-2001              | 11%                                                 | 11%  | 0%                                          |                                                                  |
|                                                            |                                     | 1994 and earlier       | 8%                                                  | 8%   | 100%                                        |                                                                  |
| Average Annual Consumption per Size [kWh/ft <sup>3</sup> ] | <i>AvgConsumptionPer</i>            | -                      | 37.4                                                | 37.4 | 58.9                                        | Calculation                                                      |
| Average Refrigerator Size [ft <sup>3</sup> ]               | <i>AvgSize</i>                      | -                      | 18.5                                                | 10.4 |                                             |                                                                  |
| Occupant Adjustment Ratio                                  | <i>OAR</i>                          | -                      | 1.11                                                |      |                                             | 2019 NYPDS                                                       |
| Part-use Factor                                            | <i>PuF</i>                          | -                      | 0.86                                                | 0.38 | N/A                                         |                                                                  |
| Consumption of the New Refrigerator [kWh]                  | <i>NewConsumption</i>               | -                      | N/A                                                 |      | 339                                         | Average from 2021, 2022 and 2023 tracking sheets                 |
| Unitary Energy Savings [kWh/year]                          | <i>Energy Savings<sub>kWh</sub></i> | -                      | 660                                                 | 164  | 674                                         | Calculation                                                      |

## Installation Rates

The installation rates are assumed to be 100%.



### (3) Freezer Retirements/Replacements

#### Summary

Table 85 presents a summary of the values used to calculate freezer retirement and replacement savings. The detailed methodology follows.

**Table 85: Freezer Retirement/Replacement Measure Summary**

| Parameter                                          | ARet                                              |                                               | HomeWarming / MHEEP                       | Reference                                                                              |
|----------------------------------------------------|---------------------------------------------------|-----------------------------------------------|-------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                   |                                               |                                           |                                                                                        |
| Measure                                            | Retirement and recycling of old freezers          |                                               | New efficient freezers                    | -                                                                                      |
| Baseline                                           | Continued usage of old freezers                   |                                               | Existing freezer manufactured before 1995 |                                                                                        |
| Measure Subcategory                                | Full-sized freezers – 7 ft. <sup>3</sup> and more | Small freezers – less than 7 ft. <sup>3</sup> | -                                         |                                                                                        |
| General Parameters                                 |                                                   |                                               |                                           |                                                                                        |
| Installation Rate                                  | -                                                 |                                               | 100%                                      | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 4                                                 |                                               | 4                                         | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                   |                                               |                                           |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 726                                               | 230                                           | 1,380                                     | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.138                                             |                                               |                                           | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 100                                               | 31.7                                          | 190                                       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                |                                               |                                           | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                |                                               |                                           | See Subsection 2.4.1                                                                   |

## Electrical Unitary Energy Savings

To determine the electrical unitary energy savings value of retired (ARet) and replaced (ASFH, MHEEP) freezers, the following equations are used.

$$\text{Energy Savings}_{kWh} = \text{AvgConsumptionPerSize} \times \text{AvgSize} \times \text{OAR} \times \text{PuF} - \text{NewConsumption}$$

$$\text{AvgConsumptionPerSize} = \sum(\text{ConsumptionPerSize} \times \% \text{ManufactureSplit})$$

For regular and small freezers retired through ARet, the average annual per-cubic-foot energy consumption is calculated using 2017 metering activity results<sup>131</sup> for appliances manufactured before 2002 and the results of NRCAN data analyses for appliances manufactured in or after 2002.

Since most retired units in the category “manufactured in or after 2002” are now more recent than the most recent units used in the 2017 metering activity, unitary savings values for refrigerators manufactured in 2002 or later were established using data extracted from NRCAN EnerGuide appliance directories from 2001 to 2012.<sup>132</sup> Model numbers in the 2022 and 2023 tracking sheets were matched with EnerGuide data to extract energy consumption values.<sup>133</sup> Given retired appliances manufactured in 2002 or later are on average 15 years old, the Evaluator increased the EnerGuide energy consumption level by 27% to account for the efficiency loss due to aging based on findings from a recently published metering study.<sup>134</sup>

Average annual consumption values by manufacture-year class<sup>135,136,137</sup> were established and a weighted average was calculated based on 2024 tracking sheet proportion of units per manufacture-year class. The occupant adjustment factor is based on the metering protocol of the New York Department of Public Service<sup>138</sup> and the part-use factor is calculated based on 2022 participant survey data.<sup>139</sup>

For freezers replaced through HomeWarming and MHEEP, the unitary savings value is based on the average annual per-cubic-foot energy consumption of freezers manufactured in 1994 and earlier because eligible freezers correspond to this age category. It is assumed that all replaced freezers are primary freezers since it is a program component criterion and therefore no part-use factor is applied. The average size is based on data from the 2021, 2022 and 2023 tracking sheet for HomeWarming and MHEEP. The energy consumption of installed new freezers is calculated based on 2021, 2022 and 2023 HomeWarming and MHEEP tracking sheet data and the energy consumption rating of each model as labeled by EnerGuide retrieved using the ENERGY STAR Product Finder Tool.<sup>140</sup>

<sup>131</sup> Econoler, *Residential Efficient Product Rebates Program – 2017 DSM Evaluation*, Final Report presented to Efficiency Nova Scotia, March 15, 2018.

<sup>132</sup> Natural Resources Canada, *EnerGuide appliance directory*, <https://publications.gc.ca/site/eng/9.500453/publication.html> (last accessed October 10, 2024).

<sup>133</sup> Only two years of data were used since the exercise of matching NRCAN data began in 2022, yet three years of data will be used in the next update of the Measure Assessment.

<sup>134</sup> Paul A. et al., *Impact of aging on the energy efficiency of household refrigerating appliances*, *Applied Thermal Engineering*, Volume 205(117992), 25 March 2022. <https://doi.org/10.1016/j.applthermaleng.2021.117992> (last accessed November 30, 2022).

<sup>135</sup> U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Energy Conservation: Program for Consumer Products: Energy Conservation Standards for Refrigerators, Refrigerator-Freezers and Freezers*, 10 CFR Part 430, April 28, 1997.

<sup>136</sup> Natural Resources Canada, *Refrigerators, Refrigerator-Freezers and Wine Chillers - Energy Efficiency Regulations*, <http://www.nrcan.gc.ca/energy/energy-efficiency/energy-efficiency-regulations/regulatory-announcements/amendment-13/18419> (last accessed January 17, 2019).

<sup>137</sup> Natural Resources Canada, *Registration and Publication of Regulations Amending Canada's Energy Efficiency Regulations*, <https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-regulations/regulatory-announcements/amendment-13/18419> (last accessed October 1, 2020).

<sup>138</sup> New York Department of Public Service, *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs - Residential, Multi-Family, and Commercial/Industrial Measures*, April 15, 2019, p. 29.

<sup>139</sup> Econoler, *Residential Efficient Product Rebates Program – 2022 DSM Evaluation*, Final Report presented to Efficiency Nova Scotia, March 2023.

<sup>140</sup> ENERGY STAR, *Product Finder Tool*, <https://www.energystar.gov/productfinder/product/certified-residential-freezers/results?SetLanguage=English&NRCAN=on> (last accessed September 3, 2020).

Table 86 below presents the parameters of the above equations as well as the unitary savings calculations for the freezer retirement and replacement measures.

**Table 86: Electrical Unitary Savings Values for Freezer Retirements/Replacements**

| Parameter                                                  | Symbol                              | Manufacture-year Class | ARet (Retirement)                              |                                           | HomeWarming / MHEEP (Replacement) |     | Reference                                                        |
|------------------------------------------------------------|-------------------------------------|------------------------|------------------------------------------------|-------------------------------------------|-----------------------------------|-----|------------------------------------------------------------------|
|                                                            |                                     |                        | Regular Freezers ( $\geq 7$ ft. <sup>3</sup> ) | Small Freezers ( $< 7$ ft. <sup>3</sup> ) |                                   |     |                                                                  |
| Annual Consumption per Size [kWh/ft <sup>3</sup> ]         | <i>ConsumptionPerSize</i>           | 2002 and later         | 33.3                                           |                                           |                                   |     | NRCan data analysis (see text before the table for more details) |
|                                                            |                                     | 1995-2001              | 56.2                                           |                                           |                                   |     | 2017 metering activities, 1997 USDE, NRCan EE Regulations        |
|                                                            |                                     | 1994 and earlier       | 118                                            |                                           |                                   |     |                                                                  |
| Proportion of Freezers                                     | %ManufactureSplit                   | 2002 and later         | 69%                                            | 61%                                       | 0%                                |     | ARet: 2024 tracking sheet<br>Replacement: Assumption             |
|                                                            |                                     | 1995-2001              | 12%                                            | 21%                                       | 0%                                |     |                                                                  |
|                                                            |                                     | 1994 and earlier       | 19%                                            | 18%                                       | 100%                              |     |                                                                  |
| Average Annual Consumption per Size [kWh/ft <sup>3</sup> ] | <i>AvgConsumptionPer.</i>           | -                      | 52.1                                           | 53.4                                      | 118                               |     | Calculation                                                      |
| Average Freezer Size [ft <sup>3</sup> ]                    | <i>AvgSize</i>                      | -                      | 14.1                                           | 10.2                                      |                                   |     |                                                                  |
| Occupant Adjustment Ratio                                  | <i>OAR</i>                          | -                      | 1.11                                           |                                           |                                   |     | 2019 NYDPS                                                       |
| Part-use Factor                                            | <i>PuF</i>                          | -                      | 0.89                                           | 0.38                                      | N/A                               |     |                                                                  |
| Consumption of the New Freezer [kWh]                       | <i>NewConsumption</i>               | -                      | N/A                                            |                                           |                                   | 270 | Average from 2021, 2022 and 2023 tracking sheets                 |
| Unitary Energy Savings [kWh/year]                          | <i>Energy Savings<sub>kWh</sub></i> | -                      | 726                                            | 230                                       | 1,380                             |     | Calculation                                                      |

## Installation Rates

The installation rates are assumed to be 100%.

## (4) Room Air Conditioner Retirements

### Summary

Table 87 presents a summary of the values used to calculate room air conditioner retirement savings. The detailed methodology follows.

**Table 87: Room Air Conditioner Retirement Measure Summary**

| Parameter                                          | ARet                                                  | Reference                                                                              |
|----------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                       |                                                                                        |
| Measure Description                                | Retirement and recycling of old room air conditioners | -                                                                                      |
| Baseline                                           | Continued usage of old room air conditioners          |                                                                                        |
| General Parameters                                 |                                                       |                                                                                        |
| Installation Rate                                  | -                                                     | -                                                                                      |
| Effective Useful Life [years]                      | 3                                                     | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                       |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 184                                                   | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                                 | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0                                                     | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                    | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                    | See Subsection 2.4.1                                                                   |

### Electrical Unitary Energy Savings

The electrical unitary energy savings of retired room air conditioners are calculated using the equations below.

$$Energy\ Savings_{kWh} = \frac{Q \times HOU}{SEER \times 1,000}$$
$$SEER = EER \times RACER$$

The retired unit average capacity variable is calculated using tracking sheet data from 2021 through 2023.

The hours of operation variable is based on NRCan's EnerGuide Room Air Conditioner Directory,<sup>141</sup> which provides local data for four cities in Nova Scotia, namely Halifax, Yarmouth, Sydney, and Greenwood, and is calculated by taking into account the proportion of those participants who retired a room air conditioner in each of the regions of these four cities in 2022. The participants' postal codes recorded in the ARet tracking sheet were used to determine their locations. The following formula was used to calculate the weighted average hours of operation across the province.

$$\begin{aligned} \text{Annual Hours of Operation} \left[ \frac{\text{hr}}{\text{yr}} \right] &= (\%_{\text{people}} \times \text{HOU})_{\text{Halifax}} + (\%_{\text{people}} \times \text{HOU})_{\text{Yarmouth}} + (\%_{\text{people}} \times \text{HOU})_{\text{Sydney}} \\ &+ (\%_{\text{people}} \times \text{HOU})_{\text{Greenwood}} \end{aligned}$$

It is assumed that most air conditioners retired through ARet meet the energy efficiency ratio (EER) of 9.5 as per Natural Resources Canada values for stock room air conditioning units in 2006<sup>142</sup> since 54% of the air conditioning units retired through ARet between 2021 and 2023 were manufactured from 2003 through 2009. To account for seasonal temperature changes, the EER of 10.5 should be multiplied by a factor of 1.11 in accordance with the Ecox Technical Information Bulletin on SEER.<sup>143</sup>

Table 88 below presents the parameters of the above equations as well as the unitary savings calculations for the room air conditioner retirement measure.

**Table 88: Electrical Unitary Savings Values for Room Air Conditioner Retirement**

| Parameter                                                                    | Symbol                                   | ARet       | Reference                                           |
|------------------------------------------------------------------------------|------------------------------------------|------------|-----------------------------------------------------|
| Average Capacity of the Retired Equipment [Btu/h]                            | $Q$                                      | 6,310      | Average of 2021, 2022 and 2023 ARet tracking sheets |
| Annual Hours of Use [h/year]                                                 | $HOU$                                    | 306        | Calculated                                          |
| Energy Efficiency Ratio of the Retired Equipment [Btu/W*h]                   | $EER$                                    | 9.5        | 2006 NRCan <sup>144</sup>                           |
| Factor Used to Determine the SEER of a Room Air Conditioner Based on its EER | $RACER$                                  | 1.11       | Ecox Bulletin No. E-004-EN <sup>145</sup>           |
| Seasonal Energy Efficiency Ratio of the Retired Equipment [Btu/W*h]          | $SEER$                                   | 10.5       | Calculated                                          |
| Conversion Factor [W/kW]                                                     | 1,000                                    | 1,000      | Convention                                          |
| <b>Unitary Energy Savings [kWh/year]</b>                                     | <b><math>Energy Savings_{kWh}</math></b> | <b>184</b> | <b>Calculation</b>                                  |

<sup>141</sup> NRCan's Office of Energy Efficiency, *EnerGuide Room Air Conditioner Directory* 2012, May 2012, p. 88.

<sup>142</sup> Natural Resources Canada, *National Energy Use Database, Residential Sector, Nova Scotia, Table 27: Cooling System Stock by Type, New Unit Efficiencies, Stock Efficiencies and Unit Capacity Ratio, 2007-2012*  
<https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=27&page=2> (last accessed September 19, 2024).

No conversion from SEER to SEER2 was made for this measure since it does not apply to room air-conditioning.

<sup>143</sup> Ecox, *Technical Information Bulletin No. E-004-EN: SEER*, [www.ecoxline.com](http://www.ecoxline.com) (last accessed March 3, 2016).

<sup>144</sup> Natural Resources Canada, *National Energy Use Database, Residential Sector, Nova Scotia, Table 27: Cooling System Stock by Type, New Unit Efficiencies, Stock Efficiencies and Unit Capacity Ratio, 2007-2012*  
<https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=27&page=2> (last accessed September 19, 2024).

<sup>145</sup> Ecox, *Technical Information Bulletin No. E-004-EN: SEER*, [www.ecoxline.com](http://www.ecoxline.com) (last accessed March 3, 2016).

## (5) Dehumidifier Replacements or Retirements/ENERGY STAR Certified Dehumidifiers

### Summary

Table 89 presents a summary of the values used to calculate dehumidifier replacement or retirement and ENERGY STAR certified dehumidifier savings. The detailed methodology follows.

**Table 89: Dehumidifier Replacement or Retirement / ENERGY STAR Certified Dehumidifier Measure Summary**

| Parameter                                          | ARet, ASFH, MHEEP <sup>146</sup>               | Instant Savings                                       | Reference                                                                              |
|----------------------------------------------------|------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                |                                                       |                                                                                        |
| Measure                                            | Replacement or retirement of old dehumidifiers | ENERGY STAR certified dehumidifiers rebated in store  | -                                                                                      |
| Baseline                                           | Continued usage of existing dehumidifier       | New non-ENERGY STAR certified efficiency dehumidifier |                                                                                        |
| General Parameters                                 |                                                |                                                       |                                                                                        |
| Installation Rate                                  | 100%                                           |                                                       | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 5                                              | 12                                                    | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                |                                                       |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 616                                            | 45.2                                                  | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.335                                          |                                                       | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 206                                            | 15.1                                                  | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                             |                                                       | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                             |                                                       | See Subsection 2.4.1                                                                   |

### Electrical Unitary Energy Savings

For both ARet and Instant Savings, dehumidifier electrical unitary energy savings are calculated using the equation below.

$$Energy\ Savings_{kWh} = AWRC \times AOD \times \left( \frac{1}{EF_{base}} - \frac{1}{EF_{new}} \right)$$

<sup>146</sup> While dehumidifier replacements are offered and reported under ASFH and MHEEP, this measure is administered by ARet.

For ARet, the baseline energy factor is based on the 2011 Ontario Power Authority (OPA) Prescriptive Measures and Assumptions report.<sup>147</sup> The new energy factor is calculated using ARet tracking sheet data from 2021 through 2023. While ARet drop-off events offer an opportunity to retire a dehumidifier without necessarily replacing it, the Evaluator assumed that participants replaced their unit since it is unlikely that a home stopped needing dehumidification.

For Instant Savings, the base energy factor corresponds to the average CEF of the non-ENERGY STAR models available in Canada listed by NRCAN.<sup>148</sup> The new energy factor is based on the 2024 Instant Savings tracking sheet and the ENERGY STAR guidelines for dehumidifiers.

For both program components, the average water removal capacity and the average operating days are based on the 2011 OPA Prescriptive Measures and Assumptions report.

Table 90 below presents the parameters of the above equations as well as the unitary savings calculations for the dehumidifier replacement and ENERGY STAR certified dehumidifier measures.

**Table 90: Electrical Unitary Savings Values for Dehumidifier Replacements or Retirements/ ENERGY STAR Certified Dehumidifiers**

| Parameter                                                           | Symbol                 | ARet, ASFH, MHEEP |      | Instant Savings                                                                                                                              |
|---------------------------------------------------------------------|------------------------|-------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Average Water Removal Capacity [L/day]                              | $AWRC$                 | 3.87              |      | 2011 OPA                                                                                                                                     |
| Average Operating Days [days/year]                                  | $AOD$                  | 168               |      | 2011 OPA                                                                                                                                     |
| Energy Factor of the Baseline Dehumidifier [L/kWh]                  | $EF_{base}$            | 0.66              | 1.60 | ARet: 2011 OPA<br>Instant Savings: Average of non-ENERGY STAR models available in Canada, NRCAN                                              |
| Energy Factor of the New ENERGY STAR Certified Dehumidifier [L/kWh] | $EF_{new}$             | 1.76              | 1.80 | ARet: Average of 2021, 2022 and 2023 ARet tracking sheets<br>Instant Savings: 2024 Instant Savings tracking sheet and ENERGY STAR guidelines |
| Unitary Energy Savings [kWh/year]                                   | $Energy\ Savings_{kW}$ | 616               | 45.2 | Calculation                                                                                                                                  |

## Installation Rates

The installation rates are assumed to be 100%.

<sup>147</sup> Ontario Power Authority (OPA). 2011 Prescriptive Measures and Assumptions, Released Version 1, March 2011.

<sup>148</sup> Natural Resources Canada, Search: Dehumidifiers - portable. Available at: <https://oee.nrcan.gc.ca/pml-lmp/index.cfm?action=app.search-recherche&appliance=DEHUMIDIFIERS> (last accessed September 25, 2024).

## (6) ENERGY STAR Certified Clothes Dryers

### Summary

Table 91 presents a summary of the values used to calculate ENERGY STAR certified clothes dryer savings. The detailed methodology follows.

**Table 91: ENERGY STAR Certified Clothes Dryer Measure Summary**

| Parameter                                          | Instant Savings                                       | Reference                                                                              |
|----------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                       |                                                                                        |
| Measure                                            | ENERGY STAR certified clothes dryers rebated in store | -                                                                                      |
| Baseline                                           | New non-ENERGY STAR certified dryers                  |                                                                                        |
| General Parameters                                 |                                                       |                                                                                        |
| Installation Rate                                  | 100%                                                  | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 12                                                    | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                       |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 25.0                                                  | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.138                                                 | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 3.45                                                  | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                    | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                    | See Subsection 2.4.1                                                                   |

### Electrical Unitary Energy Savings

The electrical unitary energy savings of the ENERGY STAR certified clothes dryer measure are calculated using the equations below.

$$Energy\ Savings_{kWh} = ADL \times ALW \times \left( \frac{1}{CEF_{base}} - \frac{1}{CEF_{new}} \right)$$

The average number of dried loads (ADL) was calculated from the NRCAN 2015 Survey of Household Energy Use that contained data on the number of loads per province or region such as the Atlantic region.

The combined energy factor (CEF) of the new units is based on the weighted average CEF of the 10 most installed models in 2024.

The CEF of the base unit replaced through Instant Savings corresponds to the average CEF of the non-ENERGY STAR models available in Canada listed by NRCAN.<sup>149</sup>

<sup>149</sup> Natural Resources Canada, Search: Clothes dryers| Energy Efficiency Ratings. Available at: <https://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESDRYERS> (last accessed September 25, 2024).



Table 92 below presents the parameters of the above equations as well as the unitary savings calculations for the ENERGY STAR Certified clothes dryer measure.

**Table 92: Electrical Unitary Savings Values for ENERGY STAR Certified Clothes Dryer**

| Parameter                                         | Symbol                                   | Instant Savings | Reference                                                    |
|---------------------------------------------------|------------------------------------------|-----------------|--------------------------------------------------------------|
| Average Dried Loads per Year [load/year]          | $ADL$                                    | 197             | 2015 NRCan <sup>150</sup>                                    |
| Average Load Weight [lbs/load]                    | $ALW$                                    | 8.45            | 2019 PUC TRM <sup>151</sup>                                  |
| Combined Energy Factor of New Unit [lbs/kWh]      | $CEF_{new}$                              | 3.94            | 2024 IS tracking sheet                                       |
| Combined Energy Factor of Baseline Unit [lbs/kWh] | $CEF_{base}$                             | 3.72            | Average of non-ENERGY STAR models available in Canada, NRCan |
| <b>Unitary Energy Savings [kWh/year]</b>          | <b><math>Energy\ Savings_{kW}</math></b> | <b>25.0</b>     | <b>Calculation</b>                                           |

## Installation Rates

The installation rates are assumed to be 100%.

## (7) Efficient Clothes Washers

### Summary

Table 93 presents a summary of the values used to calculate efficient clothes washer savings. The detailed methodology follows.

**Table 93: Efficient Clothes Washer Measure Summary**

| Parameter                                          | Instant Savings                               | Reference                                                                              |
|----------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                               |                                                                                        |
| Measure                                            | ENERGY STAR clothes washers, rebated in store | -                                                                                      |
| Baseline                                           | New non-ENERGY STAR clothes washer            |                                                                                        |
| General Parameters                                 |                                               |                                                                                        |
| Installation Rate                                  | 100%                                          | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 11                                            | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                               |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 138                                           | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.138                                         | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 19.0                                          | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                            | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                            | See Subsection 2.4.1                                                                   |

<sup>150</sup> NRCan, 2015 Survey of Household Energy Use, Table 10.6. Calculated average annual dried loads for Atlantic, assuming 100 days of summer and 265 days of winter.

<sup>151</sup> Pennsylvania Public Utility Commission (PUC), *Technical Reference Manual*, August 2019, Subsection 2.4 – Appliances.

## Electrical Unitary Energy Savings

For efficient clothes washers, the electrical unitary savings value is determined by comparing baseline and efficient clothes washer annual energy consumption values, adjusted to consider the proportion of electrically heated hot water used by the appliance.

### Energy Consumption Calculation

First, the energy consumption values of both baseline and efficient clothes washers are determined using the following equation.

$$\text{Clothes Washer Energy Consumption [kWh]} = \frac{\text{Number of Loads} \left[ \frac{\text{Loads}}{\text{Year}} \right] * \text{Capacity[L]}}{\text{IMEF} \left[ \frac{\text{L}}{\text{kWh}} \right]}$$

Table 94 below lists the parameters and corresponding values applied in the equations above for baseline and efficient clothes washers and their resulting energy consumption.

**Table 94: Clothes Washer Energy Consumption**

| Parameter                                              | Symbol                                   | Value for Baseline Clothes Washer | Value for Efficient Clothes Washer | Reference                                                                                                                                                                                                                              |
|--------------------------------------------------------|------------------------------------------|-----------------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of Loads [Loads/Year]                           | <i>Number of Loads</i>                   | 218                               |                                    | 2015 NRCan <sup>152</sup>                                                                                                                                                                                                              |
| Capacity [L]                                           | <i>Capacity</i>                          | 127                               |                                    | Weighted average capacity based on 10 most rebated models in 2024 and ENERGY STAR Certified Clothes Washers database <sup>153</sup>                                                                                                    |
| Integrated Modified Energy Factor (IMEF) [L/kWh/cycle] | <i>IMEF</i>                              | 56.4                              | 82.8                               | <b>Baseline:</b> Average of non-ENERGY STAR models available in Canada, NRCan <sup>154</sup><br><b>Efficient:</b> Weighted average capacity based on 10 most rebated models in 2024 and ENERGY STAR Certified Clothes Washers database |
| Clothes Washer Energy Consumption [kWh/year]           | <i>Clothes Washer Energy Consumption</i> | 492                               | 335                                | Calculation                                                                                                                                                                                                                            |

<sup>152</sup> NRCan, 2015 Survey of Household Energy Use, Table 10.6. Calculated average annual washed loads for Atlantic, assuming 100 days of summer and 265 days of winter. Available at: <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=SH&sector=aaa&juris=ca&year=2015&rn=38&page=1> (last accessed September 13, 2024).

<sup>153</sup> ENERGY STAR, ENERGY STAR Certified Residential Clothes Washers, <https://www.energystar.gov/productfinder/product/certified-clothes-washers/> (last accessed December 21, 2018).

<sup>154</sup> Natural Resources Canada, Search: Clothes Washers | Energy Efficiency Ratings, <http://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESWASHERS> (last accessed September 13, 2024).

## Water Heating Adjustment

Both energy consumption values do not take into account the proportion of hot water for clothes washers produced with electricity in Nova Scotia, nor the use of cold water for washing. Therefore, the energy consumption of both baseline and efficient clothes washers is broken down for each stage of the washing process, as presented in Table 95, to apply correction factors separately at each stage.

**Table 95: Energy Consumption Breakdown for Baseline and Efficient Clothes Washers**

| Energy Consumption Breakdown for Clothes Washers | Proportion of Overall Consumption <sup>155</sup> | Baseline Clothes Washer Electricity Consumption (kWh/year) | Efficient Clothes Washer Electricity Consumption (kWh/year) |
|--------------------------------------------------|--------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|
| Water Heating System                             | 24.8%                                            | 122                                                        | 83                                                          |
| Clothes Dryer                                    | 68.1%                                            | 335                                                        | 228                                                         |
| Clothes Washer Drum                              | 7.1%                                             | 35                                                         | 24                                                          |
| Total                                            | 100.0%                                           | 492                                                        | 335                                                         |

To estimate the savings attributable to water heating system energy consumption, the percentage of electrically heated water is calculated, as presented in Table 96 below. The proportion of electrical DHW tanks in Nova Scotia is used to calculate the overall proportion of electrically heated water for both baseline and efficient clothes washers. The proportion of electrical DHW tanks in Nova Scotia is based on participant data collected in the 2022 and 2023 EPI tracking sheets.<sup>156,157</sup>

**Table 96: Water Heating Sources for Clothes Washers**

| DHW Tank Type  | Proportion |
|----------------|------------|
| Electrical     | 76%        |
| Non-electrical | 24%        |

For water heating consumption, an adjustment factor for cold water washing is applied. Thus, to account for the usage of cold water for washing, the water heating energy consumption value is multiplied by a factor of 0.67, which is based on a survey conducted by Hydro-Québec that found that 67% of washes are done in heated water.<sup>158</sup>

## Adjusted Energy Consumption

Table 97 and Table 98 present the calculations of total electricity consumption for baseline and efficient clothes washers respectively.

<sup>155</sup> Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, p. 18.

<sup>156</sup> The proportions of electric water heating published by NRCAN are not consistent and significantly lower than the value obtained from EPI participants. Therefore, the proportion of electrical water heating is based on EPI tracking sheet data.

<sup>157</sup> Given the change in the EPI program in 2021, the data for the proportion of electric water heating didn't reflect what was previously observed. Therefore, data from only the 2022 and 2023 EPI tracking sheets were used.

<sup>158</sup> Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, p. 19.

**Table 97: Electricity Consumption for Baseline Clothes Washers**

| Energy Consumption Component | Energy Consumption (kWh/year) | Adjustment Factor for Electrical Water Heating | Adjustment Factor for Cold Water Usage | Adjusted Energy Consumption (kWh/year) |
|------------------------------|-------------------------------|------------------------------------------------|----------------------------------------|----------------------------------------|
| Water Heating System         | 122                           | 0.76                                           | 0.67                                   | 62                                     |
| Internal Clothes Dryer       | 335                           | -                                              | -                                      | 335                                    |
| Washing Machine Drum         | 35                            | -                                              | -                                      | 35                                     |
| Total                        | 492                           | -                                              | -                                      | 432                                    |

**Table 98: Electricity Consumption for Efficient Clothes Washers**

| Energy Consumption Component | Energy Consumption (kWh/year) | Adjustment Factor for Electrical Water Heating | Adjustment Factor for Cold Water Usage | Adjusted Electricity Consumption (kWh/year) |
|------------------------------|-------------------------------|------------------------------------------------|----------------------------------------|---------------------------------------------|
| Water Heating System         | 83                            | 0.76                                           | 0.67                                   | 42                                          |
| Internal Clothes Dryer       | 228                           | -                                              | -                                      | 228                                         |
| Washing Machine Drum         | 24                            | -                                              | -                                      | 24                                          |
| Total                        | 335                           | -                                              | -                                      | 294                                         |

Therefore, the unitary energy savings value is established using the energy consumption between baseline and efficient clothes washers, as presented in Table 99.

**Table 99: Electrical Unitary Savings Value for Clothes Washer**

| Parameters                                                         | Value |
|--------------------------------------------------------------------|-------|
| Adjusted Energy Consumption of Baseline Clothes Washer [kWh/year]  | 432   |
| Adjusted Energy Consumption of Efficient Clothes Washer [kWh/year] | 294   |
| Unitary Energy Savings [kWh/year]                                  | 138   |

## Installation Rates

The installation rate is assumed to be 100%.

## (8) Efficient Washer-Dryer Combination Units

### Summary

Table 100 presents a summary of the values used to calculate efficient washer-dryer combination unit savings. The detailed methodology follows.

**Table 100: Efficient Washer-Dryer Combination Units**

| Parameter                                          | Instant Savings                                             | Reference                                                                              |
|----------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                             |                                                                                        |
| Measure                                            | ENERGY STAR washer-dryer combination units rebated in store | -                                                                                      |
| Baseline                                           | New non-ENERGY STAR washer-dryer combination units          |                                                                                        |
| General Parameters                                 |                                                             |                                                                                        |
| Installation Rate                                  | 100%                                                        | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 11                                                          | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                             |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 144                                                         | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.138                                                       | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 19.9                                                        | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                          | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                          | See Subsection 2.4.1                                                                   |

### Electrical Unitary Energy Savings

For efficient washer-dryer combination units, the current models available through the program consist of a dryer and a washer with separate drums that operate separately. Therefore, the energy savings are calculated by summing the savings obtained using the same methodology as for efficient dryers (see Subsection 1.1.1(6)) and clothes washers (see Subsection 1.1.1(7)).

The electrical unitary energy savings of efficient clothes dryers are calculated using the equations below.

$$Energy\ Savings_{kWh} = ADL \times ALW \times (1/CEF_{base} - 1/(CEF_{new}))$$

The average number of dried loads (ADL) was calculated from the NRCan 2015 Survey of Household Energy Use that contained data on the number of loads per province or region such as the Atlantic region. The combined energy factor (CEF) of the new units is based on the weighted average CEF of the 10 most installed models in 2024. The CEF of the base unit replaced through Instant Savings corresponds to the average CEF of the non-ENERGY STAR models available in Canada listed by NRCan.

Table 101 below presents the parameters of the above equations as well as the unitary savings calculations for the clothes dryer replacement measure.

**Table 101: Electrical Unitary Savings Values for the Efficient Clothes Dryer Component of Efficient Washer-Dryer Combination Units**

| Parameter                                         | Symbol                  | Instant Savings | Source                                                                      |
|---------------------------------------------------|-------------------------|-----------------|-----------------------------------------------------------------------------|
| Average Dried Loads per Year [load/year]          | $ADL$                   | 197             | 2015 NRCan <sup>159</sup>                                                   |
| Average Load Weight [lbs/load]                    | $ALW$                   | 8.45            | 2019 PUC TRM <sup>160</sup>                                                 |
| Combined Energy Factor of New Unit [lbs/kWh]      | $CEF_{new}$             | 3.92            | 2024 tracking sheet                                                         |
| Combined Energy Factor of Baseline Unit [lbs/kWh] | $CEF_{base}$            | 3.72            | Average of non-ENERGY STAR models available in Canada, NRCan <sup>161</sup> |
| Unitary Energy Savings [kWh/year]                 | $Energy\ Savings_{kWh}$ | 22.8            | Calculation                                                                 |

For efficient clothes washers, the electrical unitary savings value is determined by comparing baseline and efficient clothes washer annual energy consumption values adjusted to consider the proportion of electrically heated hot water used by the appliance.

First, the energy consumption values of both baseline and efficient clothes washers are determined using the following equation.

$$Clothes\ Washer\ Energy\ Consumption\ [kWh] = \frac{Number\ of\ Loads\ \left[\frac{Loads}{Year}\right] * Capacity[L]}{IMEF\ \left[\frac{L}{kWh}\right]}$$

Table 102 below lists the parameters and corresponding values applied in the equations above for baseline and efficient clothes washers and their resulting energy consumption.

<sup>159</sup> NRCan, 2015 Survey of Household Energy Use, Table 10.6. Calculated average annual dried loads for Atlantic, assuming 100 days of summer and 265 days of winter. Available at: <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=SH&sector=aaa&juris=ca&year=2015&n=38&page=1> (last accessed September 13, 2024).

<sup>160</sup> Pennsylvania Public Utility Commission (PUC), *Technical Reference Manual*, August 2019, Subsection 2.4 – Appliances.

<sup>161</sup> Natural Resources Canada, *Search: Clothes dryers| Energy Efficiency Ratings*. Available at: <https://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESDRYERS> (last accessed September 25, 2024).

**Table 102: Clothes Washer Energy Consumption**

| Parameter                                              | Value for Baseline Clothes Washer | Value for Efficient Clothes Washer | Source                                                                                                                                                                  |
|--------------------------------------------------------|-----------------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of Loads [Loads/Year]                           | 218                               |                                    | 2015 NRCan <sup>162</sup>                                                                                                                                               |
| Capacity [L]                                           | 127                               |                                    | Weighted average capacity based on rebated models in 2024 and ENERGY STAR Certified Clothes Washers database <sup>163</sup>                                             |
| Integrated Modified Energy Factor (IMEF) [L/kWh/cycle] | 58.6                              | 82.4                               | <b>Baseline:</b> NRCan <sup>164</sup><br><b>Efficient:</b> Weighted average capacity based on rebated models in 2024 and ENERGY STAR Certified Clothes Washers database |
| Clothes Washer Energy Consumption [kWh/year]           | 473                               | 336                                | Calculation                                                                                                                                                             |

Both energy consumption values do not consider the proportion of hot water for clothes washers produced with electricity in Nova Scotia or the use of cold water for washing. Therefore, the energy consumption of both baseline and efficient clothes washers is broken down for each stage of the washing process, as presented in Table 103, to apply correction factors separately at each stage.

**Table 103: Energy Consumption Breakdown for Baseline and Efficient Clothes Washers**

| Energy Consumption Breakdown for Clothes Washers | Proportion of Overall Consumption <sup>165</sup> | Baseline Clothes Washer Electricity Consumption (kWh/year) | Efficient Clothes Washer Electricity Consumption (kWh/year) |
|--------------------------------------------------|--------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|
| Water Heating System                             | 24.8%                                            | 117                                                        | 83                                                          |
| Clothes Dryer                                    | 68.1%                                            | 322                                                        | 229                                                         |
| Clothes Washer Drum                              | 7.1%                                             | 34                                                         | 24                                                          |
| Total                                            | 100.0%                                           | 473                                                        | 336                                                         |

To estimate the savings attributable to water heating system energy consumption, the percentage of electrically heated water is calculated as presented in Table 104 below. The proportion of electrical DHW tanks in Nova Scotia is used to calculate the overall proportion of electrically heated water for both baseline and efficient clothes washers. The proportion of electrical DHW tanks in Nova Scotia is based on participant data collected in the 2022 and 2023 EPI tracking sheets.<sup>166,167</sup>

<sup>162</sup> NRCan, 2015 Survey of Household Energy Use, Table 10.6. Calculated average annual washed loads for Atlantic, assuming 100 days of summer and 265 days of winter. Available at: <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=SH&sector=aaa&juris=ca&year=2015&rn=38&page=1> (last accessed September 13, 2024).

<sup>163</sup> ENERGY STAR, *ENERGY STAR Certified Residential Clothes Washers*, <https://www.energystar.gov/productfinder/product/certified-clothes-washers/> (last accessed December 21, 2018).

<sup>164</sup> Natural Resources Canada, *Search: Clothes Washers | Energy Efficiency Ratings*, <http://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESWASHERS> (last accessed September 13, 2024).

<sup>165</sup> Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, p. 18.

<sup>166</sup> The proportions of electric water heating published by NRCan are not consistent and significantly lower than the value obtained from EPI participants. Therefore, the proportion of electrical water heating is based on EPI tracking sheet data.

<sup>167</sup> Given the change in the EPI program in 2021, the data for the proportion of electric water heating didn't reflect what was previously observed. Therefore, data from only the 2022 and 2023 EPI tracking sheets were used.

**Table 104: Water Heating Sources for Clothes Washers**

| DHW Tank Type  | Proportion |
|----------------|------------|
| Electrical     | 76%        |
| Non-electrical | 24%        |

For water heating consumption, an adjustment factor for cold water washing is applied. Thus, to account for the usage of cold water for washing, the water heating energy consumption value is multiplied by a factor of 0.67, which is based on a survey conducted by Hydro-Québec that found that 67% of washes are done using heated water.<sup>168</sup>

Table 105 and Table 106 present the calculations of total electricity consumption for baseline and efficient clothes washers respectively.

**Table 105: Electricity Consumption for Baseline Clothes Washers**

| Energy Consumption Component | Energy Consumption (kWh/year) | Adjustment Factor for Electrical Water Heating | Adjustment Factor for Cold Water Usage | Adjusted Energy Consumption (kWh/year) |
|------------------------------|-------------------------------|------------------------------------------------|----------------------------------------|----------------------------------------|
| Water Heating System         | 117                           | 0.76                                           | 0.67                                   | 60                                     |
| Internal Clothes Dryer       | 322                           | -                                              | -                                      | 322                                    |
| Washing Machine Drum         | 34                            | -                                              | -                                      | 34                                     |
| Total                        | 473                           | -                                              | -                                      | 416                                    |

**Table 106: Electricity Consumption for Efficient Clothes Washers**

| Energy Consumption Component | Energy Consumption (kWh/year) | Adjustment Factor for Electrical Water Heating | Adjustment Factor for Cold Water Usage | Adjusted Electricity Consumption (kWh/year) |
|------------------------------|-------------------------------|------------------------------------------------|----------------------------------------|---------------------------------------------|
| Water Heating System         | 83                            | 0.76                                           | 0.67                                   | 42                                          |
| Internal Clothes Dryer       | 229                           | -                                              | -                                      | 229                                         |
| Washing Machine Drum         | 24                            | -                                              | -                                      | 24                                          |
| Total                        | 336                           | -                                              | -                                      | 295                                         |

The unitary energy savings value is established using the difference between the energy consumption of baseline and efficient clothes washers as presented in Table 107.

**Table 107: Electrical Unitary Savings Value for the Clothes Washer Component of Efficient Washer-Dryer Combination Units**

| Parameters                                                         | Value |
|--------------------------------------------------------------------|-------|
| Adjusted Energy Consumption of Baseline Clothes Washer [kWh/year]  | 416   |
| Adjusted Energy Consumption of Efficient Clothes Washer [kWh/year] | 295   |
| Unitary Energy Savings [kWh/year]                                  | 121   |

<sup>168</sup> Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, p. 19.



Summing the unitary energy savings of 22.8 kWh and 121 kWh for efficient clothes dryers and washers respectively resulted in unitary energy savings of 144 kWh for efficient washer-dryer combination units.

## Installation Rates

The installation rate is assumed to be 100%.

## (9) ENERGY STAR Certified Room Air Purifiers

### Summary

Table 108 presents a summary of the values used to calculate ENERGY STAR certified room air purifier savings. The detailed methodology follows.

**Table 108: ENERGY STAR Certified Room Air Purifier Measure Summary**

| Parameter                                          | Instant Savings                                            | Reference                                                                              |
|----------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                            |                                                                                        |
| Measure                                            | ENERGY STAR certified room air purifiers, rebated in store | -                                                                                      |
| Baseline                                           | New Non-ENERGY STAR certified room air purifier            |                                                                                        |
| General Parameters                                 |                                                            |                                                                                        |
| Installation Rate                                  | 100%                                                       | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 9                                                          | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                            |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 768                                                        | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.171                                                      | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 131                                                        | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                         | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                         | See Subsection 2.4.1                                                                   |

## Electrical Unitary Energy Savings

The electrical unitary energy savings value is determined by using the following equation for ENERGY STAR certified room air purifiers.

$$\begin{aligned} \text{Energy Savings} \left[ \frac{kWh}{year} \right] &= \left[ CADR[cfm] \times \left( \frac{1}{EF_{base}} - \frac{1}{EF_{eff}} \right) \left[ \frac{W}{cfm} \right] \times HOU \left[ \frac{hours}{year} \right] \right. \\ &\quad \left. + (SBP_{base} - SBP_{eff})[W] \times (8,760 - HOU) \left[ \frac{hours}{year} \right] \right] \times \frac{1 kW}{1,000 W} \end{aligned}$$

Table 109 below lists the parameters and corresponding values applied in the equation above and the resulting unitary savings values. Most values are based on the 10 most sold models under Instant Savings in 2024, which represent 57% of air purifier sales under the program component. Other values are based on the Savings Calculator for ENERGY STAR Qualified Appliances since the Canadian government currently has no minimum requirements for room air purifiers.

**Table 109: Electrical Unitary Savings Values for ENERGY STAR Certified Room Air Purifiers**

| Parameter                             | Symbol                 | Instant Savings | Reference                                                              |
|---------------------------------------|------------------------|-----------------|------------------------------------------------------------------------|
| Clean Air Delivery Rate [cfm]         | $CADR$                 | 172             | Weighted average of the 10 most sold models in the 2024 tracking sheet |
| Efficiency for Baseline Unit [cfm/W]  | $EF_{base}$            | 1.00            | Savings Calculator for ENERGY STAR Qualified Appliances <sup>169</sup> |
| Efficiency for Efficient Unit [cfm/W] | $EF_{eff}$             | 4.24            | Weighted average of the 10 most sold models in the 2024 tracking sheet |
| Annual Operating Hours [hours/year]   | $HOU$                  | 5,840           | Savings Calculator for ENERGY STAR Qualified Appliances                |
| Standby Power for Baseline Unit [W]   | $SBP_{base}$           | 1               | Savings Calculator for ENERGY STAR Qualified Appliances                |
| Standby Power for Efficient Unit [W]  | $SBP_{eff}$            | 0.73            | Weighted average of the 10 most sold models in the 2024 tracking sheet |
| Unitary Energy Savings [kWh/year]     | $Energy Savings_{kWh}$ | 768             | Calculation                                                            |

## Installation Rates

The installation rate is assumed to be 100%.

<sup>169</sup> ENERGY STAR, Savings Calculator for ENERGY STAR Qualified Appliances, <https://dnr.mo.gov/sites/dnr/files/media/file/2021/01/energy-star-appliance-calculator.xlsx>, (last accessed December 1, 2019).

## (10) ENERGY STAR Certified Dishwashers

### Summary

Table 110 below presents a summary of the values used to calculate ENERGY STAR certified dishwasher savings. The detailed methodology follows.

**Table 110: ENERGY STAR Certified Dishwasher Measure Summary**

| Parameter                                          | Instant Savings                                                                | Reference                                                                              |
|----------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                |                                                                                        |
| Measure                                            | ENERGY STAR certified dishwashers that use less than 250 kWh, rebated in store | -                                                                                      |
| Baseline                                           | New non-ENERGY Star certified dishwashers                                      |                                                                                        |
| General Parameters                                 |                                                                                |                                                                                        |
| Installation Rate                                  | 100%                                                                           | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 11                                                                             | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                                |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 15.2                                                                           | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.0915                                                                         | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 1.39                                                                           | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                             | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                             | See Subsection 2.4.1                                                                   |

### Electrical Unitary Energy Savings

The electrical unitary energy savings value is determined by using the following equation for ENERGY STAR certified dishwashers.

$$\begin{aligned}
 \text{Energy Savings} \left[ \frac{\text{kWh}}{\text{year}} \right] &= \left( \text{Consumption}_{\text{base}} - \text{Consumption}_{\text{eff}} \right) \times \left( (\% \text{Operation} + (\% \text{Water Heating} \times \% \text{Electric})) \right) \\
 &\times \frac{\text{Nb Loads}}{\text{Nb Loads Standard}}
 \end{aligned}$$

Table 111 lists the parameters and corresponding values applied in the equation above and the resulting unitary savings values. The baseline corresponds to all non-ENERGY STAR certified models available in Canada.

**Table 111: Electrical Unitary Savings Values for ENERGY STAR Certified Dishwashers**

| Parameter                                                               | Symbol                      | Instant Savings | Source                                                                                                                                   |
|-------------------------------------------------------------------------|-----------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Baseline Consumption [kWh]                                              | Consumption <sub>base</sub> | 260             | Average of non-ES models in Natural Resources Canada, Searchable product list for dishwashers, retrieved January 22, 2024 <sup>170</sup> |
| Efficient Unit Consumption [kWh]                                        | Consumption <sub>eff</sub>  | 239             | 2024 Instant Savings Database (average of all models for which at least 10 units were sold)                                              |
| Percentage of Dishwasher Energy Consumption Used for Unit Operation [%] | %Operation                  | 44%             | Illinois TRM 2022 <sup>171</sup>                                                                                                         |
| Percentage of Dishwasher Energy Consumption Used for Water Heating [%]  | %Water Heating              | 56%             | Illinois TRM 2022 <sup>172</sup>                                                                                                         |
| Percentage of DHW Savings that Are Electric [%]                         | %Electric                   | 76%             | The proportion of electrical DHW tanks in Nova Scotia is based on participant data collected in the 2022 and 2023 EPI tracking sheets    |
| Average Annual Number of Loads in Atlantic Region [loads]               | Nb Loads                    | 180             | NRCAN, 2015 Survey of Household Energy Use <sup>173</sup>                                                                                |
| Average Annual Number of Loads Assumed in EnerGuide Rating [loads]      | Nb Loads Standard           | 215             | NRCAN, 2013 "Choosing and Using Appliances with EnerGuide" <sup>174</sup>                                                                |
| Unitary Energy Savings [kWh/year]                                       | Energy Savings [kWh/year]   | 15.2            | Calculation                                                                                                                              |

## Installation Rates

The installation rate is assumed to be 100%.

<sup>170</sup> NRCAN, Search: Dishwasher | Energy Efficiency Ratings | Natural Resources Canada, <https://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=DISHWASHERS> (last accessed January 22, 2024).

<sup>171</sup> Illinois Energy Efficiency Stakeholder Advisory Group, 2022 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 10.0, Volume 2, September 24, 2021, p. 21.

<sup>172</sup> Ibid.

<sup>173</sup> NRCAN, 2015 Survey of Household Energy Use, Table 10.4. Calculated average annual loads for Atlantic region. Available at: <https://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=SH&sector=aaa&juris=ca&year=2015&m=36&page=1>, (last accessed September 13, 2024).

<sup>174</sup> NRCAN, Choosing and Using Appliances with EnerGuide, available at <https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/pdf/energystar/EnerGuideappliances.pdf>, 2013, p.23.

## (11) Humidity Sensors for Bathroom Exhaust Fans

### Summary

Table 112 presents a summary of the values used to calculate humidity sensor for bathroom exhaust fan savings. The detailed methodology follows.

**Table 112: Humidity Sensor for Bathroom Exhaust Fan Summary**

| Parameter                                          | Instant Savings, EPI                                                              | Reference                                                                              |
|----------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                   |                                                                                        |
| Measure                                            | Added humidity sensors on existing bathroom exhaust fans with direct installation | -                                                                                      |
| Baseline                                           | Existing fans with no controls                                                    | -                                                                                      |
| <b>General Parameters</b>                          |                                                                                   |                                                                                        |
| Installation Rate                                  | 100%                                                                              | See details below under Installation Rates.                                            |
| Effective Useful Life [years]                      | 9.5                                                                               | See Subsection 3.2                                                                     |
| <b>Electrical Savings Parameters</b>               |                                                                                   |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 143                                                                               | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.1                                                                               | See Subsection 2.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 14.3                                                                              | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                | See Subsection 2.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                | See Subsection 2.4.1                                                                   |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for humidity sensor for bathroom exhaust fan are calculated using the variables defined and listed in the equation and Table 113 below.

$$Energy Savings_{fan} \left[ \frac{kWh}{year} \right] = \% Savings \times \left( HOU_{fan} \times CFM \left[ \frac{ft^3}{min} \right] \times \frac{1}{\eta_{fan}} \right)$$

$$Energy Savings_{heating} =$$

$$= \times CFM \left[ \frac{ft^3}{min} \right] \times \left( \left[ 0.028317 \frac{m^3}{ft^3} \right] \times \rho \left[ \frac{kg}{m^3} \right] \times C_p \left[ \frac{J}{kg \cdot ^\circ C} \right] \times \left[ \frac{1 W \cdot sec}{1 J} \right] \times \left[ \frac{1 min}{60 sec} \right] \times \left[ \frac{1 kW}{1,000 W} \right] \right) \times HOU_{heating} \times \Delta T \times \% Savings$$

The fan energy savings are shown in Table 113. These are the savings from the lowered fan usage due to the humidity sensor.

**Table 113: Electrical Savings Values for Humidity Sensors for Bathroom Exhaust Fans**

| Parameter                               | Symbol                    | EPI  | Reference                                                                                                                                                                                                                                 |
|-----------------------------------------|---------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fan Efficiency [CFM/W]                  | $\eta_{fan}$              | 3.5  | ENERGY STAR min standard, 2024 <sup>175</sup>                                                                                                                                                                                             |
| Savings Percentage                      | % Savings                 | 50%  | Demand controlled ventilation<br>A case study for existing Swedish multifamily buildings, 2004 <sup>176</sup>                                                                                                                             |
| Fan Exhaust Rate [CFM]                  | CFM                       | 99.1 | Weighted average from ENERGY STAR compliant model list and 2021 tracking sheet using the ENERGY STAR bathroom fan measure available in Instant Savings at the time. This was used as a proxy for the size of fan that consumers purchased |
| Annual Fan Operating Hours [hours/year] | $HOU_{fan}$               | 850  | Vermont TRM, 2023 <sup>177</sup>                                                                                                                                                                                                          |
| Fan Energy Savings [kWh/year]           | Energy Savings [kWh/year] | 12.0 | Calculation                                                                                                                                                                                                                               |

The energy savings per energy source is shown in Table 114, and the unitary energy savings are shown in Table 115. These are the savings on the electric heating system due to lower air infiltration. Excluded from the tables is the percentage of homes heated with non-electrical heating systems, since those would not generate electrical savings.

<sup>175</sup> ENERGY STAR, *ENERGY STAR Ventilation Fans Key Product Criteria*, [https://www.energystar.gov/products/ventilation\\_fans/key\\_product\\_criteria#:~:text=All%20certifying%20bathroom%20and%20utility,measure d%20by%20industry%20standard%20testing](https://www.energystar.gov/products/ventilation_fans/key_product_criteria#:~:text=All%20certifying%20bathroom%20and%20utility,measure d%20by%20industry%20standard%20testing) (last accessed October 1, 2024).

<sup>176</sup> Vitalijus Pavlovas. *Demand controlled ventilation, A case study for existing Swedish multifamily buildings*. 2004.

<sup>177</sup> Efficiency Vermont *Technical Reference Manual*, Program Year 2023, pp. 225-226.

**Table 114: Electrical Heating per Heating Source Savings Values for Humidity Sensors for Bathroom Exhaust Fans**

| Parameter                                                                 | Symbol                    | EPI   | Reference                                                                                                                              |
|---------------------------------------------------------------------------|---------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------|
| Density of Air [kg/m <sup>3</sup> ]                                       | $\rho$                    | 1.293 | Convention                                                                                                                             |
| Heat Capacity of Air [J/kg/°C]                                            | $C_p$                     | 1005  | Convention                                                                                                                             |
| Fan Operating Hours During Heating Season [hours/year]                    | $HOU_{heating}$           | 703   | Operation hours corrected for days that drop below an 18°C average temperature during a 15-year average in Halifax                     |
| Average Yearly Temperature Difference Between Indoor and Outdoor Air [°C] | $\Delta T$                | 13.4  | Difference between 15-year average of outdoor temperature in Halifax during the heating days and an assumed indoor temperature of 21°C |
| COP for Electric Resistance                                               | $COP_{HeatingSource}$     | 1     | Assumption <sup>178</sup>                                                                                                              |
| COP for Heat Pumps                                                        | $COP_{HeatingSource}$     | 1.8   | Assumption <sup>179</sup>                                                                                                              |
| Energy Savings for Electric Resistance [kWh/year]                         | Energy Savings [kWh/year] | 347   | Calculation                                                                                                                            |
| Energy Savings for Heat Pumps [kWh/year]                                  | Energy Savings [kWh/year] | 193   | Calculation                                                                                                                            |

**Table 115: Electrical Savings Values for Humidity sensor for Bathroom Exhaust Fan**

| Parameter                                         | Percentage of Heating Source | Energy Savings per Heating Source | Unitary Energy Savings | Reference                        |
|---------------------------------------------------|------------------------------|-----------------------------------|------------------------|----------------------------------|
| Energy Savings for Electric Resistance [kWh/year] | 26%                          | 347                               | 90.2                   | Statistics Canada <sup>180</sup> |
| Energy Savings for Heat Pumps [kWh/year]          | 21%                          | 193                               | 40.5                   |                                  |
| Fan Energy Savings [kWh/year]                     | -                            | -                                 | 12.0                   | -                                |
| Energy Savings [kWh/year]                         | -                            | -                                 | 143                    | Calculation                      |

## Installation Rates

Installation rates for humidity sensors for bathroom exhaust fan are estimated at 100%.

<sup>178</sup> Assuming a COP of 1 for electric resistance (including baseboard and in-floor) and a COP of 1.8 for heat assuming an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for “Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained” as per the NRCAN regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

<sup>179</sup> Assuming a COP of 1 for electric resistance (including baseboard and in-floor) and a COP of 1.8 for heat assuming an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for “Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained” as per the NRCAN regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

<sup>180</sup> Statistics Canada, Table 38-10-0286-01 (formerly CANSIM 153-0145) Primary heating systems and type of energy, 2021, December 12, 2022. [https://www150.statcan.gc.ca/t1/tbl1/en/cv/recreate.action?pid=3810028601&selectedNodeIds=1D4&checkedLevels=1D1&refPeriods=2017\\_0101,20210101&dimensionLayouts=layout3,layout3,layout2&vectorDisplay=false](https://www150.statcan.gc.ca/t1/tbl1/en/cv/recreate.action?pid=3810028601&selectedNodeIds=1D4&checkedLevels=1D1&refPeriods=2017_0101,20210101&dimensionLayouts=layout3,layout3,layout2&vectorDisplay=false) (last accessed September 13, 2024).

## 2.5 Plug Load Controls

### 2.5.1 Interactive Effects

No interactive effects factors are calculated for power bars and outdoor devices because they are assumed to be negligible.

Table 116 summarizes the interactive effects factors for plug load control measures.

**Table 116: Interactive Effects Factors for Plug Load Control Measures**

| Measure                                          | Interactive Effects Factor for Energy Savings | Interactive Effects Factor for Peak Demand Savings | Reference  |
|--------------------------------------------------|-----------------------------------------------|----------------------------------------------------|------------|
| Smart Power Controller for Audiovisual Equipment | 0%                                            | 0%                                                 | Assumption |
| Power Bar with Integrated Timer                  |                                               |                                                    |            |
| Heavy-duty Outdoor Timer                         |                                               |                                                    |            |
| ENERGY STAR Certified Pool Pump                  |                                               |                                                    |            |

### 2.5.2 Peak Demand Savings Factors

For most plug load control measures, peak demand savings are calculated using the peak demand-to-energy ratios developed by Navigant in the 2016-2018 DSM Plan. These ratios were established for various product categories based on modelled system-coincident peak demand savings and electrical energy savings for a projected deployment of products. Navigant used local data to establish the ratios applicable for the 2016-2018 period. The Evaluator recommends using the same ratios during the 2020-2023 DSM cycle.

As for ENERGY STAR certified variable speed pool pumps, the Evaluator assumes a peak demand-to-energy ratio of zero since these products are not likely used on cold winter days when peak conditions occur.

Table 117 summarizes the peak demand-to-energy ratios established for each plug load control measure.

**Table 117: Peak Demand-to-energy Ratios for Plug Load Control Measures**

| Measure                                          | Peak Demand-to-energy Ratio (W/kWh) | Source                                              |
|--------------------------------------------------|-------------------------------------|-----------------------------------------------------|
| Smart Power Controller for Audiovisual Equipment | 0.000                               | RES-Plug Load Controls, Navigant 2016-2018 DSM Plan |
| Power Bar with Integrated Timer                  |                                     |                                                     |
| Heavy-duty Outdoor Timer                         |                                     |                                                     |
| ENERGY STAR Certified Pool Pump                  | 0.000                               | Assumed by the Evaluator                            |



## 2.5.3 Plug Load Control Measures

### (1) Smart Power Controllers for Audiovisual Equipment

#### Summary

Table 118 presents a summary of the values used to calculate smart power controller for audiovisual equipment savings. The detailed methodology follows.

**Table 118: Smart Power Controllers for Audiovisual Equipment Measure Summary**

| Parameter                                          | EPI                                                                                                                    | Instant Savings    | Reference                                                                              |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                        |                    |                                                                                        |
| Measure                                            | Smart power controllers for audiovisual equipment with direct installation (EPI) or rebated in store (Instant Savings) |                    | -                                                                                      |
| Baseline                                           | Non-smart power controllers                                                                                            |                    |                                                                                        |
| Measure Subcategory                                | Tier 2 power strip                                                                                                     | Tier 1 power strip |                                                                                        |
| General Parameters                                 |                                                                                                                        |                    |                                                                                        |
| Installation Rate                                  | 100%                                                                                                                   | 86%                | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 4                                                                                                                      |                    | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                                                                        |                    |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 207                                                                                                                    | 105                | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                                                                                                  |                    | See Subsection 2.5.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0.00                                                                                                                   | 0.00               | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                     |                    | See Subsection 2.5.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                     |                    | See Subsection 2.5.1                                                                   |

#### Electrical Unitary Energy Savings

Smart power bars rebated under EPI are classified as Tier 2, while those rebated under Instant Savings are classified as Tier 1. Tier 1 smart power bars have a master outlet that switches off other outlets when the master device is turned off. Tier 2 smart power bars have the same functionality as Tier 1 yet will additionally switch devices off when they are not used. A sensor will sense the engagement of the user. Based on those differences, a specific electrical unitary savings is defined for each program component.

The electrical unitary savings energy value associated with the use of Tier 1 and Tier 2 smart power controllers for audiovisual equipment installed under EPI is based on a metering study, published in 2019, of 133 households across Massachusetts.<sup>181</sup> This study represents the most up-to-date research using treatment and control sites with a significantly large sample size.

Table 119 presents the annual unitary savings values for EPI and for Instant Savings and the source of those values.

**Table 119: Electrical Unitary Savings Values for Smart Power Controller Audiovisual Equipment**

| Parameter                         | EPI | Instant Savings | Reference                      |
|-----------------------------------|-----|-----------------|--------------------------------|
| Unitary Energy Savings [kWh/year] | 207 | 105             | NMR Group, 2019 <sup>182</sup> |

## Installation Rates

For EPI, Table 120 lists the installation rate for smart power controllers for audiovisual equipment.

**Table 120: EPI Smart Power Controller for Audiovisual Equipment Installation Rate**

| Installation Rate | Margin of Error | Reference                              |
|-------------------|-----------------|----------------------------------------|
| 100%              | 0.0%            | 2024 EPI on-site visits <sup>183</sup> |

For Instant Savings, the installation rate is 86% is based on the impact evaluation<sup>184</sup> done in parallel to the 2019 Massachusetts metering study.

<sup>181</sup> NMR Group Inc., *RLPNC 17-3: Advanced Power Strip Metering Study*, March 18, 2019.

<sup>182</sup> Ibid.

<sup>183</sup> The installation rate was not updated through the 2021 EPI site visits since this measure is no longer offered in EPI.

<sup>184</sup> NMR Group Inc., *RLPNC 17-4 and 17-5: Products Impact Evaluation of In-service and Short-Term Retention Rates Study*, October 5, 2018.

## (2) Power Bars with Integrated Timers

### Summary

Table 121 presents a summary of the values used to calculate power bar with integrated timer savings. The detailed methodology follows.

**Table 121: Power Bar with Integrated Timer Measure Summary**

| Parameter                                          | Instant Savings                                                           | Reference                                                                              |
|----------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                           |                                                                                        |
| Measure Description                                | Power bars with integrated timer rebated in store                         | -                                                                                      |
| Baseline                                           | Power bars without an integrated timer, controlling a variety of end uses |                                                                                        |
| General Parameters                                 |                                                                           |                                                                                        |
| Installation Rate                                  | 100%                                                                      | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 4                                                                         | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                                           |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 47.9                                                                      | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                                                     | See Subsection 2.5.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0.00                                                                      | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                                        | See Subsection 2.5.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                        | See Subsection 2.5.1                                                                   |

### Electrical Unitary Energy Savings

Table 122 below presents the parameters used in equation below to calculate the electrical unitary savings resulting from the installation of power bars with integrated timers. The methodology and parameters used were drawn from the 2011 OPA Prescriptive Measures and Assumptions List,<sup>185</sup> with a minor adjustment to the number of days used per year; notably, the total 12-month period was set at 365 days instead of 12 times 30 days (360 days).

$$\begin{aligned}
 \text{Energy Savings} \left[ \frac{\text{kWh}}{\text{year}} \right] &= \text{Average Standby Wattage [W]} \times \frac{\text{kW}}{1,000 \text{ W}} \times (\text{Old Operating Time} - \text{New Operating Time}) \left[ \frac{\text{hrs}}{\text{day}} \right] \\
 &\times \text{Number of Days}
 \end{aligned}$$

<sup>185</sup> Ontario Power Authority (OPA), 2011 Prescriptive Measures and Assumptions Version 1, March 2011.

**Table 122: Electrical Unitary Savings Value for Power Bars with Integrated Timers**

| Parameter                                    | Entertainment Centre | Computer System | Lighting              | Other      |
|----------------------------------------------|----------------------|-----------------|-----------------------|------------|
| Proportion                                   | 40.3%                | 15.7%           | 19.4%                 | 24.6%      |
| Average Standby Wattage                      | 38.1 W               | 28 W            | 21.6 W <sup>186</sup> | 28 W       |
| Old Operating Time                           | 9 hrs/day            | 14 hrs/day      | 6 hrs/day             | 11 hrs/day |
| New Operating Time – with Timer              | 5 hrs/day            | 8 hrs/day       | 3 hrs/day             | 4 hrs/day  |
| Number of Days                               | 365                  | 365             | 259                   | 262        |
| Calculated Unitary Energy Savings [kWh/year] | 55.6                 | 61.3            | 16.8                  | 51.4       |
| Weighted Unitary Energy Savings [kWh/year]   | 47.9                 |                 |                       |            |

## Installation Rates

The installation rate is assumed to be 100%.

### (3) Heavy-duty Outdoor Timers

#### Summary

Table 123 below presents a summary of the values used to calculate heavy-duty outdoor timer savings. The detailed methodology follows.

**Table 123: Heavy-duty Outdoor Timer Measure Summary**

| Parameter                                          | Instant Savings                            | Reference                                                                              |
|----------------------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                            |                                                                                        |
| Measure Description                                | Heavy-duty outdoor timers rebated in store | -                                                                                      |
| Baseline                                           | Outdoor outlets without timers             |                                                                                        |
| General Parameters                                 |                                            |                                                                                        |
| Installation Rate                                  | 100%                                       | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                         | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                            |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 122                                        | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                      | See Subsection 2.5.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0.00                                       | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                         | See Subsection 2.5.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                         | See Subsection 2.5.1                                                                   |

<sup>186</sup> Weighted average wattage per installed lamp of different lighting technologies observed in residences by the United States Department of Energy: U.S. Department of Energy. 2020 U.S. Lighting Market Characterization, April 2024, p. 37.

## Electrical Unitary Energy Savings

For heavy-duty outdoor timers, the electrical unitary energy savings value of 122 kWh is based on the results of the OPA 2012 Consumer Program Evaluation.<sup>187</sup> The survey conducted for that evaluation states that heavy-duty outdoor timers sold through the OPA biannual coupon program are used for outdoor lighting, pool pumps, and car block heaters, all of which correspond to possible usages for heavy-duty outdoor timers sold through Instant Savings. Table 124 presents the annual unitary savings value for Instant Savings.

**Table 124: Electrical Unitary Savings Values of Heavy-duty Outdoor Timers**

| Parameter                         | Value | Source                   |
|-----------------------------------|-------|--------------------------|
| Unitary Energy Savings [kWh/year] | 122   | OPA, 2012 <sup>188</sup> |

## Installation Rates

The installation rate is assumed to be 100%.

### (4) ENERGY STAR Certified Pool Pumps

#### Summary

Table 125 presents a summary of the values used to calculate ENERGY STAR certified pool pump savings. The detailed methodology follows.

**Table 125: ENERGY STAR Certified Pool Pump Measure Summary**

| Parameter                                          | Instant Savings                                   | Reference                                                                              |
|----------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                   |                                                                                        |
| Measure Description                                | ENERGY STAR certified pool pumps rebated in store | -                                                                                      |
| Baseline                                           | Standard efficiency electric pool pump            |                                                                                        |
| General Parameters                                 |                                                   |                                                                                        |
| Installation Rate                                  | 100%                                              | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                                | See Subsection 3.2                                                                     |
| Electrical Savings Parameters                      |                                                   |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 530                                               | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.000                                             | See Subsection 2.5.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 0.00                                              | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                | See Subsection 2.5.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                | See Subsection 2.5.1                                                                   |

<sup>187</sup> Research into Action, *Final Report: 2012 Consumer Program Evaluation*, Report presented to OPA, October 11, 2013, p. 154.

<sup>188</sup> Ibid.

## Electrical Unitary Energy Savings

The electrical unitary energy savings values of ENERGY STAR certified pool pumps are calculated using the equations below.

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \text{Base Consumption} - \text{Reduced Consumption}$$

$$\text{Base Consumption} \left[ \frac{kWh}{yr} \right] = \text{Average Power} [kW] \times \text{Old HOU} \left[ \frac{h}{day} \right] \times \text{Pool Season} \left[ \frac{days}{yr} \right]$$

$$\text{Reduced Consumption} \left[ \frac{kWh}{yr} \right] = \text{Average Power} [kW] \times \text{RSF} [-] \times \text{New HOU} \left[ \frac{h}{day} \right] \times \text{Pool Season} \left[ \frac{days}{yr} \right]$$

The unitary savings value of 530 kWh comes from the 2020 NEEP TRM<sup>189</sup> and the Pool Pump Demand Response Potential Report.<sup>190</sup> The value is based on the difference in consumption between an average pool pump operating 5.18 hours per day during a 100-day pool season and a two-speed pool pump with the same power consumption but operating at its lower speed (half speed) for twice the operation time, which is 10.4 hours in this case. The savings are generated through pump affinity laws, which dictate that pump power is proportional to the cube of pump speed. Therefore, if a pump is operating at half speed, its power demand is at one-eighth its usual amount, and since it is operating for twice the usual time, the same amount of water is moved.

Table 126 presents the annual unitary savings value for Instant Savings.

**Table 126: Unitary Savings Values of ENERGY STAR Certified Pool Pumps**

| Parameter                         | Value | Reference                                                       |
|-----------------------------------|-------|-----------------------------------------------------------------|
| Average Power [kW]                | 1.36  | Pool Pump Demand Response Potential Report, 2008 <sup>191</sup> |
| Old Operating Time [h/day]        | 5.18  | Pool Pump Demand Response Potential Report, 2008 <sup>192</sup> |
| Pool Season [days/year]           | 100   | 2020 NEEP TRM <sup>193</sup>                                    |
| New Operating Time [h/day]        | 10.4  | Assumption                                                      |
| Reduced Speed Factor (RSF) [-]    | 0.125 | Pump affinity law convention                                    |
| Unitary Energy Savings [kWh/year] | 530   | Calculation                                                     |

## Installation Rates

The installation rate is assumed to be 100%.

<sup>189</sup> Northeast Energy Efficiency Partnership (NEEP), *Mid-Atlantic Technical Reference Manual Version 10*, May 2020, p. 195.

<sup>190</sup> Southern California Edison, *Pool Pump Demand Response Potential*, June 2008.

<sup>191</sup> Southern California Edison, *Pool Pump Demand Response Potential*, June 2008, p. 13.

<sup>192</sup> Southern California Edison, *Pool Pump Demand Response Potential*, June 2008, p. 19.

<sup>193</sup> Northeast Energy Efficiency Partnership (NEEP), *Mid-Atlantic Technical Reference Manual Version 10*, May 2020, p. 195.

## 2.6 Demand Reduction

For one category of demand reduction measures, namely demand response measures, the peak demand savings are replaced by the available DR capacity that differs from peak demand savings because the available DR capacity considers the potential load reduction that was made available instead of the actual load reduction that coincided with the actual utility peak.

### 2.6.1 Interactive Effects

For demand reduction measures, interactive effects are assumed to be nil.

### 2.6.2 Peak Demand Savings Factors

For demand reduction measures, peak demand savings are not determined using a peak demand-to-energy ratio since they do not generate energy savings. For more details, refer to Subsections 1.1.1(1), (2), (3), and 1.1.1(4).

### 2.6.3 Demand Reduction Measures

#### (1) Three-element Water Heaters

##### Summary

Table 127 presents a summary of the values used to calculate three-element water heater (TEWH) savings. The detailed methodology follows.

**Table 127: Three-element Water Heater Measure Summary**

| Parameter                                          | Green Heat                                         | Reference                                           |
|----------------------------------------------------|----------------------------------------------------|-----------------------------------------------------|
| Measure Description and Identification             |                                                    |                                                     |
| Measure Description                                | Three-element water heaters rebated after purchase | -                                                   |
| Baseline                                           | Conventional two-element water heaters             |                                                     |
| General Parameters                                 |                                                    |                                                     |
| Installation Rate                                  | 100%                                               | See details below under Installation Rates          |
| Effective Useful Life [years]                      | 12                                                 | See Subsection 3.2                                  |
| Electrical Savings Parameters                      |                                                    |                                                     |
| Unitary Energy Savings [kWh/year]                  | N/A                                                | N/A                                                 |
| Peak Demand-to-energy Ratio [W/kWh]                | N/A                                                | N/A                                                 |
| Unitary Peak Demand Savings [W]                    | 200                                                | See details below under Unitary Peak Demand Savings |
| Interactive Effects Factor for Energy Savings      | N/A                                                | See Subsection 2.6.1                                |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                 | See Subsection 2.6.1                                |

## Electrical Unitary Energy Savings

No energy savings are expected from this measure.

## Unitary Peak Demand Savings

The unitary peak demand savings for three-element water heaters (TEWHs) were drawn from a Hydro-Québec study<sup>194</sup> that established the peak demand savings of 200 W based on tests performed on TEWHs during the 2007/2008 heating season. The results of that study were used since it was the only study found on TEWHs, the methodology is sound, and peak periods observed in the study include the Nova Scotia peak period.

## Installation Rates

Installation rates for three-element water heaters are estimated at 100% due to their relatively high cost.

### (2) Domestic Water Heater Timers

#### Summary

Table 128 presents a summary of the values used to calculate domestic water heater timer (DWHT) savings. The detailed methodology follows.

**Table 128: Domestic Water Heater Timer Measure Summary**

| Parameter                                          | Green Heat                                          | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                     |                                                           |
| Measure Description                                | Domestic water heater timers rebated after purchase | -                                                         |
| Baseline                                           | Electric water heaters without timers               |                                                           |
| General Parameters                                 |                                                     |                                                           |
| Installation Rate                                  | 100%                                                | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                  | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                     |                                                           |
| Unitary Energy Savings [kWh/year]                  | N/A                                                 | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | N/A                                                 | N/A                                                       |
| Unitary Peak Demand Savings [W]                    | 500                                                 | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | N/A                                                 | See Subsection 2.6.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                  | See Subsection 2.6.1                                      |

<sup>194</sup> Hydro-Québec. *Essais terrain 2007-2008 d'un nouveau concept de chauffe-eau électrique à 3 éléments*, Provided by Hydro-Québec - Not publicly available, February 9, 2009.



## Electrical Unitary Energy Savings

No energy savings are expected from this measure.

## Unitary Peak Demand Savings

Since no information could be found in the literature, the peak demand savings of DWHTs were based on Nova Scotia Power estimates in their 2019 Load Forecast Report.<sup>195</sup>

In that report, the average peak contribution is estimated at 0.57 kW per tank. Therefore, shutting down the hot water system results in 0.57 kW in peak demand savings. This value is based on internal research on metered hot water tanks for which no details are available, except that the average tank power is approximately 3 kW and the coincident system peak of water heaters indicates that approximately one in five water heaters is on.

To account for uncertainties around this value, the peak demand savings were rounded down to 500 W. This value was deemed acceptable and conservative since it is lower than the baseline peak demand in the Hydro-Québec study for three-element water heaters.

## Installation Rates

Installation rates for DWHTs are estimated at 100% since they are installed and programmed by certified installers. In addition, the programming is locked after installation, meaning that participants need to contact the installer or Nova Scotia Power to prevent their interruption, leaving little room for savings to end prematurely.

### (3) Electric Thermal Storage

#### Summary

Table 129 presents a summary of the values used to calculate electric thermal storage savings. The detailed methodology follows.

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<sup>195</sup> Nova Scotia Power. *2019 Load Forecast Report - Redacted*, April 30, 2019, p. 28.

**Table 129: Electric Thermal Storage Measure Summary**

| Parameter                                          | Green Heat                                                  | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                             |                                                           |
| Measure Description                                | Electric thermal storage systems rebated after purchase     | -                                                         |
| Baseline                                           | Heating systems without electric thermal storage systems    |                                                           |
| General Parameters                                 |                                                             |                                                           |
| Installation Rate                                  | 100%                                                        | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 18                                                          | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                             |                                                           |
| Unitary Energy Savings [kWh/year]                  | -                                                           | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | -                                                           | -                                                         |
| Unitary Peak Demand Savings [W]                    | Maximum storage capacity in eight hours divided by 16 hours | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | N/A                                                         | See Subsection 2.6.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                          | See Subsection 2.6.1                                      |

## Electrical Unitary Energy Savings

No energy savings are expected from this measure.

## Unitary Peak Demand Savings

For electric thermal storage, an eight-hour charging period is assumed based on the residential off-peak period in Nova Scotia Power's time of day rate. It is also assumed that the stored heat is provided equally throughout the remaining 16 hours of the day.

Therefore, the unitary peak demand unitary savings for electric thermal storage are calculated using the equation below where the maximum storage capacity is drawn from manufacturer specification sheets and is the lowest value between either the maximum system storage capacity or the maximum amount of energy the system can store in eight hours.

$$Peak\ Demand\ Savings_W = \text{Maximum Storage Capacity in 8h} / 16h$$

## Installation Rates

Installation rates for electric thermal storage systems are estimated at 100% due to their relatively high cost.

## (4) Domestic Water Heater Load Control

### Summary

Table 130 presents a summary of the values used to calculate domestic water heater load control savings. The detailed methodology follows.

**Table 130: Domestic Water Heater Load Control Measure Summary**

| Parameter                                            | Demand Response                                                         | Reference                                                     |
|------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------|
| Measure Description and Identification               |                                                                         |                                                               |
| Measure                                              | Direct load control for domestic water heaters with direct installation | -                                                             |
| Baseline                                             | Domestic water heaters without direct load control                      |                                                               |
| General Parameters                                   |                                                                         |                                                               |
| Installation Rate                                    | 81%                                                                     | See details below under Installation Rates                    |
| Effective Useful Life [years]                        | 7                                                                       | Applicable to new available DR capacity<br>See Subsection 3.2 |
| Electrical Savings Parameters                        |                                                                         |                                                               |
| Unitary Energy Savings [kWh/year]                    | -                                                                       | See details below under Electrical Unitary Energy Savings     |
| Peak Demand-to-energy Ratio [W/kWh]                  | -                                                                       | -                                                             |
| Available DR Capacity [W]                            | 385 ± 3%                                                                | See details below under Unitary Peak Demand Savings           |
| Interactive Effects Factor for Energy Savings        | N/A                                                                     | See Subsection 2.6.1                                          |
| Interactive Effects Factor for Available DR Capacity | 0%                                                                      | See Subsection 2.6.1                                          |

### Electrical Unitary Energy Savings

No energy savings are expected from this measure.

### Available DR Capacity

The unitary available DR capacity for domestic water heater load controls is based on the metering data analysis results from the 2023 Residential Demand Response evaluation. During the 2021-2022 and 2022-2023 heating seasons, E1 collected data for all participating units and all events. Using the metering data, it was established that each unit reduced demand by an average of 385 W during the two first hours when events were called.

### In-service Rates

While all controllers remained installed, connectivity issues resulted in not all controllers generating savings when events were called, the impact of which was included through the in-service rates as listed in Table 131.

**Table 131: Domestic Water Heater Load Control Measure In-service Rates**

| Type    | In-service Rate | Margin of Error | Source                         |
|---------|-----------------|-----------------|--------------------------------|
| Shifted | 81%             | 4%              | Residential DR 2023 Evaluation |

## 2.7 Renewables

### 2.7.1 Interactive Effects

Interactive effects are assumed to be nil for solar photovoltaic (PV) projects since the equipment involved in such systems is typically installed outdoors.

### 2.7.2 Peak Demand Savings Factors

For solar PV projects, peak demand savings are nil since the solar PV energy production from those systems coinciding with the peak period is negligible.

### 2.7.3 Renewable Measures

#### (1) Solar Photovoltaic Systems

##### Summary

Table 132 presents a summary of the values used to calculate savings for solar photovoltaic (PV) projects. The detailed methodology follows.

**Table 132: Solar Photovoltaic System Measure Summary**

| Parameter                                          | HEA                                                                 | Reference                                         |
|----------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------|
| Measure Description and Identification             |                                                                     |                                                   |
| Measure                                            | Solar PV systems of a maximum of 100 kW, rebated after installation | -                                                 |
| Baseline                                           | No solar PV systems                                                 |                                                   |
| General Parameters                                 |                                                                     |                                                   |
| Installation Rate                                  | 100%                                                                | See details below under Installation Rates        |
| Effective Useful Life [years]                      | 30                                                                  | See Subsection 3.2                                |
| Electrical Savings Parameters                      |                                                                     |                                                   |
| Unitary Energy Savings [kWh/year]                  | Calculation based on data for each installed system                 | See details below under Electrical Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | 0                                                                   | See Subsection 2.7.2                              |
| Unitary Peak Demand Savings [W]                    | 0                                                                   | Calculation                                       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                  | See Subsection 2.7.1                              |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                  | Ibid                                              |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for solar PV under HEA come from the average savings of projects rebated by SolarHomes (government funded). The SolarHomes project savings were calculated using the variables defined and listed in the equations and tables below. For each solar PV project, modelled energy production should be obtained either with PV Watts should include 14% of miscellaneous losses as pre-defined in the modelling tool, as well as a snow loss factor.

$$\text{Energy Savings per Project [kWh]} = \text{Modelled Energy Production [kWh]} \times \text{Adj. Ratio}$$

**Table 133: Electrical Savings Values for SolarHomes**

| Parameter                         | Symbol     | Value                                              | Reference                                                         |
|-----------------------------------|------------|----------------------------------------------------|-------------------------------------------------------------------|
| Modelled Energy Production [kWh]  | -          | Varies per project                                 | Project documentation, using PV Watts                             |
| Snow Loss Factor [%]              | -          | For panel tilt angles $\geq 25^\circ$ : 1%         | Northern Alberta Institute of Technology <sup>196</sup>           |
|                                   |            | For panel tilt angles $< 25^\circ$ : 4%            |                                                                   |
| Adjustment Ratio                  | Adj. Ratio | Projects modelled with PV Watts: 1.009             | Calibration study done as part of SolarHomes 2022/2023 Evaluation |
| Unitary Energy Savings [kWh/year] | -          | Calculated based on data for each installed system | Calculation                                                       |

For HEA, savings are calculated by multiplying the system capacity in kW by a factor of 1,086 kWh/kW, which was obtained by averaging the calibrated savings (i.e. including the 1.009 adjustment factor) for all 2021/2022 and 2022/23 projects in SolarHomes.

## Installation Rates

The installation rate is assumed to be 100% given the verification of the measure that is done through HEA's E assessment and the fact that the calibration study for SolarHomes would have captured any discrepancies in installed systems.

<sup>196</sup> Northern Alberta Institute of Technology, *Solar Photovoltaic Reference Array Report*, March 31, 2016.

### 3 Effective Useful Life

This section outlines the EUL values used to calculate lifetime energy savings. This section also presents EUL values for demand reduction measures; these values are not used to calculate lifetime energy savings since those measures do not save energy. For demand response measures, the EUL represents the number of years for which the demand reduction is expected to persist. The EUL values should be used when calculating cost-effectiveness ratios for measures, in order to account for lifetime benefits.

#### 3.1 LED Lamps and Fixtures

To establish lifetime energy savings for LED lamps and fixtures, the equipment life is determined using rated lifetimes identified in product specification sheets and annual HOU, as described in the equation below.

$$\text{Equipment Life [Years]} = \frac{\text{Rated Lifetime [Hours]}}{\text{Annual HOU [Hours]}}$$

Since regulatory changes will cause the baseline to increase over the lifetime of LEDs and thus decrease annual savings over the lifetime of the product, an equivalent EUL is necessary to determine lifetime savings. The equivalent EUL is multiplied by first-year savings to obtain lifetime energy savings. Since the equivalent EUL is based on upcoming regulatory changes, it must be updated annually to take into account the changing duration of each baseline. The detailed assumptions and calculations to obtain equivalent EUL values are presented in Appendix II.

Table 134 summarizes the equivalent EUL values for residential LED lamps and fixtures.

**Table 134: EUL Values for Residential LED Lamps and Fixtures**

| Measure               | Program Component | Average Rated Lifetime (hours) | Annual HOU (hours/year) | Equipment Life (years) | 2024 Equivalent EUL (years) |
|-----------------------|-------------------|--------------------------------|-------------------------|------------------------|-----------------------------|
| <b>LED A19 Lamps</b>  |                   |                                |                         |                        |                             |
| 9 W Replacing 25 W    | EPI               | 25,000                         | 949                     | 26                     | 1.0                         |
| 9 W Replacing 29 W    |                   |                                |                         |                        | 1.0                         |
| 9 W Replacing 40 W    |                   |                                |                         |                        | 1.0                         |
| 9 W Replacing 43 W    |                   |                                |                         |                        | 1.0                         |
| 9 W Replacing 60 W    |                   |                                |                         |                        | 1.0                         |
| 9 W Replacing 72 W    |                   |                                |                         |                        | 1.0                         |
| 9 W Replacing 100 W   |                   |                                |                         |                        | 1.0                         |
| 9 W Replacing 150 W   |                   |                                |                         |                        | 1.0                         |
| 9.5 W Replacing 25 W  |                   |                                |                         |                        | 1.0                         |
| 9.5 W Replacing 29 W  |                   |                                |                         |                        | 1.0                         |
| 9.5 W Replacing 40 W  |                   |                                |                         |                        | 1.0                         |
| 9.5 W Replacing 43 W  |                   |                                |                         |                        | 1.0                         |
| 9.5 W Replacing 60 W  |                   |                                |                         |                        | 1.0                         |
| 9.5 W Replacing 72 W  |                   |                                |                         |                        | 1.0                         |
| 9.5 W Replacing 100 W |                   |                                |                         |                        | 1.0                         |

| Measure                                                                      | Program Component    | Average Rated Lifetime (hours) | Annual HOU (hours/year) | Equipment Life (years) | 2024 Equivalent EUL (years)                    |
|------------------------------------------------------------------------------|----------------------|--------------------------------|-------------------------|------------------------|------------------------------------------------|
| 9.5 W Replacing 150 W                                                        |                      |                                |                         |                        | 1.0                                            |
| 18 W Replacing 75 W                                                          |                      |                                |                         |                        | 1.0                                            |
| 18 W Replacing 100 W                                                         |                      |                                |                         |                        | 1.0                                            |
| 7 W Black-out Bulbs Replacing 60 W                                           |                      |                                |                         |                        | 1.0                                            |
| LED Reflector Lamps                                                          |                      |                                |                         |                        |                                                |
| PAR20 7 W Replacing 50 W                                                     | EPI                  | 25,000                         | 949                     | 26                     | 1.0                                            |
| PAR30 8 W Replacing 53 W                                                     |                      |                                |                         |                        | 1.0                                            |
| PAR30 8 W Replacing 75 W                                                     |                      |                                |                         |                        | 1.0                                            |
| PAR38 15 W Replacing 90 W                                                    |                      |                                |                         |                        | 1.0                                            |
| PAR38 15 W Replacing 120 W                                                   |                      |                                |                         |                        | 1.0                                            |
| PAR38 15 W Replacing 150 W                                                   |                      |                                |                         |                        | 1.0                                            |
| GU10 7 W Replacing 35 W                                                      |                      |                                |                         |                        | 1.0                                            |
| GU10 7 W Replacing 50 W                                                      |                      |                                |                         |                        | 1.0                                            |
| LED Decorative Lamps                                                         |                      |                                |                         |                        |                                                |
| 4.5 W G25                                                                    | EPI                  | 15,000                         | 949                     | 16                     | 1.0                                            |
| 5 W Chandelier E12                                                           |                      |                                |                         |                        |                                                |
| Other LED Lighting                                                           |                      |                                |                         |                        |                                                |
| LED Nightlights                                                              | EPI                  | 100,000                        | 4,380                   | 23                     | 1.0                                            |
| LED Non-A-type Lamps                                                         |                      |                                |                         |                        |                                                |
| ENERGY STAR Certified LED Non-A-type Lamps (R, BR, and Decorative)           | Instant Savings      | 15,952                         | 1,022                   | 16                     | 1.0                                            |
| ENERGY STAR Certified LED Non-A-type Lamps (Excluding R, BR, and Decorative) |                      | 25,000                         |                         | 24                     | 1.0                                            |
| LED Fixtures                                                                 |                      |                                |                         |                        |                                                |
| ENERGY STAR Certified LED Recessed Downlight Fixtures                        | Instant Savings      | 35,400                         | 1,022                   | 35                     | 1.0                                            |
| ENERGY STAR Certified LED Fixtures without Motion Sensors                    |                      | 50,000                         | 1,022                   | 49                     | 1.0                                            |
| ENERGY STAR Certified LED Fixtures with Motion Sensors                       |                      | 49,044                         | 1,059                   | 46                     | 1.6                                            |
| Solar Fixtures                                                               | Instant Savings, EPI | N/A – EUL based on literature  | N/A                     | 10                     | <u>Instant Savings:</u> 1.9<br><u>EPI:</u> 2.5 |

## 3.2 Other Measures

The EUL values for non-LED lighting measures were established by conducting a literature review of the most recent sources, notably technical reference manuals (TRMs) and studies, used in other jurisdictions.

Table 135 summarizes the EUL values and their source for residential measures.

**Table 135: EUL Values and Sources for Non-LED Lighting Residential Measures**

| Measure Name                             |                       |    |                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------|-----------------------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Appliances</b>                        |                       |    |                                                                                                                                                                                                                                                                                                                                                   |
| Clotheslines and Outdoor Drying Racks    | Instant Savings       | 10 | IESO PMA List, 2019 (Value for indoor clothes drying racks, retractable clotheslines or drying racks)                                                                                                                                                                                                                                             |
| Indoor Drying Racks                      | EPI                   | 10 | IESO, PMA List, 2019 (Value for indoor clothes drying racks, retractable clotheslines or drying racks)                                                                                                                                                                                                                                            |
| Refrigerator Retirements                 | ARet                  | 4  | ENERGY STAR Calculator, Appliance Magazine Market Research Report, 2011<br>Calculation based on the assumption that the EUL of the retired appliance (4 years) corresponds to one third of the EUL of a new appliance (12 years). An equivalent EUL is calculated to account for the baseline increase occurring over the lifetime of the measure |
| Refrigerator Replacements                | HW, ASFH, MHEEP       | 5  | ENERGY STAR Calculator, Appliance Magazine Market Research Report, 2011<br>Calculation based on the assumption that the EUL of the retired appliance (4 years) corresponds to one third of the EUL of a new appliance (12 years). An equivalent EUL is calculated to account for the baseline increase occurring over the lifetime of the measure |
| Freezer Retirements/ Replacements        | ARet, HW, ASFH, MHEEP | 4  | ENERGY STAR Calculator, Appliance Magazine Market Research Report, 2011<br>Calculation based on the assumption that the EUL of the retired appliance (4 years) corresponds to one third of the EUL of a new appliance (12 years). An equivalent EUL is calculated to account for the baseline increase occurring over the lifetime of the measure |
| Room Air-conditioner Retirements         | ARet                  | 3  | DEER, 2014 (Value for room air conditioner recycling)                                                                                                                                                                                                                                                                                             |
| Dehumidifier Replacements                | ARet, HW, ASFH, MHEEP | 5  | ENERGY STAR Calculator, Appliance Magazine Market Research Report, 2011<br>Calculation based on the assumption that the EUL of the retired appliance (4 years) corresponds to one third of the EUL of a new appliance (12 years). An equivalent EUL is calculated to account for the baseline increase occurring over the lifetime of the measure |
| ENERGY STAR Certified Dehumidifiers      | Instant Savings       | 12 | ENERGY STAR Calculator, 2016 (Value for dehumidifiers)                                                                                                                                                                                                                                                                                            |
| ENERGY STAR Certified Clothes Dryers     | Instant Savings       | 12 | ENERGY STAR Calculator, 2016 (Value for clothes dryers)                                                                                                                                                                                                                                                                                           |
| Efficient Clothes Washers                | Instant Savings       | 11 | ENERGY STAR Calculator, 2016 (Value for clothes washers)<br>DOE, Building Energy Data Book, 2011, Table 5.7.15 (Value for clothes washers)<br>DEER, 2014 (Value for high efficiency clothes washers)                                                                                                                                              |
| Efficient Washer-Dryer Combination Units | Instant Savings       | 11 | Minimum between clothes washer and dryer EUL values                                                                                                                                                                                                                                                                                               |
| ENERGY STAR Certified Room Air Purifiers | Instant Savings       | 9  | ENERGY STAR Calculator, 2016 (Value for air purifiers)                                                                                                                                                                                                                                                                                            |



| Measure Name                              |                                   |    |                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------|-----------------------------------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Humidity Sensor for Bathroom Exhaust Fans | EPI                               | 9  | Illinois TRM, 2024 (Half the value of High Efficiency Bathroom Exhaust Fan to account for remaining useful life of existing fan)                                                                                                                                                                                                                  |
| ENERGY STAR Certified Dishwashers         | Instant Savings                   | 11 | DEER, 2014 <sup>197</sup> (Value for high efficiency dishwashers)                                                                                                                                                                                                                                                                                 |
| Appliance Upgrade                         | AMH                               | 11 | Values for appliance upgrades typically vary between 10 and 12 years, so a value of 11 years was assumed                                                                                                                                                                                                                                          |
| <b>Lighting Controls</b>                  |                                   |    |                                                                                                                                                                                                                                                                                                                                                   |
| Dimmer Switches                           | Instant Savings, EPI              | 10 | IESO PMA List, 2019 (Value for dimmer switches)                                                                                                                                                                                                                                                                                                   |
| Motion Sensors                            | Instant Savings, EPI              | 10 | IESO PMA List, 2019 (Value for motion sensors)                                                                                                                                                                                                                                                                                                    |
| <b>Water Heating</b>                      |                                   |    |                                                                                                                                                                                                                                                                                                                                                   |
| Drain Water Heat Recovery                 | HEA, MHEEP                        | 20 | Minnesota TRM, 2020 (Value for residential hot water – drainpipe heat exchangers)                                                                                                                                                                                                                                                                 |
| Solar Domestic Hot Water                  | HEA, Green Heat                   | 20 | ENERGY STAR Residential Water Heaters: Draft Criteria Analysis <sup>198</sup> (Table 1, value for solar water heaters)                                                                                                                                                                                                                            |
| Heat Pump Water Heaters                   | HEA, MHEEP, Instant Savings       | 15 | Connecticut Energy Efficiency Board, 2022 <sup>199</sup> (Value for heat pump water heaters)                                                                                                                                                                                                                                                      |
| Low-flow Showerheads                      | EPI, Instant Savings              | 10 | DEER, 2014 (Value for low-flow showerheads)                                                                                                                                                                                                                                                                                                       |
| Faucet Aerators                           | EPI                               | 10 | DEER, 2014 (value for faucet aerators)                                                                                                                                                                                                                                                                                                            |
| Thermostatic Shower Valves                | EPI                               | 10 | Efficiency Maine TRM, 2019<br>New York TRM, 2019: UPC certification under the International Association of Plumbing and Mechanical Officials Standard IGC 244-2007a. A standard that includes a lifecycle test consisting of 10,000 cycles without fail. 10,000 cycles are the equivalent of three users showering daily for more than nine years |
| Pipe Insulation                           | EPI                               | 13 | DEER, 2014 (Value for pipe insulation – electric water heater)                                                                                                                                                                                                                                                                                    |
| Hot Water Tank Wraps                      | EPI                               | 7  | DEER, 2014 (Value for water heater tank wraps)                                                                                                                                                                                                                                                                                                    |
| Water Heating                             | AMH                               | 10 | DEER, 2014 (Value for heat pump water heaters)                                                                                                                                                                                                                                                                                                    |
| <b>Space Heating</b>                      |                                   |    |                                                                                                                                                                                                                                                                                                                                                   |
| Mini-split Heat Pumps                     | Green Heat, HEA, MHEEP, AMH, ASFH | 18 | GDS, 2007 (Table 1 – Residential Measures, value for AC/heat pumps)                                                                                                                                                                                                                                                                               |
| Central Air-source Heat Pumps             | Green Heat, HEA                   | 18 | GDS, 2007 (Table 1, value for AC/heat pumps)                                                                                                                                                                                                                                                                                                      |

<sup>197</sup> California Public Utilities Commission. DEER 2014. *EUL table* update, Excel spreadsheet (version 2014) downloadable via READI <http://www.deeresources.com/index.php/23-deer-versions/27-deer-2014> (last accessed June 16, 2020).

<sup>198</sup> Retrieved from [https://www.energystar.gov/ia/partners/prod\\_development/new\\_specs/downloads/water\\_heaters/WaterHeaterDraftCriteriaAnalysis.pdf](https://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/WaterHeaterDraftCriteriaAnalysis.pdf).

<sup>199</sup> MichaelsEnergy. *X2001: Connecticut Measure Life/EUL Update Study – Residential & Commercial*, May 11, 2023, p. 17.

| Measure Name                                                                             |                                   |    |                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------|-----------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ground-source Heat Pumps                                                                 | Green Heat, HEA                   | 25 | Life expectancy estimated by the U.S. Department of Energy <sup>200</sup> (up to 24 years for the inside component and more than 50 years for the ground loop) and by Natural Resources Canada <sup>201</sup> (about 20 to 25 years)                                                                                                                                     |
| Wood Stoves/Fireplace Inserts                                                            | Green Heat, HEA                   | 18 | GDS, 2007 (Table 1 – Residential Measures, value for replacement/retrofit of heating and cooling systems)                                                                                                                                                                                                                                                                |
| Pellet Stoves/Fireplace Inserts                                                          | Green Heat, HEA                   | 18 | GDS, 2007 (Table 1 – Residential Measures, value for replacement/retrofit of heating and cooling systems)                                                                                                                                                                                                                                                                |
| Wood Furnaces/Boilers                                                                    | Green Heat, HEA                   | 18 | GDS, 2007 (Table 1 – Residential Measures, value for replacement/retrofit of heating and cooling systems)                                                                                                                                                                                                                                                                |
| Pellet Furnaces/Boilers                                                                  | Green Heat, HEA                   | 18 | GDS, 2007 (Table 1 – Residential Measures, value for replacement/retrofit of heating and cooling systems)                                                                                                                                                                                                                                                                |
| Solar Air Heating                                                                        | Green Heat                        | 20 | ENERGY STAR Residential Water Heaters: Draft Criteria Analysis <sup>202</sup> (Table 1, value for solar water heaters)<br><br>No information specific to solar air heating was available in the literature. The EUL of solar air heating systems is at least equivalent to that of solar DHW systems because solar air heating has very few mobile mechanical components |
| Air Sealing Products                                                                     | EPI                               | 15 | GDS, 2007 (Table 1 – Residential Measures, value for air sealing)                                                                                                                                                                                                                                                                                                        |
| Window Film Kits                                                                         | EPI                               | 1  | Assumption based on the unlikelihood that the same film would be removed and reapplied every year without it being damaged and replaced over time                                                                                                                                                                                                                        |
| Programmable Thermostats                                                                 | Instant Savings, MHEEP, ASFH      | 10 | GDS, 2007 (Table 1 – Residential Measures; value for residential programmable thermostats)                                                                                                                                                                                                                                                                               |
| Smart Thermostats for Electrical Heating Systems                                         | EPI, Instant Savings, MHEEP, ASFH | 10 | Various EUL values are used among jurisdictions. The common practice is to use the same EUL value as for programmable thermostats                                                                                                                                                                                                                                        |
| Advanced Learning Thermostat for Central Heating Systems                                 | EPI                               | 10 | Various EUL values are used among jurisdictions. The common practice is to use the same EUL value as for programmable thermostats                                                                                                                                                                                                                                        |
| <b>Plug Load Controls</b>                                                                |                                   |    |                                                                                                                                                                                                                                                                                                                                                                          |
| Smart Power Controllers for Audiovisual Equipment/Load Sensing Power Bars (Smart Strips) | EPI, Instant Savings              | 4  | David Rogers, PowerSmart Engineering “Smart Strip Electrical Savings Usability.” October 2008, p. 22                                                                                                                                                                                                                                                                     |
| Power Bars with Integrated Timer                                                         | Instant Savings                   | 4  | David Rogers, PowerSmart Engineering “Smart Strip Electrical Savings Usability.” October 2008, p. 22                                                                                                                                                                                                                                                                     |
| Heavy-duty Outdoor Timers                                                                | Instant Savings                   | 10 | IESO PMA List, 2019 (Value for heavy duty plug-in timers)                                                                                                                                                                                                                                                                                                                |
| ENERGY STAR Certified Pool Pumps                                                         | Instant Savings                   | 10 | ENERGY STAR Calculator, 2016 (Value for pool pumps)                                                                                                                                                                                                                                                                                                                      |

<sup>200</sup> Retrieved from <https://energy.gov/energysaver/heat-and-cool/heat-pump-systems/geothermal-heat-pumps#306534-tab-1>.

<sup>201</sup> Retrieved from <https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about-energy-star-canada/energy-star-announcements/publications/heating-cooling-heat-pump/ground-source-heat-pumps-earth-energy-systems/6833>.

<sup>202</sup> Retrieved from [https://www.energystar.gov/ia/partners/prod\\_development/new\\_specs/downloads/water\\_heaters/WaterHeaterDraftCriteriaAnalysis.pdf](https://www.energystar.gov/ia/partners/prod_development/new_specs/downloads/water_heaters/WaterHeaterDraftCriteriaAnalysis.pdf).

| Measure Name                                                    |                 |      |                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------|-----------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Demand Reduction</b>                                         |                 |      |                                                                                                                                                                                                                                                                     |
| Three-element Water Heaters                                     | Green Heat      | 12   | Hydro-Québec, 2011 <sup>203</sup>                                                                                                                                                                                                                                   |
| Domestic Water Heater Timers                                    | Green Heat      | 15   | GDS, 2007 (Appendix C – Additional Documentation on Targeted Measures and Preliminary Measure Life Value Data for Other Residential and C&I End-Use Equipment, Value for Water Heater Controls)                                                                     |
| Electric Thermal Storage                                        | Green Heat      | 18   | The EUL is expected to be comparable to other heating systems. The EUL therefore corresponds to the value used for stoves, furnaces/boilers, and air-source heat pumps                                                                                              |
| Domestic Water Heater Load Control                              | Demand Response | 7    | This value is applicable to new available DR capacity. In 2023, 80% of participants reenrolled. Assuming a fixed drop-out rate of 20%, the Evaluator calculated an EUL of 7 years. This EUL is likely to be updated once more annual reenrollment data is available |
| <b>Renewables</b>                                               |                 |      |                                                                                                                                                                                                                                                                     |
| Solar PV                                                        | HEA, SolarHomes | 30   | NREL, 2020. <sup>204</sup> Nearly 90% of respondents to this study gave an EUL of at least 30 years, making this a conservative estimate                                                                                                                            |
| <b>Other</b>                                                    |                 |      |                                                                                                                                                                                                                                                                     |
| Modelled Space Heating Equipment and Building Envelope Measures | HEA, MHEEP      | 20.5 | The EUL value of 20.5 years for building envelope measures and space heating equipment modelled in HOT2000 was established by calculating the weighted average of EUL values associated with building envelope and heat pump measures installed under HEA in 2024.  |
| Building Envelope                                               | AMH             | 30   | California Public Utilities Commission, 2023 <sup>205</sup>                                                                                                                                                                                                         |

<sup>203</sup> Hydro-Québec. *Essais terrain 2007-2008 d'un nouveau concept de chauffe-eau électrique à 3 éléments*, provided by Hydro-Québec - Not publicly available, March 15, 2011.

<sup>204</sup> NREL. *Benchmarking Utility-Scale PV Operational Expenses and Project Lifetimes*, June 2020, p.3.

<sup>205</sup> DNV. *Residential Insulation Measure Effective Useful Life Study Final Report*, December 22, 2023, p.16.

# COMMERCIAL MEASURE ASSESSMENT CHANGE LOG

**Table 136: Commercial Measure Assessment Change Log**

| Change Type | Section                                                                                                                                                                                                      | Description                                                                                                                                                                                                                                                            | Date       |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Update      | 1.1.1(2) Advanced RTU Controls                                                                                                                                                                               | Update savings calculation methodology                                                                                                                                                                                                                                 | 2023-03-09 |
| Update      | 3.1 EUL - LED Lamps and Fixtures<br>Appendix II                                                                                                                                                              | Update EUL values and rationale for using an equivalent EUL to account for LED lamps becoming the baseline in 2025                                                                                                                                                     | 2023-03-09 |
| New Measure | 1.1.1(6) Compressed Air Leak Repairs                                                                                                                                                                         | Added compressed air leak repairs since a standard approach was developed for these Custom projects                                                                                                                                                                    | 2023-03-09 |
| New Measure | 3.6 (1) Variable Frequency Drives for non-HVAC Applications                                                                                                                                                  | Added variable frequency drives for non-HVAC fans and pumps applications since this measure was added to the BER Application Rebates offering                                                                                                                          | 2023-03-09 |
| Update      | 5.1.1 Interactive Effects<br>Lighting Measures                                                                                                                                                               | Update interactive effects factors for commercial lighting measures                                                                                                                                                                                                    | 2023-03-09 |
| Removal     | Booster Pump (for BER Instant Rebates only)                                                                                                                                                                  | No longer offered                                                                                                                                                                                                                                                      | 2024-03-12 |
| Format      | All sections                                                                                                                                                                                                 | Creation of separate documents for Residential and Commercial Measure Assessment Reports                                                                                                                                                                               | 2025-03-19 |
| New Measure | 1.1.1(8) LED Roadway Lighting                                                                                                                                                                                |                                                                                                                                                                                                                                                                        | 2025-03-19 |
| New Measure | (3) Smart Thermostats for Electric Heating                                                                                                                                                                   | Added smart thermostats for electric baseboards to the BER Application Rebates offering. Unitary savings developed based on the residential measure                                                                                                                    | 2025-03-19 |
| New Measure | 5.8 Solar                                                                                                                                                                                                    | Added a section for the solar DHW system and solar space heating system measures for BER Application Rebates and SBES, adapted from the residential entries. Also added the photovoltaic system measure to the BER Application Rebates and SBES offerings. EUL updated | 2025-03-19 |
| New Measure | 5.7 Pool Pumps                                                                                                                                                                                               | Added a section for the pool pump measures for BER Application Rebates and SBES                                                                                                                                                                                        | 2025-03-19 |
| Update      | 3.2 EUL – Other Measures                                                                                                                                                                                     | Update the EUL the commercial Small ASHP                                                                                                                                                                                                                               | 2025-03-19 |
| New Measure | 5.3.4 HVAC Measures<br>(6) Heat Pump Water Heaters<br>5.5.4 Compressed Air Measures<br>5.9 Refrigeration<br>5.10 Agriculture<br>5.11 Commercial Kitchen<br>5.13 Commercial IT and<br>5.12 Commercial Laundry | Added measures that were previously only described in the BER CIRx Screening Tool v1.6                                                                                                                                                                                 | 2025-03-19 |

| Change Type | Section                                                                   | Description                                                                                                                                                                                                                       | Date                                                                                  |
|-------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Update      | 1.1.1(1) LED Lamps                                                        | PCF was corrected from 59% to 54%                                                                                                                                                                                                 | 2025-03-19                                                                            |
| Update      | Lighting Measures                                                         | For LED Linear Fixtures, LED Linear Lamps, LED Outdoor Fixtures, and LED Directional and Architectural Fixtures, the HOU for BER-IR updated based on 2021-2023 BER-AR and SBES. Savings algorithms were added for BER-AR and SBES | 2025-03-19                                                                            |
| Update      |                                                                           | (6) Occupancy/Motion Sensors                                                                                                                                                                                                      | Update average wattage with BER-AR-SBES 2020-2023                                     |
| Update      |                                                                           | (7) LED Nightlights                                                                                                                                                                                                               | EUL corrected to 1.0 to align with all other general-use lamp baseline change in 2025 |
| New Measure |                                                                           | (9) Horticultural Lighting                                                                                                                                                                                                        | Added horticultural lighting to BER-IR and BER-AR offerings                           |
| Update      | (4) Air-source Heat Pumps Less Than 65,000 Btu/h (excluding air-to-water) | Updated the baseline default Seasonal energy efficiency ratio (SEER) value                                                                                                                                                        | 2025-03-19                                                                            |
| Update      | 5.4.1 Water Heating Interactive Effects                                   | Modification of HP COP to 1.8                                                                                                                                                                                                     | 2025-03-19                                                                            |
| Update      | 5.4.4(1) Low-flow Showerheads                                             | Updated electric water heating efficiency                                                                                                                                                                                         | 2025-03-19                                                                            |
| Update      | 5.4.4(2) Faucet Aerators                                                  | Updated electric water heating efficiency                                                                                                                                                                                         | 2025-03-19                                                                            |
| Update      | 5.4.4(3) Thermostatic Shower Valve                                        | Updated electric water heating efficiency                                                                                                                                                                                         | 2025-03-19                                                                            |
| Update      | 5.4.4(5) Hot Water Tank Wraps                                             | Updated electric water heating efficiency                                                                                                                                                                                         | 2025-03-19                                                                            |
| Update      | (7) Efficient Refrigeration Compressors (Scroll Refrigeration Compressor) | Discus compressors are no longer in other TRMs and were also not rebated in recent years. We removed the discus compressors and simplified the algorithm to match Iowa's algorithm                                                | 2025-03-19                                                                            |
| Update      | (9) Brushless DC Motors                                                   | Updated the algorithm including the load factor and rated motor outputs                                                                                                                                                           | 2025-03-19                                                                            |
| Update      | (7) Dairy Scroll Compressors                                              | The milk weight and base EER were updated, along with the change in milk temperature                                                                                                                                              | 2025-03-19                                                                            |

## 4 Commercial Measure Assessment Scope

Table 137 below lists the commercial measures and associated programs included in the 2024-2025 DSM MA.

The MA includes all necessary parameters and calculations to obtain gross energy and peak demand savings for all portfolio prescriptive measures, as well as SBES and BER semi-prescriptive measures. The SBES and BER Application Rebate semi-prescriptive measures are added to the MA for the first time in 2024. In addition, effective useful life values are included for all prescriptive, semi-prescriptive, and custom measures.

For reference, savings calculations for prescriptive measures use fixed assumptions for all participants. The savings are identical for all units installed and represent the average savings for all units. Conversely, savings calculations for custom measures use inputs that are specific to each unit installed and thus represent the actual savings for each unit. Semi-prescriptive measures use a mix of two previous approaches by using unit-specific inputs as well as certain non-specific inputs to determine savings.

**Table 137: Included Commercial Measures**

| Program Components                                                                                                                                                                 |                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>Lighting</b>                                                                                                                                                                    |                      |
| LED Lamps                                                                                                                                                                          | SBES                 |
| LED Linear Fixtures                                                                                                                                                                | BER-IR, BER-AR, SBES |
| LED Linear Lamps                                                                                                                                                                   | BER-IR, BER-AR, SBES |
| LED Outdoor Fixtures                                                                                                                                                               | BER-IR, BER-AR, SBES |
| LED Directional and Architectural Fixtures                                                                                                                                         | BER-IR, BER-AR, SBES |
| Occupancy Sensors                                                                                                                                                                  | BER-IR, BER-AR, SBES |
| LED Nightlights                                                                                                                                                                    | SBES                 |
| LED Roadway Lighting                                                                                                                                                               | BER-AR               |
| Horticultural Lighting                                                                                                                                                             | BER-AR               |
| <b>Pumps</b>                                                                                                                                                                       |                      |
| Circulator Pumps                                                                                                                                                                   | BER-IR, BER-AR       |
| Booster Pumps                                                                                                                                                                      | BER-AR               |
| <b>Space Heating</b>                                                                                                                                                               |                      |
| Electric Thermal Storage                                                                                                                                                           | BER-AR               |
|                                                                                                                                                                                    | SBES                 |
| Advanced Rooftop Unit Controls                                                                                                                                                     | BER-AR               |
| <b>HVAC</b>                                                                                                                                                                        |                      |
| Electric Thermal Storage                                                                                                                                                           | BER-AR, SBES         |
| Advanced Rooftop Unit Controls                                                                                                                                                     | BER AR               |
| Smart Thermostats for Electric Heating                                                                                                                                             | BER AR               |
| Air-source Heat Pumps Less Than 65,000 Btu/h (excluding air-to-water)                                                                                                              | BER-AR, SBES         |
| Air-source Heat Pumps Greater Than or Equal to 65,000 Btu/hr; Ground-source Heat Pumps; Water Source Heat Pumps; Air-to-water Heat Pumps; and Packaged Terminal Heat Pumps (PTHPs) | BER-AR, SBES         |

| Program Components                                                    |                         |
|-----------------------------------------------------------------------|-------------------------|
| Dual Enthalpy Economizer Controls                                     | BER-AR, SBES            |
| HVAC Hotel Occupancy Sensors                                          | BER-AR, SBES            |
| <b>Water Heating</b>                                                  |                         |
| Low-flow Showerheads                                                  | SBES                    |
| Faucet Aerators                                                       | SBES                    |
| Thermostatic Shower Valves                                            | SBES                    |
| Pipe Insulation                                                       | SBES                    |
| Hot Water Tank Wraps                                                  | SBES                    |
| Heat Pump Water Heaters                                               | BER-AR, SBES            |
| <b>Compressed Air</b>                                                 |                         |
| Compressed Air Leak Repairs                                           | Custom                  |
| Cycling Refrigerated Air Dryers                                       | BER-AR, SBES            |
| Air-entraining Air Nozzles                                            | BER-AR, SBES            |
| No-loss Drains                                                        | BER-AR, SBES            |
| <b>Variable Frequency Drives (VFDs)</b>                               |                         |
| VFD for non-HVAC Applications                                         | BER-AR                  |
| <b>Pool Pump</b>                                                      |                         |
| ENERGY STAR® Pool Pumps                                               | BER-AR, SBES            |
| <b>Solar</b>                                                          |                         |
| Solar Photovoltaic Systems                                            | BER-AR, Custom Retrofit |
| Solar Domestic Hot Water (DHW)                                        | BER-AR                  |
| Solar Air Heating                                                     | BER-AR                  |
| <b>Refrigeration</b>                                                  |                         |
| Cooler Night Covers/Display Strip Curtains                            | BER-AR, SBES            |
| Zero-energy Doors                                                     | BER-AR, SBES            |
| Door Heater Controls                                                  | BER-AR, SBES            |
| Evaporator Fan Motor Controls                                         | BER-AR, SBES            |
| Intelligent Freezer Defrost Controls                                  | BER-AR, SBES            |
| Vertical Refrigeration Open-to-closed Cooler Conversions              | BER-AR, SBES            |
| Efficient Refrigeration Compressors (Scroll Refrigeration Compressor) | BER-AR, SBES            |
| Refrigeration Economizers                                             | BER-AR, SBES            |
| Brushless DC Motors                                                   | BER-AR, SBES            |
| Refrigerated Vending Machine Controllers                              | BER-AR, SBES            |
| <b>Agriculture</b>                                                    |                         |
| High Volume Low Speed Fans                                            | BER-AR, SBES            |
| Energy Efficient Ventilation Fans and Circulation Fans                | BER-AR, SBES            |
| Dual and Natural Ventilation                                          | BER-AR, SBES            |

| Program Components                                  |              |
|-----------------------------------------------------|--------------|
| Zero-energy and Low-energy Livestock Waterers       | BER-AR, SBES |
| Agriculture Heat Pads                               | BER-AR, SBES |
| Tractor Engine Block Heater Timers                  | BER-AR, SBES |
| Dairy Scroll Compressors                            | BER-AR, SBES |
| Heat Reclaimer Units                                | BER-AR, SBES |
| Milk Pre-coolers                                    | BER-AR, SBES |
| VFD for Milk Vacuum Pumps                           | BER-AR, SBES |
| VFD for Milk Transfer Pumps                         | BER-AR, SBES |
| <b>Commercial Kitchen Equipment</b>                 |              |
| Dishwashers                                         | BER-AR, SBES |
| Freezers/Refrigerators                              | BER-AR, SBES |
| Fryers                                              | BER-AR, SBES |
| Griddles                                            | BER-AR, SBES |
| Hot Food Holding Cabinets                           | BER-AR, SBES |
| Ice Machines                                        | BER-AR, SBES |
| Steam Cookers                                       | BER-AR, SBES |
| Ovens                                               | BER-AR, SBES |
| Kitchen Exhaust Demand Controlled Ventilation (DCV) | BER-AR, SBES |
| <b>Commercial IT and Datacentres</b>                |              |
| Server Virtualization and Decommissioning           | BER-AR, SBES |
| Server-based Power Management Software              | BER-AR, SBES |
| Uninterruptible Power Supply (UPS)                  | BER-AR, SBES |
| <b>Commercial Laundry Equipment</b>                 |              |
| Commercial Washing Machines                         | BER-AR, SBES |
| Commercial Clothes Dryers - Heat Pumps              | BER-AR, SBES |



## 5 BNI Measure Gross Savings Parameters

The following sections outline all necessary parameters to calculate gross energy savings for BER Instant Rebates, SBES and Custom Retrofit semi-prescriptive measures.

### 5.1 Lighting

#### 5.1.1 Interactive Effects

The interactive effects methodology for commercial lighting was reviewed as part of the 2024 DSM Measure Assessment update. The updated interactive effect factors and methodology are presented in Appendix IV. These updates will be applied in 2025 to align with updates to the BER-AR adjustment ratios also planned for 2025. Therefore, the interactive effect factors applied in 2024 are unchanged from 2023 and are presented below.

For BER Application Rebates and SBES (except for the direct install offer), the interactive effect factors are based on the building type as well as the space heating and cooling type specific to each project, as per the following two tables.

**Table 138: BER-AR Interactive Effects (IE) Factors for Lighting**

| Building Type                   | IE Peak Demand<br>(if electrical heating) | IE Energy          |                    |                                |
|---------------------------------|-------------------------------------------|--------------------|--------------------|--------------------------------|
|                                 |                                           | Electrical Heating | Electrical Cooling | Electrical Heating and Cooling |
| Agriculture                     | 0.75                                      | 0.81               | 1.04               | 0.85                           |
| Banking / Financial             | 0.74                                      | 0.8                | 1.04               | 0.84                           |
| Education                       | 0.74                                      | 0.8                | 1.04               | 0.84                           |
| Entertainment / Public Assembly | 0.71                                      | 0.78               | 1.04               | 0.82                           |
| Healthcare                      | 0.72                                      | 0.83               | 1.04               | 0.87                           |
| Hospitality                     | 0.69                                      | 0.81               | 1.04               | 0.85                           |
| Manufacturing / Industrial      | 0.7                                       | 0.77               | 1.06               | 0.83                           |
| Office / Commercial             | 0.71                                      | 0.78               | 1.04               | 0.82                           |
| Public Service                  | 0.72                                      | 0.79               | 1.04               | 0.83                           |
| Residential                     | 0.69                                      | 0.81               | 1.04               | 0.85                           |
| Restaurant / Bar                | 0.74                                      | 0.8                | 1.06               | 0.86                           |
| Retail                          | 0.74                                      | 0.8                | 1.06               | 0.86                           |
| Technology / Science            | 0.72                                      | 0.79               | 1.04               | 0.83                           |
| Warehouse / Storage             | 0.71                                      | 0.82               | 1.04               | 0.86                           |

**Table 139: SBES Interactive Effects Factors for Lighting**

| Building type                   | IE Peak Demand<br>(if electrical heating) |                          | IE Energy             |                          |                    |                                |                          |
|---------------------------------|-------------------------------------------|--------------------------|-----------------------|--------------------------|--------------------|--------------------------------|--------------------------|
|                                 |                                           |                          | Electrical Heating    |                          | Electrical Cooling | Electrical Heating and Cooling |                          |
|                                 | Less than 20,000 SQFT                     | Greater than 20,000 SQFT | Less than 20,000 SQFT | Greater than 20,000 SQFT | All sizes          | Less than 20,000 SQFT          | Greater than 20,000 SQFT |
| Agriculture                     | 0.61                                      | 0.76                     | 0.7                   | 0.81                     | 1.04               | 0.74                           | 0.85                     |
| Banking / Financial             | 0.46                                      | N/A                      | 0.58                  | N/A                      | 1.04               | 0.62                           | N/A                      |
| Education                       | 0.53                                      | 0.8                      | 0.64                  | 0.85                     | 1.04               | 0.68                           | 0.89                     |
| Entertainment / Public Assembly | 0.51                                      | 0.78                     | 0.62                  | 0.83                     | 1.04               | 0.66                           | 0.87                     |
| Healthcare                      | 0.49                                      | 0.81                     | 0.68                  | 0.88                     | 1.04               | 0.72                           | 0.92                     |
| Hospitality                     | 0.41                                      | 0.78                     | 0.63                  | 0.86                     | 1.04               | 0.67                           | 0.9                      |
| Manufacturing / Industrial      | 0.46                                      | 0.78                     | 0.58                  | 0.83                     | 1.04               | 0.62                           | 0.89                     |
| Office / Commercial             | 0.46                                      | 0.86                     | 0.59                  | 0.89                     | 1.04               | 0.63                           | 0.93                     |
| Public Service                  | 0.49                                      | 0.75                     | 0.6                   | 0.81                     | 1.04               | 0.64                           | 0.85                     |
| Residential                     | 0.56                                      | 0.77                     | 0.73                  | 0.86                     | 1.04               | 0.77                           | 0.9                      |
| Restaurant / Bar                | 0.46                                      | N/A                      | 0.58                  | N/A                      | 1.04               | 0.62                           | N/A                      |
| Retail                          | 0.54                                      | 0.75                     | 0.65                  | 0.81                     | 1.04               | 0.69                           | 0.87                     |
| Technology / Science            | 0.33                                      | 0.85                     | 0.48                  | 0.89                     | 1.04               | 0.52                           | 0.93                     |
| Warehouse / Storage             | 0.56                                      | 0.77                     | 0.73                  | 0.86                     | 1.04               | 0.77                           | 0.9                      |

For indoor lighting measures offered through BER Instant Rebates, the interactive effects factors for energy and peak demand savings used are based on the average values of indoor lighting products installed through BER Application Rebates (BER-AR) and SBES in 2022 since no customer-specific information is available for BER Instant Rebates. In SBES and BER-AR, a standardized approach based on a methodology published in the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Journal<sup>206</sup> is used to calculate the interactive effects for lighting projects on a per building-type basis. Additionally, the interactive effects factors are multiplied by 57% to consider the limited interaction of recessed fixtures with heating and cooling systems;<sup>207</sup> this factor applies to lighting measure categories that include recessed fixtures, namely LED linear fixtures and LED linear lamps.

For indoor lighting measures offered through the SBES direct install offer, the interactive effects factors used for energy and peak demand savings are based on the average values of indoor lighting products installed through SBES in 2022.

For outdoor lighting measures, interactive effects are nil.

Table 140 summarizes the interactive effects factors established for each lighting measure.

<sup>206</sup> Rundquist, Robert A. et al., "Calculating Lighting and HVAC Interactions," ASHRAE Journal, November 1993, pp. 28-37.

<sup>207</sup> Chantrasilalai and Fisher, "Lighting heat gain parameters: Experimental results" in *HVAC&R Research*, 12(2), pp. 305-324.

**Table 140: Interactive Effects for BNI Lighting Measures**

| Measure                                    |              | Interactive Effects Factor for Energy Savings | Interactive Effects Factor for Peak Demand Savings |
|--------------------------------------------|--------------|-----------------------------------------------|----------------------------------------------------|
| <b>BER Instant Rebates</b>                 |              |                                               |                                                    |
| Linear LED Fixtures                        | Recessed     | -8.7% x 57% = -4.9%                           | -16.1% x 57% = -9.2%                               |
|                                            | Non-recessed | -8.7%                                         | -16.1%                                             |
| Linear LED Lamps                           | Recessed     | -2.9% x 57% = -1.6%                           | -12.5% x 57% = -7.1%                               |
|                                            | Non-recessed | -2.9%                                         | -12.5%                                             |
| Outdoor LED Fixtures                       |              | 0%                                            | 0%                                                 |
| Directional and Architectural LED Fixtures |              | 4.0%                                          | 0%                                                 |
| Indoor Occupancy/Motion Sensors            |              | -4.1%                                         | -13.2%                                             |
| Outdoor Motion Sensors                     |              | 0%                                            | 0%                                                 |
| <b>SBES</b>                                |              |                                               |                                                    |
| LED Lamps                                  |              | -17.9%                                        | -31.8%                                             |
| LED Nightlights                            |              | -17.9%                                        | -31.8%                                             |

### 5.1.2 Peak Demand Savings Factors

Lighting measures use peak coincidence factor (PCF) for calculating peak demand savings. For indoor lighting measures offered through Instant Rebates, the PCF is based on the weighted average PCF value of all indoor lighting products installed through BER-AR and SBES in 2022 since no customer-specific information is available for BER Instant Rebates. The average PCF is 60%.

For indoor lighting measures offered through SBES CDI Pilot, the PCF is based on the average PCF value of indoor lighting products installed through SBES in 2022. The average PCF is 54%.

For outdoor lighting measures, since lighting is typically turned on between 5 p.m. and 7 p.m. throughout December, January, and February, a PCF of 100% is applied.

### Unitary Peak Demand Savings Calculations

Peak demand savings are calculated by multiplying the unitary demand savings value by the peak coincidence factor as detailed in the equation below.

$$\text{Unitary Peak Demand Savings (W)} = \text{Unitary Demand Savings (W)} \times \text{Peak Coincidence Factor (\%)}$$

The unitary demand savings value corresponds to the unitary energy savings divided by the hours of use (HOU), as presented in the equation below.

$$\text{Unitary Demand Savings (W)} = \frac{\text{Unitary Energy Savings (kWh)} \times 1,000}{\text{HOU (h)}}$$

### 5.1.3 Adjustment Ratios

The adjustment ratios in Table 141 were established through the latest comprehensive impact evaluation for each program. They should be applied for all lighting measures in SBES and BER-AR, except for CDI measures and LED roadway lighting measures.

**Table 141: 2023 Lighting Gross Savings Adjustments Ratios**

| Program Component                                      | Source Evaluation Report | Energy Savings   |                 | Peak Demand Savings |                 |
|--------------------------------------------------------|--------------------------|------------------|-----------------|---------------------|-----------------|
|                                                        |                          | Adjustment Ratio | Margin of Error | Adjustment Ratio    | Margin of Error |
| SBES Lighting Measures                                 | 2023                     | 1.070            | 5.3%            | 0.917               | 8.9%            |
| BER-AR Lighting Measures (except LED Roadway Lighting) | 2021                     | 0.993            | 6.7%            | 0.841               | 7.5%            |
| SBES CDI Pilot – A-type LED Lamps                      | 2019                     | 0.960            | 5%              | 0.960               | 5%              |
| SBES CDI Pilot – Other Products                        | 2019                     | 1.000            | -               | 1.000               | -               |
| BER-AR LED Roadway Lighting                            | -                        | 1.00             | -               | 1.00                | -               |

## 5.1.4 Lighting Measures

### (1) LED Lamps

#### Summary

Table 142 presents a summary of the values used to calculate A-type, reflector, and decorative LED lamp savings. These measures are only offered through the Commercial Direct Install (CDI) Pilot and use unitary savings values rather than measure-specific calculations. The detailed methodology follows.

**Table 142: LED Lamp Measure Summary**

| Parameter                                          | SBES                                                                     | Reference                                                                              |
|----------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                          |                                                                                        |
| Measure Description                                | LED lamps installed with direct installation                             | -                                                                                      |
| Baseline                                           | Existing lighting being replaced                                         |                                                                                        |
| Measure Subcategory                                | A-type, reflector, and decorative LED lamps                              |                                                                                        |
| General Parameters                                 |                                                                          |                                                                                        |
| Installation Rate                                  | 100%                                                                     | See details below under Installation Rates                                             |
| Energy Savings Adjustment Ratio                    | 0.960                                                                    | See Subsection 5.1.3                                                                   |
| Peak Demand Savings Adjustment Ratio               | 0.960                                                                    |                                                                                        |
| Effective Useful Life [years]                      | Varies depending on replaced and installed wattages as well as lamp type | See Subsection 6.1                                                                     |
| Electrical Savings Parameters                      |                                                                          |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | Vary depending on replaced and installed wattages. See Table 143 below   | See details below under Electrical Unitary Energy Savings                              |
| Peak Coincidence Factor                            | 54%                                                                      | See Subsection 5.1.2                                                                   |
| Unitary Peak Demand Savings [W]                    | Vary depending on replaced and installed wattages. See Table 143 below   | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | -17.9%                                                                   | See Subsection 5.1.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | -31.8%                                                                   |                                                                                        |

#### Electrical Unitary Energy Savings

The equation below is used to determine the unitary savings values of LED lamps for each pairing of old and new wattages. Table 143 below lists the parameters and corresponding values used in the equation and the resulting unitary savings values.

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \frac{(\text{Old Wattage} - \text{New Wattage})[W] \times \text{Operating Hours} \left[ \frac{h}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

**Table 143: Electrical Unitary Savings Values for LED Lamps**

| Type of LED                        | Old Wattage (W) | New Wattage (W) | Displaced Wattage (W) | Operating Hours (hrs/year) | Unitary Savings Value (kWh/year) |
|------------------------------------|-----------------|-----------------|-----------------------|----------------------------|----------------------------------|
| 9 W Replacing 25 W                 | 25              | 9               | 16                    | 3,600                      | 57.6                             |
| 9 W Replacing 29 W                 | 29              | 9               | 20                    |                            | 72.0                             |
| 9 W Replacing 40 W                 | 40              | 9               | 31                    |                            | 112                              |
| 9 W Replacing 43 W                 | 43              | 9               | 34                    |                            | 122                              |
| 9 W Replacing 60 W                 | 60              | 9               | 51                    |                            | 184                              |
| 9 W Replacing 72 W                 | 72              | 9               | 63                    |                            | 227                              |
| 9 W Replacing 100 W                | 100             | 9               | 91                    |                            | 328                              |
| 9 W Replacing 150 W                | 150             | 9               | 141                   |                            | 508                              |
| 9.5 W Replacing 25 W               | 25              | 9.5             | 15.5                  |                            | 55.8                             |
| 9.5 W Replacing 29 W               | 29              | 9.5             | 19.5                  |                            | 70.2                             |
| 9.5 W Replacing 40 W               | 40              | 9.5             | 30.5                  |                            | 110                              |
| 9.5 W Replacing 43 W               | 43              | 9.5             | 33.5                  |                            | 121                              |
| 9.5 W Replacing 60 W               | 60              | 9.5             | 50.5                  |                            | 182                              |
| 9.5 W Replacing 72 W               | 72              | 9.5             | 62.5                  |                            | 225                              |
| 9.5 W Replacing 100 W              | 100             | 9.5             | 90.5                  |                            | 326                              |
| 9.5 W Replacing 150 W              | 150             | 9.5             | 140.5                 |                            | 506                              |
| 18 W Replacing 75 W                | 75              | 18              | 57                    |                            | 205                              |
| 18 W Replacing 100 W               | 100             | 18              | 82                    |                            | 295                              |
| 7 W Black-out Bulbs Replacing 60 W | 60              | 7               | 53                    |                            | 191                              |
| PAR20 7 W Replacing 50 W           | 50              | 7               | 43                    |                            | 155                              |
| PAR30 8 W Replacing 53 W           | 53              | 8               | 45                    |                            | 162                              |
| PAR30 8 W Replacing 75 W           | 75              | 8               | 67                    |                            | 241                              |
| PAR38 15 W Replacing 90 W          | 90              | 15              | 75                    |                            | 270                              |
| PAR38 15 W Replacing 120 W         | 120             | 15              | 105                   |                            | 378                              |
| PAR38 15 W Replacing 150 W         | 150             | 15              | 135                   |                            | 486                              |
| 7 W GU10 Replacing 35 W            | 35              | 7               | 28                    |                            | 101                              |
| 7 W GU10 Replacing 50 W            | 50              | 7               | 43                    |                            | 155                              |
| 7 W G25 Replacing 40 W             | 40              | 7               | 33                    |                            | 119                              |
| 5 W Chandelier E12 Replacing 40 W  | 40              | 5               | 35                    |                            | 126                              |

Previous evaluations confirmed that installed LED lamps had a light output wattage equivalent to that of the replaced lamps for almost all replacements. In other cases, the savings calculations are still based on the difference in real wattage values. The equivalent incandescent and halogen wattage values were assumed to be the same as those for the residential sector.

Average hours of operation of 3,600 hours were used for SBES indoor lighting products. These hours of operation are based on the average values of indoor lighting products installed through SBES in 2019.

## Unitary Peak Demand Savings

Unitary peak demand savings are calculated as described in Subsection 5.1.2.

**Table 144: Electrical Unitary Peak Demand Savings Values for LED Lamps**

| Type of LED                        | Displaced Wattage (W) | Peak Coincidence Factor (%) | Unitary Peak Demand Savings Value (W) |
|------------------------------------|-----------------------|-----------------------------|---------------------------------------|
| 9 W Replacing 25 W                 | 16                    | 54%                         | 8.6                                   |
| 9 W Replacing 29 W                 | 20                    |                             | 10.8                                  |
| 9 W Replacing 40 W                 | 31                    |                             | 16.7                                  |
| 9 W Replacing 43 W                 | 34                    |                             | 18.4                                  |
| 9 W Replacing 60 W                 | 51                    |                             | 27.5                                  |
| 9 W Replacing 72 W                 | 63                    |                             | 34.0                                  |
| 9 W Replacing 100 W                | 91                    |                             | 49.1                                  |
| 9 W Replacing 150 W                | 141                   |                             | 76.1                                  |
| 9.5 W Replacing 25 W               | 15.5                  |                             | 8.4                                   |
| 9.5 W Replacing 29 W               | 19.5                  |                             | 10.5                                  |
| 9.5 W Replacing 40 W               | 30.5                  |                             | 16.5                                  |
| 9.5 W Replacing 43 W               | 33.5                  |                             | 18.1                                  |
| 9.5 W Replacing 60 W               | 50.5                  |                             | 27.3                                  |
| 9.5 W Replacing 72 W               | 62.5                  |                             | 33.8                                  |
| 9.5 W Replacing 100 W              | 90.5                  |                             | 48.9                                  |
| 9.5 W Replacing 150 W              | 140.5                 |                             | 75.9                                  |
| 18 W Replacing 75 W                | 57                    |                             | 30.8                                  |
| 18 W Replacing 100 W               | 82                    |                             | 44.3                                  |
| 7 W Black-out Bulbs Replacing 60 W | 53                    |                             | 28.6                                  |
| PAR20 7 W Replacing 50 W           | 43                    |                             | 23.2                                  |
| PAR30 8 W Replacing 53 W           | 45                    |                             | 24.3                                  |
| PAR30 8 W Replacing 75 W           | 67                    |                             | 36.2                                  |
| PAR38 15 W Replacing 90 W          | 75                    |                             | 40.5                                  |
| PAR38 15 W Replacing 120 W         | 105                   |                             | 56.7                                  |
| PAR38 15 W Replacing 150 W         | 135                   |                             | 72.9                                  |
| 7 W GU10 Replacing 35 W            | 28                    |                             | 15.1                                  |
| 7 W GU10 Replacing 50 W            | 43                    |                             | 23.2                                  |
| 7 W G25 Replacing 40 W             | 33                    |                             | 17.8                                  |
| 5 W Chandelier E12 Replacing 40 W  | 35                    |                             | 18.9                                  |

## Installation Rate

For light-emitting diode (LED) lamps in SBES, an installation rate of 100% was assumed.

## (2) Linear LED Fixtures

### Summary

Table 145 presents a summary of the values used to calculate linear LED fixture savings, followed by the detailed methodology.

**Table 145: Linear LED Fixture Measure Summary**

| Parameter                                          |              | BER-IR                                                                                                   | BER-AR                                         |       | SBES                                    | Reference                                                                         |
|----------------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------|------------------------------------------------|-------|-----------------------------------------|-----------------------------------------------------------------------------------|
| Measure Description and Identification             |              |                                                                                                          |                                                |       |                                         |                                                                                   |
| Measure                                            |              | Linear LED fixtures (Luminaires, Retrofit Kits, Linear Ambient and Low-bay Luminaires), rebated in store | Linear LED fixtures rebated after installation |       |                                         | See Table 264 for BER-IR baseline                                                 |
| Baseline                                           |              | T8 fluorescent fixtures                                                                                  | Existing fixtures                              |       |                                         |                                                                                   |
| General Parameters                                 |              |                                                                                                          |                                                |       |                                         |                                                                                   |
| In-service Rate                                    |              | 100%                                                                                                     | None, included in the adjustment ratios below. |       | See details below under In-service Rate |                                                                                   |
| Energy Savings Adjustment Ratio                    |              | -                                                                                                        | 1.070                                          | 0.993 | See Subsection 5.1.3                    |                                                                                   |
| Peak Demand Savings Adjustment Ratio               |              | -                                                                                                        | 0.917                                          | 0.841 |                                         |                                                                                   |
| Effective Useful Life [years]                      |              | Effective useful life based on type of Linear LED Fixture                                                |                                                |       |                                         | See Subsection 6.1                                                                |
| Electrical Savings Parameters                      |              |                                                                                                          |                                                |       |                                         |                                                                                   |
| Unitary Energy Savings [kWh/year]                  |              | Calculation based on specification data for each rebated unit                                            |                                                |       |                                         | See details below under Electrical Unitary Energy Savings                         |
| Peak Coincidence Factor                            |              | 60%                                                                                                      | Actual, or default 0.86                        |       |                                         | See Subsection 5.1.2                                                              |
| Unitary Peak Demand Savings [W]                    |              | Calculation based on specification data for each rebated unit                                            |                                                |       |                                         | Calculated by multiplying the demand savings value by the peak coincidence factor |
| Interactive Effects Factor for Energy Savings      | Recessed     | -4.9%                                                                                                    | Calculation based on facility characteristic   |       |                                         | See Subsection 5.1.1                                                              |
|                                                    | Non-recessed | -8.7%                                                                                                    |                                                |       |                                         |                                                                                   |
| Interactive Effects Factor for Peak Demand Savings | Recessed     | -9.2%                                                                                                    |                                                |       |                                         |                                                                                   |
|                                                    | Non-recessed | -16.1%                                                                                                   |                                                |       |                                         |                                                                                   |



## Electrical Unitary Energy Savings

Table 146 lists the parameters and corresponding values used in the equation below to calculate unitary energy savings for LED linear fixtures.

$$\begin{aligned} \text{Energy Savings [kWh/yr]} \\ &= ((\text{Baseline Wattage} \\ &\quad - \text{New Wattage})[\text{W}] \times \text{HOU}[\text{h/day}] \times 365[\text{day/yr}]) / 1,000[\text{W/kW}] \end{aligned}$$

**Table 146: Electrical Unitary Energy Savings Values for Linear LED Fixtures**

| Parameter                         | Symbol                  | Value for BER-IR                                                | Value for BER-AR and SBES | Reference                                                                                                                           |
|-----------------------------------|-------------------------|-----------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Baseline Wattage [W]              | <i>Baseline Wattage</i> | Fixed baseline based on fixture type and lumen output           | Actual                    | See Table 147 below for BER-IR                                                                                                      |
| New Wattage [W]                   | <i>New Wattage</i>      | Based on wattage listed in tracking sheet for each rebated unit | Actual                    | Use information in TS                                                                                                               |
| Hours of Operation [hrs/day]      | <i>HOU</i>              | 4,209                                                           | Actual                    | BER-IR value based on average HOU for indoor lighting products installed through BER-AR and SBES in 2021-2023 (excluding high bays) |
| Unitary Energy Savings [kWh/year] | <i>Energy Savings</i>   | Calculation based on specification data for each rebated unit   |                           | Calculated                                                                                                                          |

The linear LED fixtures category contains four subcategories of products eligible under Instant Rebates. Table 147 presents the baseline wattage used to calculate the energy savings for each of these subcategories based on lumens output. These wattages correspond to T8 fluorescent luminaires.

**Table 147: Linear LED Fixture Baseline Wattages for BER-IR**

| Subcategory                           | Lumens Output (lm) | Baseline Wattage (W) |
|---------------------------------------|--------------------|----------------------|
| 1 x 4 Luminaires                      | 1,500 – 3,500      | 61.0                 |
|                                       | ≥ 3,500            | 83.3                 |
| 2 x 2 Luminaires & Retrofit Kits      | 1,500 – 4,500      | 61.0                 |
|                                       | ≥ 4,500            | 84.0                 |
| 2 x 4 Luminaires & Retrofit Kits      | 3,000 – 6,500      | 88.0                 |
|                                       | ≥ 6,500            | 129                  |
| Linear Ambient and Low-bay Luminaires | < 2,500            | 29.5                 |
|                                       | 2,500 – 5,000      | 58.0                 |
|                                       | 5,000 – 10,000     | 112                  |
|                                       | ≥ 10,000           | 200                  |

## In-service Rate

The in-service rate for linear LED fixtures is estimated at 100% since it is unlikely that participants would purchase fixtures for stocking purposes.

### (3) Linear LED Lamps

#### Summary

Table 148 presents a summary of the values used to calculate linear LED lamp savings. The detailed methodology follows.

**Table 148: Linear LED Lamp Measure Summary**

| Parameter                                          |              | BER-IR                                                        | BER-AR                                          | SBES  | Reference                                                                         |
|----------------------------------------------------|--------------|---------------------------------------------------------------|-------------------------------------------------|-------|-----------------------------------------------------------------------------------|
| Measure Description and Identification             |              |                                                               |                                                 |       |                                                                                   |
| Measure                                            |              | Linear LED lamps, rebated in store                            | Linear LED lamps, rebated after installation    |       | See Table 147 for BER-IR baseline                                                 |
| Baseline                                           |              | T8 fluorescent lamps                                          | Existing lamps                                  |       |                                                                                   |
| General Parameters                                 |              |                                                               |                                                 |       |                                                                                   |
| In-service Rate                                    |              | 85%                                                           | None, included in the adjustment ratios below.  |       | See details below under In-service Rate                                           |
| Energy Savings Adjustment Ratio                    |              | -                                                             | 1.070                                           | 0.993 | See Subsection 5.1.3                                                              |
| Peak Demand Savings Adjustment Ratio               |              | -                                                             | 0.917                                           | 0.841 |                                                                                   |
| Effective Useful Life [years]                      |              | 11.9                                                          | Effective useful life based on type of LED Lamp |       | See Subsection 6.1                                                                |
| Electrical Savings Parameters                      |              |                                                               |                                                 |       |                                                                                   |
| Unitary Energy Savings [kWh/year]                  |              | Calculation based on specification data for each rebated unit |                                                 |       | See details below under Electrical Unitary Energy Savings                         |
| Peak Coincidence Factor                            |              | 60%                                                           | Actual, or default 0.86                         |       | See Subsection 5.1.2                                                              |
| Unitary Peak Demand Savings [W]                    |              | Calculation based on specification data for each rebated unit |                                                 |       | Calculated by multiplying the demand savings value by the peak coincidence factor |
| Interactive Effects Factor for Energy Savings      | Recessed     | -1.6%                                                         | Calculation based on facility characteristic    |       | See Subsection 5.1.1                                                              |
|                                                    | Non-recessed | -2.9%                                                         |                                                 |       |                                                                                   |
| Interactive Effects Factor for Peak Demand Savings | Recessed     | -7.1%                                                         |                                                 |       |                                                                                   |
|                                                    | Non-recessed | -12.5%                                                        |                                                 |       |                                                                                   |

## Electrical Unitary Energy Savings

Table 149 lists the parameters and corresponding values used in the equation below to calculate unitary energy savings for LED linear lamps.

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \frac{(\text{Baseline Wattage} [W] \times \text{Ballast Factor} \times \text{Baseline Quantity} - \text{New Wattage} [W] \times \text{New Quantity}) \times HOU \left[ \frac{h}{day} \right] \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

**Table 149: Electrical Unitary Energy Savings Values for Linear LED Lamps**

| Parameter                         | Symbol                   | Value for BER-IR                                              | Value for BER-AR and SBES | Reference                                                                               |
|-----------------------------------|--------------------------|---------------------------------------------------------------|---------------------------|-----------------------------------------------------------------------------------------|
| Baseline Wattage [W]              | <i>Baseline Wattage</i>  | Based on fixture type and lumen output                        | Actual                    | Based on specification data for each rebated unit. See Table 150 below                  |
| Ballast Factor                    | <i>Ballast Factor</i>    | 0.88                                                          | Actual or default 0.88    | Assumption for normal ballast factor                                                    |
| Baseline Quantity                 | <i>Baseline Quantity</i> | Actual                                                        | Actual                    | Based on quantity listed in tracking sheet for each rebated unit                        |
| New Wattage [W]                   | <i>New Wattage</i>       | Actual                                                        | Actual                    | Based on wattage listed in tracking sheet for each rebated unit                         |
| New Quantity                      | <i>New Quantity</i>      | Actual                                                        | Actual                    | Based on quantity listed in tracking sheet for each rebated unit                        |
| Hours of Operation [hrs/day]      | <i>HOU</i>               | 4,209                                                         | Actual                    | Average HOU for indoor lighting products installed through BER-AR and SBES in 2021-2023 |
| Unitary Energy Savings [kWh/year] | <i>Energy Savings</i>    | Calculation based on specification data for each rebated unit |                           | <b>Calculated</b>                                                                       |

The linear LED lamp category contains six subcategories of products eligible under Instant Rebates. Table 150 presents the baseline wattage used to calculate the energy savings based on the Duke Energy Fixture Wattage Table.<sup>208</sup> These wattages correspond to T8 fluorescent luminaires.

**Table 150: Linear LED Lamp Baseline Wattage for BER-IR**

| Subcategory                          | Baseline Wattage (W) |
|--------------------------------------|----------------------|
| 2-foot Replacement Lamps             | 17                   |
| 3-foot Replacement Lamps             | 25                   |
| 4-foot Replacement Lamps             | 32                   |
| 8-foot Replacement Lamps             | 59                   |
| U-bend Replacement Lamps             | 31                   |
| 4-foot High Output Replacement Lamps | 49                   |

<sup>208</sup> Duke Energy Progress. Fixture Wattage Table. <http://www.ahutton.com/LED/Progress%20wattages.pdf>, (last accessed November 21, 2018).

## In-service Rate

Based on a study conducted by DNV-GL for the Massachusetts Energy Efficiency Program Administrators,<sup>209</sup> an in-service rate (ISR) of 85% is applied to LED lamps as part of BER-IR, which corresponds to the proportion of in-service fluorescent and LED lighting technologies installed three years after their purchase through an instant rebates program.

## (4) Outdoor LED Fixtures

### Summary

Table 151 presents a summary of the values used to calculate outdoor LED fixture savings. The detailed methodology follows.

**Table 151: Outdoor LED Fixture Measure Summary**

| Parameter                                          | BER-IR                                                           | BER-AR                                           | SBES  | Reference                                                                         |
|----------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------|-------|-----------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                  |                                                  |       |                                                                                   |
| Measure                                            | Outdoor LED fixtures, rebated in store                           | Outdoor LED fixtures, rebated after installation |       | See Table 153 and Table 154 for BER-IR baseline                                   |
| Baseline                                           | Mix of metal halide (MH) and high pressure sodium (HPS) fixtures | Existing lamps                                   |       |                                                                                   |
| General Parameters                                 |                                                                  |                                                  |       |                                                                                   |
| In-service Rate                                    | 100%                                                             | None, included in the adjustment ratios below.   |       | See details below under In-service Rate                                           |
| Energy Savings Adjustment Ratio                    | -                                                                | 1.070                                            | 0.993 | See Subsection 5.1.3                                                              |
| Peak Demand Savings Adjustment Ratio               | -                                                                | 0.917                                            | 0.841 |                                                                                   |
| Effective Useful Life [years]                      | Effective useful life based on type of outdoor LED fixture       |                                                  |       | See Subsection 6.1                                                                |
| Electrical Savings Parameters                      |                                                                  |                                                  |       |                                                                                   |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit    |                                                  |       | See details below under Electrical Unitary Energy Savings                         |
| Peak Coincidence Factor                            | 100%                                                             | Actual                                           |       | See Subsection 5.1.2                                                              |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit    |                                                  |       | Calculated by multiplying the demand savings value by the peak coincidence factor |
| Interactive Effects Factor for Energy Savings      | 0%                                                               |                                                  |       | See Subsection 5.1.1                                                              |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                               |                                                  |       | See Subsection 5.1.1                                                              |

<sup>209</sup> DNV-GL, *Massachusetts Commercial and Industrial Upstream Lighting Program: "In Storage" Lamps Follow-up Study*, March 2015.

## Electrical Unitary Energy Savings

Table 152 lists the parameters and corresponding values used in the equation below to calculate unitary energy savings for outdoor LED fixtures.

$$\text{Energy Savings} \left[ \frac{kWh}{yr} \right] = \frac{(\text{Baseline Wattage} - \text{New Wattage})[W] \times HOU \left[ \frac{h}{day} \right] \times 365 \left[ \frac{day}{yr} \right]}{1,000 \left[ \frac{W}{kW} \right]}$$

**Table 152: Electrical Unitary Energy Savings Values for Outdoor LED Fixtures**

| Parameter                         | Symbol                  | Value for BER-IR                                              | Value for BER-AR and SBES | Reference                                                                                                                                                              |
|-----------------------------------|-------------------------|---------------------------------------------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Baseline Wattage [W]              | <i>Baseline Wattage</i> | Based on fixture type and lumen output                        | Actual                    | IR: See Table 153 for wall-mounted area luminaires and Table 154 for architectural and flood spot luminaires<br>AR: Based on specification data for each rebated unit. |
| New Wattage [W]                   | <i>New Wattage</i>      | Actual                                                        | Actual                    | Based on wattage listed in tracking sheet for each rebated unit                                                                                                        |
| Hours of Operation [hrs/day]      | <i>HOU</i>              | 4,317                                                         | Actual                    | Average HOU for outdoor lighting products installed through BER-AR and SBES in 2021-2023                                                                               |
| Unitary Energy Savings [kWh/year] | <i>Energy Savings</i>   | Calculation based on specification data for each rebated unit | Calculated                |                                                                                                                                                                        |

The outdoor LED fixture category contains outdoor wall-mounted area luminaires as well as the architectural flood and spot luminaire subcategories.

Both subcategories are divided into groups by lumens output to assign the correct baseline wattages, and the baseline technology used for each subcategory differs. Weighted averages of 50% MH and 50% HPS fixture system wattages are used to determine the baseline wattage values for outdoor full-cut-off, semi-cut-off, and non-cut-off wall-mounted area luminaires, as presented in Table 153.

**Table 153: Wattages per Lumens Output for Outdoor Wall-mounted Area Luminaires for BER-IR**

| Lumens Range          | MH Baseline Fixture Wattage (W) | HPS Baseline Fixture Wattage (W) | Weighted Average Baseline Wattage (W) |
|-----------------------|---------------------------------|----------------------------------|---------------------------------------|
| ≥ 300 and < 2,000     | 43                              | 46                               | 44.5                                  |
| ≥ 2,000 and < 5,000   | 95                              | 95                               | 95.0                                  |
| ≥ 5,000 and < 15,000  | 295                             | 250                              | 272.5                                 |
| ≥ 15,000 and < 25,000 | 458                             | 465                              | 461.5                                 |
| ≥ 25,000              | 850                             | 930                              | 890                                   |

The architectural flood and spot luminaire subcategory is divided into six ranges according to the baseline lamp technology. The typical lumens output of these fixtures is grouped into ranges to be able to select the appropriate efficient LED fixture depending on the required light output. A summary of the savings calculation parameters is provided in Table 154 below. The baseline technologies were derived from the Duke Energy Fixture Wattage Table.<sup>210</sup>

**Table 154: Wattages per Lumens Output for Architectural Flood and Spot Luminaires for BER-IR**

| Lumens Range of Efficient Luminaires | Baseline Fixture | Baseline Wattage (W) |
|--------------------------------------|------------------|----------------------|
| ≥ 250 and < 1,000                    | Halogen          | 37                   |
| ≥ 1,000 and < 5,000                  | MH (70 W)        | 95                   |
| ≥ 5,000 and < 15,000                 | MH (250 W)       | 295                  |
| ≥ 15,000 and < 30,000                | MH (250 W x 2)   | 590                  |
| ≥ 30,000 and < 50,000                | MH (1,000 W)     | 1,080                |
| ≥ 50,000                             | MH (1,500 W)     | 1,610                |

## In-service Rate

The in-service rate for outdoor LED fixtures is estimated at 100% since it is unlikely that participants would purchase fixtures for stocking purposes.

<sup>210</sup> Duke Energy, *Fixture Wattage Table*, <http://www.ahutton.com/LED/Progress%20wattages.pdf> (last accessed January 10, 2018).

## (5) Directional and Architectural LED Fixtures

### Summary

Table 155 presents a summary of the values used to calculate directional and architectural LED fixture savings. The detailed methodology follows.

**Table 155: Directional and Architectural LED Fixture Measure Summary**

| Parameter                                          | BER-IR                                                        | BER-AR                                                                 | SBES  | Reference                                                                         |
|----------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                               |                                                                        |       |                                                                                   |
| Measure                                            | Directional and architectural LED fixtures, rebated in store  | Directional and architectural LED fixtures, rebated after installation |       | See Table 157 for BER-IR baseline                                                 |
| Baseline                                           | Halogen fixtures                                              | Existing lamps                                                         |       |                                                                                   |
| General Parameters                                 |                                                               |                                                                        |       |                                                                                   |
| In-service Rate                                    | 100%                                                          | None, included in the adjustment ratios below.                         |       | See details below under In-service Rate                                           |
| Energy Savings Adjustment Ratio                    | -                                                             | 1.070                                                                  | 0.993 | See Subsection 5.1.3                                                              |
| Peak Demand Savings Adjustment Ratio               | -                                                             | 0.917                                                                  | 0.841 |                                                                                   |
| Effective Useful Life [years]                      | 11.6                                                          | Effective useful life based on type of LED fixture                     |       | See Subsection 6.1                                                                |
| Electrical Savings Parameters                      |                                                               |                                                                        |       |                                                                                   |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit |                                                                        |       | See details below under Electrical Unitary Energy Savings                         |
| Peak Coincidence Factor                            | 60%                                                           | Actual                                                                 |       | See Subsection 5.1.2                                                              |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit |                                                                        |       | Calculated by multiplying the demand savings value by the peak coincidence factor |
| Interactive Effects Factor for Energy Savings      | -4.0%                                                         | Calculation based on facility characteristic                           |       | See Subsection 5.1.1                                                              |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                            |                                                                        |       | See Subsection 5.1.1                                                              |

### Electrical Unitary Energy Savings

Table 156 lists the parameters and corresponding values used in the equation below to calculate unitary energy savings for directional and architectural LED fixtures.

$$Energy\ Savings\ \left[\frac{kWh}{yr}\right] = \frac{(Baseline\ Wattage - New\ Wattage)[W] \times HOU\ \left[\frac{h}{day}\right] \times 365\ \left[\frac{day}{yr}\right]}{1,000\ \left[\frac{W}{kW}\right]}$$

**Table 156: Electrical Unitary Energy Savings Values for Directional and Architectural LED Fixtures**

| Parameter                         | Symbol                  | Value for BER-IR                                              | Value for BER-AR and SBES | Reference                                                                                        |
|-----------------------------------|-------------------------|---------------------------------------------------------------|---------------------------|--------------------------------------------------------------------------------------------------|
| Baseline Wattage [W]              | <i>Baseline Wattage</i> | Based on fixture type and lumen output                        | Actual                    | <u>IR</u> : See Table 157 below<br><u>AR</u> : Based on specification data for each rebated unit |
| New Wattage [W]                   | <i>New Wattage</i>      | Actual                                                        | Actual                    | Use information in TS                                                                            |
| Hours of Operation [hrs/day]      | <i>HOU</i>              | 4,209                                                         | Actual                    | Average HOU for indoor lighting products installed through BER-AR and SBES in 2021-2023          |
| Unitary Energy Savings [kWh/year] | <i>Energy Savings</i>   | Calculation based on specification data for each rebated unit |                           | Calculated                                                                                       |

The directional and architectural LED fixture category contains track or mono-point directional luminaires. The baseline technology is halogen lamps generating 17 lumens/W. Table 157 presents the baseline wattage used to calculate the energy savings based on lumens output.

**Table 157: Directional and Architectural LED Fixture Baseline Wattages for BER-IR**

| Category                                   | Lumens     | Baseline Wattage (W) |
|--------------------------------------------|------------|----------------------|
| Track or Mono-point Directional Luminaires | ≥ 250      | 60.4                 |
| Wall-wash Luminaires                       | 517 - 1199 | 50.0                 |
|                                            | ≥ 1,200    | 100                  |

## In-service Rate

The in-service rate for directional and architectural LED fixtures is estimated at 100% since it is unlikely that participants would purchase fixtures for stocking purposes.



## (6) Occupancy/Motion Sensors

### Summary

Table 158 presents a summary of the values used to calculate occupancy/motion sensor savings. The detailed methodology follows.

**Table 158: Occupancy/Motion Sensor Measure Summary**

| Parameter                                          | BER-IR                                     |          | BER-AR                                                        | SBES  | Reference                                                                         |
|----------------------------------------------------|--------------------------------------------|----------|---------------------------------------------------------------|-------|-----------------------------------------------------------------------------------|
| Measure Description and Identification             |                                            |          |                                                               |       |                                                                                   |
| Measure                                            | Occupancy/Motion sensors, rebated in store |          | Occupancy/Motion sensors, rebated after installation          |       | -                                                                                 |
| Baseline                                           | No sensor                                  |          |                                                               |       |                                                                                   |
| Measure Subcategory                                | Interior                                   | Exterior | -                                                             |       |                                                                                   |
| General Parameters                                 |                                            |          |                                                               |       |                                                                                   |
| In-service Rate                                    | 100%                                       |          | None, included in the adjustment ratios below.                |       | See details below under In-service Rate                                           |
| Energy Savings Adjustment Ratio                    | -                                          |          | 1.070                                                         | 0.993 | See Subsection 5.1.3                                                              |
| Peak Demand Savings Adjustment Ratio               | -                                          |          | 0.917                                                         | 0.841 |                                                                                   |
| Effective Useful Life [years]                      | 10                                         |          |                                                               |       | See Subsection 6.1                                                                |
| Electrical Savings Parameters                      |                                            |          |                                                               |       |                                                                                   |
| Unitary Energy Savings [kWh/year]                  | 100                                        | 134      | Calculation based on specification data for each rebated unit |       | See details below under Electrical Unitary Energy Savings                         |
| Peak Coincidence Factor                            | 60%                                        | 100%     | Actual                                                        |       | See Subsection 5.1.2                                                              |
| Unitary Peak Demand Savings [W]                    | 26.3                                       | 35.3     | Calculation based on specification data for each rebated unit |       | Calculated by multiplying the demand savings value by the peak coincidence factor |
| Interactive Effects Factor for Energy Savings      | -4.1%                                      | 0%       | Calculation based on facility characteristic                  |       | See Subsection 5.1.1                                                              |
| Interactive Effects Factor for Peak Demand Savings | -13.2%                                     | 0%       |                                                               |       | See Subsection 5.1.1                                                              |

### Electrical Unitary Energy Savings

Table 159 lists the parameters and corresponding values used in the equation below for occupancy and motion sensors and the resulting unitary values.

$$Energy\ Savings\ \left[\frac{kWh}{yr}\right] = Connected\ Wattage\ (W) \times Savings\ Factor\ (\%) \times OTF \times HOU/1,000$$

**Table 159: Electrical Unitary Energy Savings Values for Occupancy/Motion Sensors**

| Parameter                         | Type of Occupancy Sensor       | Value for BER-IR | Value for BER-AR and SBES                                     | Reference                                                                                                  |
|-----------------------------------|--------------------------------|------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Connected Wattage (W)             | Interior                       | 110              | Actual                                                        | Average connected wattage for occupancy/motion sensors installed through BER-AR and SBES from 2021 to 2023 |
|                                   | Exterior                       | 86               |                                                               | 2023 Efficiency Vermont TRM <sup>211</sup>                                                                 |
| Savings Factor (%)                | Ceiling or Wall Remote-Mounted | 24%              | See table below                                               |                                                                                                            |
|                                   | Fixture Mounted                |                  |                                                               |                                                                                                            |
|                                   | Wall Switch                    |                  |                                                               |                                                                                                            |
|                                   | Exterior                       | 41%              |                                                               |                                                                                                            |
| Operational Testing Factor (OTF)  | -                              | 1                |                                                               |                                                                                                            |
| Hours of Operation (HOU) [hrs/yr] | -                              | 3,799            | Actual                                                        | 2023 Efficiency Vermont TRM                                                                                |
| Unitary Energy Savings [kWh/year] | Interior                       | 100              | Calculation based on specification data for each rebated unit | Calculated                                                                                                 |
|                                   | Exterior                       | 134              |                                                               |                                                                                                            |

The connected wattage for occupancy/motion sensors is mostly based on the average connected wattage for units installed through BER-AR and SBES from January 2021 to July 2023. The only exception is for exterior motion sensors since only three were installed under these programs during that period. The connected wattage for exterior motion sensors is based on the value presented in the 2023 Efficiency Vermont TRM. The energy savings factors and the HOU are also based on the metering study referenced in the 2023 Efficiency Vermont TRM and are listed below.

**Table 160: Savings Factor per Control Type**

| Control Type               | Savings Factor % |
|----------------------------|------------------|
| Wall Occupancy Sensors     | 24%              |
| Fixture Mounted Occupancy  | 24%              |
| Remote Mounted Occupancy   | 24%              |
| Refrigerator Case Controls | 40%              |
| Freezer Case Controls      | 40%              |
| Exterior Occupancy         | 41%              |
| Fixture Mounted Daylight   | 28%              |
| Remote Mounted Daylight    | 28%              |

## In-service Rate

The in-service rate for occupancy/motion sensors is assumed to be 100%.

<sup>211</sup> Efficiency Vermont, *Technical Reference Manual (TRM): Program Year 2023*, 2023.

## (7) LED Nightlights

### Summary

Table 161 presents a summary of the values used to calculate savings for LED nightlights. The detailed methodology follows.

**Table 161: LED Nightlight Measure Summary**

| Parameter                                          | SBES                                                           | Reference                                                                         |
|----------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                |                                                                                   |
| Measure                                            | LED nightlights through direct installation                    | N/A                                                                               |
| Baseline                                           | Existing nightlight being replaced, which must be incandescent |                                                                                   |
| General Parameters                                 |                                                                |                                                                                   |
| Installation Rate                                  | 100%                                                           | See details below under Installation Rates                                        |
| Energy Savings Adjustment Ratio                    | 1.00                                                           | See Subsection 5.1.3                                                              |
| Peak Demand Savings Adjustment Ratio               | 1.00                                                           |                                                                                   |
| Effective Useful Life [years]                      | 1.0                                                            | See Subsection 6.1                                                                |
| Electrical Savings Parameters                      |                                                                |                                                                                   |
| Unitary Energy Savings [kWh/year]                  | 29.3                                                           | See details below under Electrical Unitary Energy Savings                         |
| Peak Coincidence Factor                            | 59%                                                            | See Subsection 5.1.2                                                              |
| Unitary Peak Demand Savings [W]                    | 3.95                                                           | Calculated by multiplying the demand savings value by the peak coincidence factor |
| Interactive Effects Factor for Energy Savings      | -17.9%                                                         | See Subsection 5.1.1                                                              |
| Interactive Effects Factor for Peak Demand Savings | -31.8%                                                         |                                                                                   |

### Electrical Unitary Energy Savings

Table 162 lists the parameters and corresponding values used in the equation below for LED nightlights and the resulting unitary values. The values for displaced wattages and hours of operation are consistent with the values used by other jurisdictions such as the State of Pennsylvania.<sup>212</sup>

$$Energy\ Savings\ \left[\frac{kWh}{yr}\right] = \frac{(Old\ Wattage - New\ Wattage)[W] \times HOU\ \left[\frac{h}{day}\right] \times 365\ \left[\frac{day}{yr}\right]}{1,000\ \left[\frac{W}{kW}\right]}$$

<sup>212</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual – State of Pennsylvania*, August 2019, p. 7.

**Table 162: Electrical Unitary Energy Savings Values for LED Nightlights**

| Parameter                         | Value | Reference                                                                   |
|-----------------------------------|-------|-----------------------------------------------------------------------------|
| Old Wattage [W]                   | 7.0   | Assumption based on the typical wattage value of an incandescent nightlight |
| New Wattage [W]                   | 0.3   | Wattage value of the LED nightlight installed through SBES (E1)             |
| Average Displaced Wattage [W]     | 6.7   | Calculation                                                                 |
| Hours of Operation [hrs/day]      | 12    | Assumption based on the average length of night                             |
| Unitary Energy Savings [kWh/year] | 29.3  | Calculation                                                                 |

## Unitary Peak Demand Savings

Unitary peak demand savings are calculated as described in Subsection 5.1.2.

## Installation Rates

An in-service rate of 100% was assumed since SBES LED nightlights are currently only offered through a direct install service; such services typically have installation rates close to 100% for lighting products.

## (8) LED Roadway Lighting

### Summary

Table 163 presents a summary of the values used to calculate savings for LED roadway lighting. The detailed methodology follows.

**Table 163: LED Roadway Lighting Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                                      | Reference                                                                         |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                                             |                                                                                   |
| Measure                                            | LED, DLC Premium qualified roadways lighting with a minimum efficacy of 150 lm/W, with advanced dimming based on real-time data, rebated after installation | -                                                                                 |
| Baseline                                           | Existing LED roadway fixtures                                                                                                                               |                                                                                   |
| General Parameters                                 |                                                                                                                                                             |                                                                                   |
| Installation Rate                                  | 100%                                                                                                                                                        | See details below under Installation Rates                                        |
| Effective Useful Life [years]                      | 13.7                                                                                                                                                        | See Subsection 6.1                                                                |
| Electrical Savings Parameters                      |                                                                                                                                                             |                                                                                   |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                               | See details below under Electrical Unitary Energy Savings                         |
| Peak Coincidence Factor                            | 100%                                                                                                                                                        | See Subsection 5.1.2                                                              |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                               | Calculated by multiplying the demand savings value by the peak coincidence factor |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                                                          | See Subsection 5.1.1                                                              |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                                                          |                                                                                   |

### Electrical Unitary Energy Savings

Table 164 lists the parameters and corresponding values used in the equation below for LED roadway lighting and the resulting unitary values.

$$Energy\ Savings\ \left[\frac{kWh}{yr}\right] = \frac{(Old\ Wattage - New\ Wattage)[W] \times HOU\ \left[\frac{h}{yr}\right]}{1,000\ \left[\frac{W}{kW}\right]}$$

**Table 164: Electrical Unitary Energy Savings Values for LED Roadway Lighting**

| Parameter                         | Value                 | Reference                                                     |
|-----------------------------------|-----------------------|---------------------------------------------------------------|
| Old Wattage [W]                   | Actual                | Use information in TS                                         |
| New Wattage [W]                   | Actual                | Use information in TS                                         |
| Hours of Operation [hrs/year]     | Actual or 4662        | Calculated based on sunset and sunrise times for Nova Scotia  |
| Unitary Energy Savings [kWh/year] | <i>Energy Savings</i> | Calculation based on specification data for each rebated unit |

## Unitary Peak Demand Savings

Unitary peak demand savings are calculated as described in Subsection 5.1.2.

## Installation Rates

An installation rate of 100% was assumed in the absence of measured data, since roadway lighting

## (9) Horticultural Lighting

### Summary

Table 165 presents a summary of the values used to calculate savings for horticultural lighting. The detailed methodology follows.

**Table 165: Horticultural Lighting Measure Summary**

| Parameter                                          | BER-AR                                                        |                           | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|---------------------------|-----------------------------------------------------------|
|                                                    | Retrofit                                                      | New Construction          |                                                           |
| Measure Description and Identification             |                                                               |                           |                                                           |
| Measure Description                                | Horticultural lighting rebated after installation             |                           | -                                                         |
| Baseline                                           | Existing lighting                                             | Metal halide HID fixtures |                                                           |
| General Parameters                                 |                                                               |                           |                                                           |
| Installation Rate                                  | 100%                                                          |                           | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 8.3                                                           |                           | See Subsection 6.1                                        |
| Electrical Savings Parameters                      |                                                               |                           |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit |                           | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | Actual                                                        |                           | -                                                         |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit |                           | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | Actual                                                        |                           | -                                                         |
| Interactive Effects Factor for Peak Demand Savings | Actual                                                        |                           |                                                           |

### Electrical Unitary Energy Savings

Table 166 lists the parameters and corresponding values used in the equation below for horticultural lighting and the resulting unitary values.

$$Unitary\ Energy\ Savings\ \left[\frac{kWh}{yr}\right] = \frac{(W_b[W] \times Qty_b[-] - W_b[W] \times Qty_b[-]) \times HOU\ \left[\frac{h}{yr}\right] \times IE}{1,000}$$

**Table 166: Electrical Unitary Energy Savings Values for Horticultural Lighting**

| Parameter                                     | Symbol                        | BER-AR                            |                  | Reference                                                                                                                    |
|-----------------------------------------------|-------------------------------|-----------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------|
|                                               |                               | Retrofit                          | New Construction |                                                                                                                              |
| Baseline Wattage [W]                          | $W_b$                         | Actual                            | 1,000            | Retrofit: Use information in TS<br>New Construction: 2020 Iowa TRM <sup>213</sup><br>Remillard & Collins 2017 <sup>214</sup> |
| Baseline Quantity [-]                         | $Qty_b$                       | Actual                            | Same as $Qty_e$  | Retrofit: Use information in TS<br>New Construction: Assumption                                                              |
| New Wattage [W]                               | $W_e$                         | Actual                            |                  | Use information in TS                                                                                                        |
| New Quantity [-]                              | $Qty_e$                       | Actual                            |                  | Use information in TS                                                                                                        |
| Hours of Operation [hours/year]               | HOU                           | Actual                            |                  | Use information in TS                                                                                                        |
| Energy Savings Interactive Effects Factor [-] | IE                            | Actual                            |                  | Use information in TS                                                                                                        |
| Conversion Factor [W/kW]                      | -                             | 1,000                             |                  | Convention                                                                                                                   |
| Unitary Energy Savings [kWh/year]             | <i>Unitary Energy Savings</i> | Calculation based on project data |                  | Calculation                                                                                                                  |

## Unitary Peak Demand Savings

Table 167 lists the parameters and corresponding values used in the equation below for horticultural lighting and the resulting unitary peak demand savings values.

$$Unitary\ Peak\ Demand\ Savings\ [kW] = \frac{(W_b[W] \times Qty_b[-] - W_e[W] \times Qty_e[-]) \times PCF \times IE_{PD}}{1,000}$$

**Table 167: Unitary Peak Demand Savings Values for Horticultural Lighting**

| Parameter                                     | Symbol                             | BER-AR                            |                  | Reference             |
|-----------------------------------------------|------------------------------------|-----------------------------------|------------------|-----------------------|
|                                               |                                    | Retrofit                          | New Construction |                       |
| Peak Coincidence Factor [-]                   | PCF                                | Actual                            |                  | Use information in TS |
| Energy Savings Interactive Effects Factor [-] | $IE_{PD}$                          | Actual                            |                  | Use information in TS |
| Conversion Factor [W/kW]                      | -                                  | 1,000                             |                  | Convention            |
| Unitary Energy Savings [kW]                   | <i>Unitary Peak Demand Savings</i> | Calculation based on project data |                  | Calculation           |

## Installation Rates

Installation rates for horticultural lighting products are estimated at 100%.

<sup>213</sup> Iowa Utilities Commission. *Iowa Energy Efficiency Statewide Technical Reference Manual Version 5.0, Volume 3: Nonresidential Measures*, July 22, 2020, pp. 43-47.

<sup>214</sup> Jesse Remillard and Nick Collins, *Trends and Observations of Energy Use in the Cannabis Industry*, 2017 ACEEE Summer Study on Energy Efficiency in Industry.



## **5.2 Pumps**

### **5.2.1 Interactive Effects**

For pumps, interactive effects are assumed to be nil because pumps are typically installed in non-conditioned spaces.

### **5.2.2 Peak Demand Savings Factors**

For pumps, the methodology used to determine peak demand savings is detailed in the measure-specific sections below.

### **5.2.3 Adjustment Ratios**

For pump measures, no adjustment ratios were calculated.

## 5.2.4 Pump Measures

### (1) Circulator Pumps

#### Summary

Table 168 presents a summary of the values used to calculate circulator pump savings. The detailed methodology follows.

**Table 168: Circulator Pump Measure Summary**

| Parameter                                          | BER-IR, BER-AR                                                                          |                                     |                                       | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                         |                                     |                                       |                                                           |
| Measure                                            | Variable speed electronically commutated motor (ECM) circulator pumps, rebated in store |                                     |                                       | -                                                         |
| Baseline                                           | Single-speed circulator pump                                                            |                                     |                                       |                                                           |
| Measure Subcategory                                | Max input power < 150 W                                                                 | Max input power ≥ 150 W and < 500 W | Max input power ≥ 500 W and < 2,500 W |                                                           |
| General Parameters                                 |                                                                                         |                                     |                                       |                                                           |
| Installation Rate                                  | 100%                                                                                    |                                     |                                       | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                                                      |                                     |                                       | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                         |                                     |                                       |                                                           |
| Unitary Energy Savings [kWh/year]                  | 412                                                                                     | 800                                 | 1,974                                 | See details below under Electrical Energy Unitary Savings |
| Peak Coincidence Factor                            | 100%                                                                                    |                                     |                                       | See details below under Peak Coincidence Factor           |
| Unitary Peak Demand Savings [W]                    | 67.5                                                                                    | 95.3                                | 127                                   | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                      |                                     |                                       | See Subsection 5.2.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                      |                                     |                                       | See Subsection 5.2.1                                      |

#### Electrical Energy Unitary Savings

The electrical energy unitary savings for circulator pumps are calculated using the equation below and savings data from Vermont adapted to Nova Scotia using each jurisdiction's average operating hours. Although the max input power tiers defined in the Vermont TRM and those defined by E1 differ, the difference is considered minimal, thus E1's tiers have been used in the savings assumptions for this measure. Table 169 below lists the parameters used for the calculation of electrical energy unitary savings.

$$\text{Unitary Energy Savings} \left[ \frac{kWh}{yr} \right] = UES_{VT} \left[ \frac{kWh}{yr} \right] \times \frac{HOU_{NS} \left[ \frac{hours}{yr} \right]}{HOU_{VT} \left[ \frac{hours}{yr} \right]}$$

**Table 169: Electrical Unitary Energy Savings Values for Circulator Pumps**

| Parameters                                        | Symbol                        | BER-IR                  |                                     |                                       | Reference                       |
|---------------------------------------------------|-------------------------------|-------------------------|-------------------------------------|---------------------------------------|---------------------------------|
|                                                   |                               | Max Input Power < 150 W | Max Input Power ≥ 150 W and < 500 W | Max Input Power ≥ 500 W and < 2,500 W |                                 |
| Vermont Average Unitary Energy Savings [kWh/year] | $UES_{VT}$                    | 401                     | 780                                 | 1,924                                 | 2018 Vermont TRM <sup>215</sup> |
| Vermont Average Operating Hours [hours/year]      | $HOU_{VT}$                    | 4,684                   |                                     |                                       |                                 |
| Nova Scotia Average Operating Hours [hours/year]  | $HOU_{NS}$                    | 4,805                   |                                     |                                       | Assumption <sup>216</sup>       |
| Unitary Energy Savings [kWh/year]                 | <i>Unitary Energy Savings</i> | 412                     | 800                                 | 1,974                                 | Calculation                     |

## Unitary Peak Demand Savings

The unitary demand savings value corresponds to the unitary energy savings divided by the HOU, as presented in the equation below.

### **Unitary Demand Savings [W]**

$$= (\text{Unitary Energy Savings [kWh]}) / (\text{HOU [h]} \times 1,000) \times \text{Peak Coincidence Factor [(\%)]}$$

Since circulator pumps are typically used as part of residential and commercial hydronic heating system applications, it is assumed that they operate continuously during the coldest days of winter. Thus, a PCF of 100% is applied to this measure category.

The unitary peak demand unitary savings for circulator pumps are calculated using the parameters listed in Table 170.

**Table 170: Unitary Peak Demand Savings Values for Circulator Pumps**

| Parameters                      | BER-IR                  |                                     |                                       | Reference                       |
|---------------------------------|-------------------------|-------------------------------------|---------------------------------------|---------------------------------|
|                                 | Max Input Power < 150 W | Max Input Power ≥ 150 W and < 500 W | Max Input Power ≥ 500 W and < 2,500 W |                                 |
| Average Demand Savings [kW]     | 0.0675                  | 0.0953                              | 0.1270                                | 2018 Vermont TRM <sup>217</sup> |
| Peak Coincidence Factor         | 1.000                   |                                     |                                       | Assumption                      |
| Unitary Peak Demand Savings [W] | 67.5                    | 95.3                                | 127                                   | Calculation                     |

## Installation Rates

Installation rates for circulator pumps are estimated at 100%.

<sup>215</sup> Efficiency Vermont, *Technical Reference User Manual*, December 31, 2018.

<sup>216</sup> Assuming operation between October 1 and April 30 when outside air temperature is below 55 °F (12.8 °C).

<sup>217</sup> Efficiency Vermont, *Technical Reference User Manual*, December 31, 2018.

## (2) Booster Pumps

### Summary

Table 171 presents a summary of the values used to calculate booster pump savings. The detailed methodology follows.

**Table 171: Booster Pump Measure Summary**

| Parameter                                          | BER-AR                                                            | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                   |                                                           |
| Measure                                            | High efficiency booster pumps rebated after installation          | -                                                         |
| Baseline                                           | Existing booster pumps                                            |                                                           |
| <b>General Parameters</b>                          |                                                                   |                                                           |
| Installation Rate                                  | 100%                                                              | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                                | See Subsection 3.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each installed system | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | N/A                                                               | -                                                         |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each installed system | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                | See Subsection 5.2.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                | See Subsection 5.2.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for booster pumps are calculated using the variables defined and listed in the equation and Table 172 below.

$$Energy\ Savings_{kWh} = 891.20 \times HP_{ee} + 3,523.08 \times \Delta HP_{sys}$$

**Table 172: Electrical Unitary Energy Savings Values for Booster Pumps**

| Parameter                                                                                      | Symbol                  | BER-AR                             | Reference                      |
|------------------------------------------------------------------------------------------------|-------------------------|------------------------------------|--------------------------------|
| Rated Horsepower of the New Booster Pump or Pumping System [HP]                                | $HP_{ee}$               | Specification data for each system | Tracking sheet                 |
| Reduction in the Total Rated Horsepower of the System [HP]                                     | $\Delta HP_{sys}$       | Specification data for each system | Tracking sheet                 |
| Annual Unitary Energy Savings per Rated Horsepower from the Use of a VFD Booster Pump [kWh/HP] | -                       | 891.20                             | 2020 Hawaii TRM <sup>218</sup> |
| Annual Unitary Energy Savings per Rated Horsepower Reduced [kWh/HP]                            | -                       | 3,523.08                           |                                |
| Unitary Energy Savings [kWh/year]                                                              | $Energy\ Savings_{kWh}$ | 657                                | Calculation                    |

## Unitary Peak Demand Savings

The unitary peak demand savings for booster pumps are calculated using the variables defined and listed in the equation and Table 173 below, as well as variables from Table 172 above.

$$Peak\ Demand\ Savings_W = (172 \times HP_{ee} + 671 \times \Delta HP_{sys}) \times PCF$$

**Table 173: Unitary Peak Demand Savings Values for Booster Pumps**

| Parameter                                                                                    | Symbol                    | BER-AR | Reference                                                                                    |
|----------------------------------------------------------------------------------------------|---------------------------|--------|----------------------------------------------------------------------------------------------|
| Annual Unitary Demand Savings per Rated Horsepower from the Use of a VFD Booster Pump [W/HP] | -                         | 172    | 2020 Hawaii TRM <sup>219</sup>                                                               |
| Annual Unitary Demand Savings per Rated Horsepower Reduced [W/HP]                            | -                         | 671    |                                                                                              |
| Peak Coincidence Factor                                                                      | $PCF$                     | 0.7    | Average value calculated using project data from eight Custom Retrofit booster pump projects |
| Unitary Peak Demand Savings [W]                                                              | $Peak\ Demand\ Savings_W$ | 88.8   | Calculation                                                                                  |

## Installation Rates

Installation rates for booster pumps are estimated at 100%.

<sup>218</sup> Hawaii'i Energy, *Hawaii'i Energy Efficiency Program Technical Reference Manual*, July 1, 2019.

<sup>219</sup> Ibid.

## 5.3 HVAC

### 5.3.1 Interactive Effects

For HVAC measures, interactive effects are assumed to be nil.

### 5.3.2 Peak Demand Savings Factors

For all HVAC measures, the methodology used to determine peak demand savings is detailed in the measure-specific sections below.

### 5.3.3 Adjustment Ratios

The adjustment ratios in Table 174 were established through the latest comprehensive impact evaluation for each program. They should be applied for all HVAC measures in SBES and BER-AR.

**Table 174: 2023 HVAC Gross Savings Adjustment Ratios**

| Program Component | Source Evaluation Report | Energy Savings   |                 | Peak Demand Savings |                 |
|-------------------|--------------------------|------------------|-----------------|---------------------|-----------------|
|                   |                          | Adjustment Ratio | Margin of Error | Adjustment Ratio    | Margin of Error |
| SBES              | 2023                     | 0.980            | 4.4%            | 1.009               | 8.6%            |
| BER-AR            | 2022                     | 1.002            | 0.3%            | 1.000               | 2.1%            |

## 5.3.4 HVAC Measures

### (1) Electric Thermal Storage

#### Summary

Table 175 presents a summary of the values used to calculate electric thermal storage savings. The detailed methodology follows.

**Table 175: Electric Thermal Storage Measure Summary**

| Parameter                                          | BER-AR                                                                                                | SBES  | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                       |       |                                                           |
| Measure                                            | Electric thermal storage systems to reduce peak demand space heating load, rebated after installation | -     |                                                           |
| Baseline                                           | No thermal storage                                                                                    |       |                                                           |
| General Parameters                                 |                                                                                                       |       |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                         |       |                                                           |
| Energy Savings Adjustment Ratio                    | -                                                                                                     | -     | See Subsection 5.3.3                                      |
| Peak Demand Savings Adjustment Ratio               | 1.000                                                                                                 | 1.009 |                                                           |
| Effective Useful Life [years]                      | 18                                                                                                    |       | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                       |       |                                                           |
| Unitary Energy Savings [kWh/year]                  | -                                                                                                     |       | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | -                                                                                                     |       | -                                                         |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each installed system                                     |       | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                    |       | See Subsection 5.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                    |       | See Subsection 5.3.1                                      |

#### Electrical Unitary Energy Savings

No energy savings are expected from this measure.

## Unitary Peak Demand Savings

For electric thermal storage, an eight-hour charging period is assumed based on the residential off-peak period in Nova Scotia Power's time of day rate. It is also assumed that the stored heat will be provided equally throughout the remaining 16 hours of the day.

Therefore, the unitary peak demand unitary savings for electric thermal storage are calculated using the equation below where the maximum storage capacity is drawn from manufacturer specification sheets and is either the maximum system storage capacity or the maximum amount of energy the system can store in eight hours.

$$\text{Peak Demand Savings}_W = \text{Maximum Storage Capacity in 8h/16h}$$

## (2) Advanced Rooftop Unit Controls

### Summary

Table 176 presents a summary of the values used to calculate advanced rooftop unit (RTU) control savings. The detailed methodology follows.

**Table 176: Advanced RTU Control Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                            | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                                   |                                                           |
| Measure                                            | Advanced RTU controls that include demand-controlled ventilation (DCV) and an optional variable frequency drive (VFD), rebated after installation | -                                                         |
| Baseline                                           | Control without DCV or VFD                                                                                                                        |                                                           |
| General Parameters                                 |                                                                                                                                                   |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                                     | -                                                         |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                                             | See Subsection 5.3.3                                      |
| Peak Demand Savings Adjustment Ratio               | 1.000                                                                                                                                             |                                                           |
| Effective Useful Life [years]                      | 10                                                                                                                                                | See Subsection 3.2                                        |
| Electrical Savings Parameters                      |                                                                                                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each installed system                                                                                 | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                                               | -                                                         |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each installed system                                                                                 | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                                                | See Subsection 5.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                                                | See Subsection 5.3.1                                      |



## Electrical Unitary Energy Savings

The electrical unitary energy savings for advanced RTU controls are calculated using the variables defined and listed in the equation below as well as in Table 177 and Table 178 further below.

$$\begin{aligned} \text{Energy Savings}_{kWh} &= \frac{1}{12,000} \times \left( \text{Capacity}_{cool} \times (AC \times CESF_{DCV} + VFD \times FESF_{VFD}) \right) \\ &+ \text{ElecHeat} \times \frac{\text{Capacity}_{heat} \times HESF_{DCV}}{COP_{heat}} \end{aligned}$$

**Table 177: Electrical Unitary Energy Savings Values for Advanced RTU Controls**

| Parameter                                                         | Symbol                 | BER-AR                                                                                               | Reference                                                                                                       |
|-------------------------------------------------------------------|------------------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| Indicator of Cooling in the RTU                                   | $AC$                   | RTU with AC: 1<br>RTU without AC: 0                                                                  | -                                                                                                               |
| Indicator of Electrical Heating in the RTU                        | $ElecHeat$             | RTU with electrical heating: 1<br>RTU without electrical heating: 0                                  | -                                                                                                               |
| Indicator of a Supply Fan VFD Added with Advanced RTU Controls    | $VFD$                  | Advanced RTU controls with supply fan VFD: 1<br>Advanced RTU controls without supply fan VFD: 0      | -                                                                                                               |
| Coefficient of Performance (COP) of the Heating Equipment [kW/kW] | $COP_{heat}$           | RTU with electrical resistance: 1<br>RTU with heat pump: Specification data (if unknown, assume 2.1) | AHRI certified value or assumption <sup>220</sup>                                                               |
| Rated Cooling Capacity of the Cooling Equipment [Btu/h]           | $Capacity_{cool}$      | Specification data for each system                                                                   | -                                                                                                               |
| Rated Heating Capacity of the Heating Equipment [Btu/h]           | $Capacity_{heat}$      | Specification data for each system                                                                   |                                                                                                                 |
| Cooling Energy Savings Factor for DCV [kWh/tonne]                 | $CESF_{DCV}$           | Values from Table 178                                                                                | 2021 Illinois TRM, <sup>221</sup><br>Government of Canada, <sup>222</sup> 2016 EPR<br>Evaluation <sup>223</sup> |
| Heating Energy Savings Factor for DCV [kWh/tonne]                 | $HESF_{DCV}$           |                                                                                                      |                                                                                                                 |
| Supply Fan Energy Savings Factor from VFD [kWh/tonne]             | $FESF_{VFD}$           |                                                                                                      |                                                                                                                 |
| Conversion Factor [Btu/tonne·h]                                   | 12,000                 | 12,000                                                                                               | Convention                                                                                                      |
| Unitary Energy Savings [kWh/year]                                 | $Energy Savings_{kWh}$ | Calculation based on specification data for each rebated unit                                        | Calculated                                                                                                      |

<sup>220</sup> Assuming a COP of 1 for electric resistance and an average COP of 2.1, which corresponds to the average HSPF value cited by NRCAN for air-source heat pumps converted from Btu/W·h to kW/kW (<https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about/energy-star-announcements/publications/heating-and-cooling-heat-pump/6817>).

<sup>221</sup> Illinois Energy Efficiency Stakeholder Advisory Group, 2021 *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0*, Volume 2, September 2020, p. 393.

<sup>222</sup> Government of Canada, Historical Climate Data. Retrieved from [https://climate.weather.gc.ca/historical\\_data/search\\_historic\\_data\\_e.html](https://climate.weather.gc.ca/historical_data/search_historic_data_e.html).

<sup>223</sup> Econoler, *Efficient Product Rebates 2016 DSM Evaluation*, March 8, 2017.

**Table 178: Advanced RTU Control Energy Savings Factors**

| Facility Type                            | Supply Fan Energy Savings Factors from VFD <sup>224</sup> [kWh/tonne] | Cooling Energy Savings Factors for DCV <sup>225</sup> [kWh/tonne] | Heating Energy Savings Factors for DCV <sup>226</sup> [kWh/tonne] |
|------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------|
| Convenience Store                        | 927                                                                   | 9                                                                 | 1,826                                                             |
| Education - Community College/University | 388                                                                   | 9                                                                 | 2,675                                                             |
| Education - Primary <sup>227</sup>       | 388                                                                   | 4                                                                 | 3,248                                                             |
| Education - Secondary <sup>227</sup>     | 388                                                                   | 7                                                                 | 3,474                                                             |
| Health/Medical – Clinic <sup>228</sup>   | 597                                                                   | 2                                                                 | 331                                                               |
| Health/Medical - Hospital <sup>227</sup> | 597                                                                   | 2                                                                 | 372                                                               |
| Lodging <sup>228</sup>                   | 597                                                                   | 2                                                                 | 331                                                               |
| Manufacturing                            | 798                                                                   | 2                                                                 | 166                                                               |
| Multi-family <sup>227</sup>              | 597                                                                   | 1                                                                 | 320                                                               |
| Office - Low Rise                        | 1,115                                                                 | 3                                                                 | 1,035                                                             |
| Office - Mid Rise <sup>227</sup>         | 1,115                                                                 | 4                                                                 | 1,152                                                             |
| Office - High Rise <sup>227</sup>        | 1,115                                                                 | 8                                                                 | 1,131                                                             |
| Restaurant                               | 596                                                                   | 3                                                                 | 1,035                                                             |
| Retail - Large Dept. Store               | 715                                                                   | 6                                                                 | 952                                                               |
| Retail - Strip Mall                      | 738                                                                   | 6                                                                 | 870                                                               |
| Warehouse                                | 401                                                                   | 1                                                                 | 934                                                               |
| Other/Miscellaneous <sup>229</sup>       | 692                                                                   | 4                                                                 | 1,241                                                             |

<sup>224</sup> Supply fan energy savings factors were calculated based on the difference between the normalized energy savings per cooling capacity values for the Chicago DCV and VFD w/3-speed fan control and DCV scenarios of the Advanced Rooftop Controls measure in the 2021 Illinois TRM.

<sup>225</sup> Cooling energy savings factors for DCV were calculated based on the normalized energy savings per cooling capacity values for the Chicago DCV scenario of the Advanced Rooftop Controls measure in the 2021 Illinois TRM as well as the cooling degree days from Chicago (1,865°C·day, 2021 Illinois TRM) and Halifax (325°C·day, Government of Canada).

<sup>226</sup> Heating energy savings factors for DCV were calculated based on the normalized energy savings per heating capacity values for the Chicago DCV scenario of the Advanced Rooftop Controls measure in the 2021 Illinois TRM as well as the heating degree days from Chicago (2,238°C·day, 2021 Illinois TRM) and Halifax (3,378°C·day, Government of Canada). Heating energy savings factors per capacity were multiplied by the COP assumption of 2.3 (2021 Illinois TRM) to obtain heating energy savings factors per capacity and COP.

<sup>227</sup> For primary and secondary education facilities, supply fan energy savings factors were assumed to be the same as for community college/university facilities, and cooling and heating energy savings factors were calculated based on the ratio of their full load heating and cooling hours and those of community college/university facilities (from the 2016 EPR Evaluation Report). Similarly, the savings factors for hospitals were based on the values for clinics, those for multi-family facilities were based on the values for lodging facilities, and those for mid-rise and high-rise offices were based on the values for low-rise offices.

<sup>228</sup> Energy savings factors for assisted living facilities were used for clinics and lodging facilities as they were assumed to be similar.

<sup>229</sup> Energy savings factors for the Other/Miscellaneous category were estimated to be the average values of all other categories.

## Unitary Peak Demand Savings

The unitary peak demand savings for advanced RTU controls that include a supply fan VFD are calculated using the variables defined and listed in the equation as well as in Table 179 below. For the DCV portion of advanced RTU controls, no unitary peak demand savings that could be adapted to the Nova Scotia load shape were found in the literature. To claim DCV peak demand savings, metering or simulation data would have to be collected.

$$\text{Peak Demand Savings}_W = VFD \times HP \times 1,000 \times DSVG \times PCF$$

**Table 179: Unitary Peak Demand Savings Values for Advanced RTU Controls**

| Parameter                       | Symbol                                 | BER-AR                                                        | Reference                             |
|---------------------------------|----------------------------------------|---------------------------------------------------------------|---------------------------------------|
| Demand Savings Factor [kW/hp]   | <i>DSVG</i>                            | 0.252                                                         | 2020 Massachusetts TRM <sup>230</sup> |
| Peak Coincidence Factor [-]     | <i>PCF</i>                             | 1.0                                                           |                                       |
| Conversion Factor [W/kW]        | -                                      | 1,000                                                         | Convention                            |
| Unitary Peak Demand Savings [W] | <i>Peak Demand Savings<sub>W</sub></i> | Calculation based on specification data for each rebated unit | Calculated                            |

<sup>230</sup> Mass Save, *Massachusetts Technical Reference Manual*, May 2020.

### (3) Smart Thermostats for Electric Heating

#### Summary

Table 180 presents a summary of the values used to calculate smart thermostat for electric heating savings. The detailed methodology follows.

**Table 180: Smart Thermostat for Electric Heating Measure Summary**

| Parameter                                          | BER-AR, BER-IR, SBES                                                                                            |      |                  |                   | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------|------------------|-------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                 |      |                  |                   |                                                           |
| Measure                                            | Smart thermostats for electric baseboards, in floor radiant heating, and heat pumps, rebated after installation |      |                  |                   | -                                                         |
| Baseline                                           | Manual or programmable thermostats                                                                              |      |                  |                   | -                                                         |
| Measure Sub-category                               | Electric baseboards                                                                                             | MSHP | In-floor heating | Central heat pump |                                                           |
| General Parameters                                 |                                                                                                                 |      |                  |                   |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                   |      |                  |                   | -                                                         |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                           |      |                  |                   | See Subsection 5.3.3                                      |
| Peak Demand Savings Adjustment Ratio               | 1.000                                                                                                           |      |                  |                   |                                                           |
| Effective Useful Life [years]                      | 9                                                                                                               |      |                  |                   | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                                 |      |                  |                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | 312                                                                                                             | 564  | 312              | 1,128             | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 0%                                                                                                              |      |                  |                   | See details below under Unitary Peak Demand Savings       |
| Unitary Peak Demand Savings [W]                    | 0                                                                                                               |      |                  |                   | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                               |      |                  |                   | See Subsection 5.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                               |      |                  |                   | See Subsection 5.3.1                                      |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for smart thermostats for electric baseboards for commercial applications are assumed to be equal to the savings for a residential application because the heating power of controlled thermostats is expected to be similar. The residential savings were calculated according to the equation and methodology below.

$$Energy\ Savings_{kWh} = \frac{Heating\ Energy \times \%Savings \times FMT}{COP}$$

Since no studies specific to smart thermostats connected to electric baseboards, mini-split heat pump (MSHPs), or electric in-floor heating systems were identified, the percentage of the heating load saved by thermostats is based on available studies for smart thermostats compatible with central heating systems, which have essentially the same features. Table 181 presents two billing analyses conducted for Nest smart thermostats installed on central electrical heating systems (rather than natural gas or oil heating systems). Both analyses served to assess the savings for smart thermostats installed to replace both programmable and non-programmable thermostats, which is a reasonable baseline. In both studies, heating consumption savings of 12% were evaluated for central air-source heat pumps, which is the closest heating system to electric baseboards.

**Table 181: Billing Analysis Savings Results for Smart Thermostats for Electrical Heating Systems**

| Jurisdiction                                   | Measure          | Sample Size | Heating Consumption Savings |
|------------------------------------------------|------------------|-------------|-----------------------------|
| Oregon <sup>231</sup>                          | Nest thermostats | 185         | 12% (for ASHPs)             |
| Bonneville Power Administration <sup>232</sup> | Nest thermostats | 176         | 12% (for ASHPs)             |

The savings are divided by the average number of electric heating systems within a dwelling and assuming there is one heating system and one thermostat controlling the system in each room.

Table 182 below presents the variables used for the unitary savings calculation and the resulting value per thermostat.

<sup>231</sup> Apex Analytics LLC, *Energy Trust of Oregon Nest Thermostat Heat Pump Control Pilot Evaluation*, October 10, 2014, 123 p

<sup>232</sup> Bonneville Power Administration, *Nest Learning Thermostat Pilot Program Savings Assessment Bonneville Power Administration & Franklin Public Utility District*, November 16, 2016.

**Table 182: Electrical Unitary Energy Savings Calculation for Smart Thermostats for Electric Heating**

| Parameter                                                             | Symbol                            | Value for Electric Baseboard | Value for MSHP | Value for Electric In-floor Heating | Value for Central Heat Pumps | Reference                                               |
|-----------------------------------------------------------------------|-----------------------------------|------------------------------|----------------|-------------------------------------|------------------------------|---------------------------------------------------------|
| Average Heating Energy Consumption of a Home [kWh/year]               | Heating Energy                    | 16,915                       |                |                                     |                              | 2021, 2022, and 2023 HEA tracking sheets <sup>233</sup> |
| Percentage of Heating Load Saved by Smart Thermostats                 | %Savings                          | 0.12                         |                |                                     |                              | Literature review of billing analyses, see Table 74     |
| Factor to Account for Multiple Thermostats Installed in the Same Home | FMT                               | 0.15                         | 0.5            | 0.15                                | 1                            | Assumption <sup>234</sup>                               |
| Heating System Coefficient of Performance                             | COP                               | 1                            | 1.8            | 1                                   | 1.8                          | Assumption <sup>235</sup>                               |
| Unitary Energy Savings per Thermostat [kWh/year]                      | <i>Energy Savings<sub>i</sub></i> | 312                          | 564            | 312                                 | 1,128                        | Calculation                                             |

## Unitary Peak Demand Savings

Smart thermostats are assumed to generate no peak demand savings.

<sup>233</sup> Based on the average modelled heating energy consumption of HEA participants before and after their home retrofit, including 100% electrically heated participants with no heat pumps and adjusted to take into account HOT2000 overestimation ratios from the 2018 billing analysis. The averages of each year were weighted according to the number of projects.

<sup>234</sup> Assuming 1 thermostat per room for electric baseboards and in-floor heating and 6.5 rooms on average based on Statistics Canada 2016 Census. For MSHP, Assuming 1 thermostat per indoor unit and 2 indoor units per home. Statistics Canada, Census Profile, 2016 Census, <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=PR&Code1=12&Geo2=&Code2=&Data=Count&SearchType=Begin&SearchPR=01&B1=All> (last accessed December 3, 2019).

<sup>235</sup> Assuming a COP of 1 for electric resistance (including baseboard and in-floor), a COP of 1.8 for heat pumps and an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for "Split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained" as per the NRCan regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

## (4) Air-source Heat Pumps Less Than 65,000 Btu/h (excluding air-to-water)

### Summary

Table 183 presents a summary of the values used to calculate the savings for air-source heat pumps (ASHPs) of less than 65,000 Btu/h (excluding air-to-water). The detailed methodology follows.

**Table 183: Air-source Heat Pumps Less Than 65,000 Btu/h, Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                              | SBES  | AMH (prescriptive)   | AMH (comprehensive)                   | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------------|---------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                                     |       |                      |                                       |                                                           |
| Measure                                            | Air-source heat pump less than 65,000 Btu/h used over the heating season which must be an AHRI certified matched system, rebated after installation |       |                      |                                       | -                                                         |
| Baseline                                           | Existing electric resistance heating                                                                                                                |       |                      |                                       | -                                                         |
| General Parameters                                 |                                                                                                                                                     |       |                      |                                       |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                                       |       | 100%                 |                                       | -                                                         |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                                               | 0.980 | 1.016 <sup>236</sup> | -                                     | See Subsection 5.3.3                                      |
| Peak Demand Savings Adjustment Ratio               | 1.000                                                                                                                                               | 1.009 | 1.000                | -                                     |                                                           |
| Effective Useful Life [years]                      | 18                                                                                                                                                  |       |                      |                                       | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                                                                     |       |                      |                                       |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                       |       |                      | Calculated using RETScreen or HOT2000 | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 100%                                                                                                                                                |       |                      |                                       | See details below under Unitary Peak Demand Savings       |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                       |       |                      | Calculated using RETScreen or HOT2000 | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                   |       |                      |                                       | See Subsection 5.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                   |       |                      |                                       | See Subsection 5.3.1                                      |

<sup>236</sup> This adjustment ratio is only meant to be applied in the 2024 AMH evaluation due to the fact that residential equivalent full load hour values were not adjusted last year following the change from HSPF to HSPF2. Going forward, the new equivalent full load hour values will be used.



## Electrical Unitary Energy Savings

The electrical unitary energy savings for ASHPs of less than 65,000 Btu/h (excluding air-to-water) are calculated using the variables defined and listed in the equation<sup>237</sup> and Table 184 below.

$$\Delta kWh = \left( HC * \left[ \frac{1}{HSPF2_{base}} - \frac{1}{HSPF2_{ee}} \right] * FLH_h + CC * \left[ \frac{1}{SEER2_{base}} * AC - \frac{1}{SEER2_{ee}} \right] * FLH_c \right)$$

**Table 184: Electrical Unitary Energy Savings Values for Air-source Heat Pumps Less Than 65,000 Btu/h**

| Parameter                                                                                              | Symbol         | BER-AR, SBES, AMH (prescriptive)                                           | Reference                                                                        |
|--------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Heat Pump Rated Heating Capacity [kBtu/h]                                                              | $HC$           | Actual                                                                     | Use information in TS                                                            |
| Heating Seasonal Performance Factor of the Baseline Heat Pump Equipment for Region 5 [Btu/W·h]         | $HSPF2_{base}$ | 3.412                                                                      | Convention for electric resistance                                               |
| Heating Seasonal Performance Factor of the Energy Efficient Heat Pump Equipment for Region 5 [Btu/W·h] | $HSPF2_{ee}$   | Actual                                                                     | Use information in TS                                                            |
| Heat Pump Heating Full Load Hours per Year [h]                                                         | $FLH_h$        | Based on building type                                                     | See Table 185                                                                    |
| Cooling Full Load Hours per Year [h]                                                                   | $FLH_c$        | Based on building type                                                     | See Table 185                                                                    |
| Heat Pump Rated Cooling Capacity [kBtu/h]                                                              | $CC$           | Actual                                                                     | Use information in TS                                                            |
| Cooling Seasonal Energy Efficiency Ratio of the Baseline Cooling Equipment [Btu/W·h]                   | $SEER2_{base}$ | Actual<br>If unknown, it can be estimated as follows: SEER = EER*1.1 or 14 | Use information in TS<br>Optional baseline from Vermont TRM, 2023 <sup>238</sup> |
| Cooling Seasonal Energy Efficiency Ratio of the Energy Efficient Cooling Equipment [Btu/W·h]           | $SEER2_{ee}$   | Actual<br>If unknown, it can be estimated as follows: SEER = EER*1.1       | Use information in TS                                                            |
| Air Conditioning                                                                                       | $AC$           | baseline = 1; no air-conditioning in baseline = 0                          | Use information in TS                                                            |
| Unitary Energy Savings [kWh/year]                                                                      | $\Delta kWh$   | Calculation based on specification data for each rebated unit              | Calculated                                                                       |

The FLH for heating and cooling come from the Minnesota TRM,<sup>239</sup> which were calculated for Duluth Minnesota. It is in the 4b climate zone with an average HDD of 6,956.

<sup>237</sup> Efficiency Vermont, *Technical Reference Manual (TRM) Program Year 2023*, p.90.

<sup>238</sup> Efficiency Vermont, *Technical Reference Manual (TRM) Program Year 2023*, p.91.

<sup>239</sup> Minnesota Commerce Department, *State of Minnesota Technical Reference Manual, Version 4.1*, January 31, 2024, p.340.

**Table 185: Full Load Heating and Cooling Hours for BER-AR and SBES**

| Facility Type                            | FLHh  | FLHc |
|------------------------------------------|-------|------|
| Convenience Store                        | 1,887 | 647  |
| Education - Community College/University | 1,972 | 682  |
| Education - Primary                      | 2,394 | 289  |
| Education - Secondary                    | 2,561 | 484  |
| Health/Medical - Clinic                  | 2,234 | 558  |
| Health/Medical - Hospital                | 2,508 | 663  |
| Lodging                                  | 2,361 | 401  |
| Manufacturing                            | 1,397 | 347  |
| Multi-Family                             | 2,280 | 228  |
| Office - Low Rise                        | 1,966 | 257  |
| Office - Mid Rise                        | 2,189 | 373  |
| Office - High Rise                       | 2,149 | 669  |
| Restaurant                               | 1,868 | 347  |
| Residential (AMH only)                   | 898   | 213  |
| Retail - Large Department Store          | 1,763 | 462  |
| Retail - Strip Mall                      | 1,701 | 307  |
| Warehouse                                | 1,872 | 164  |
| Other/Miscellaneous                      | 2,123 | 443  |

For AMH, most heat pumps are installed in dwelling where people live and used in a residential fashion. Therefore, it was decided to use a residential FLH value derived from the 2017 Green Heat billing analysis, unless people do not actually live in the dwellings, like when they only sleep there. For example, the residential FLH value should not be used for shelters and community centers.

## Unitary Peak Demand Savings

The unitary peak demand savings for ASHPs of less than 65,000 Btu/h (excluding air-to-water) are calculated using the variables defined and listed in the equation and Table 186 below, as well as variables from Table 184 above. The equation is from the Vermont 2023 TRM<sup>240</sup> with the performance taken at -15°C, which is the estimated temperature during the Nova Scotia peak demand period. If the heat pump is not operational at -15°C, there are no peak demand savings.

$$\Delta kW = \frac{HC_{min}}{HSPF_{base}} \times \left[ 1 - \frac{1}{COP_{ee\_min}} \right] \times PCF$$

<sup>240</sup> Efficiency Vermont, *Technical Reference Manual (TRM) Program Year 2023*, p.90.

**Table 186: Unitary Peak Demand Savings Values for Air-source Heat Pumps Less Than 65,000 Btu/h**

| Parameter                                                                                        | Symbol         | BER-AR, SBES, AMH (prescriptive)                              | Reference                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Heat Pump Rated Heating Capacity at -15°C (estimated temperature during NS peak demand) [kBtu/h] | $HC_{min}$     | Actual<br>If unknown HCmin = 37.46% * Rated HC at 47°F        | Use information in TS<br>Estimation based on average performance reductions as per simulation software (DOE- 2) performance curves shared by NRCan                            |
| Coefficient of Performance for Efficient Heat Pump Technology at -15°C [-]                       | $COP_{ee,min}$ | Actual<br>If unknown HCmin = 37.46% * Rated HC at 47°F        | Use information in TS<br>Estimation based on average performance reductions as per simulation software (DOE- 2) performance curves shared by Natural Resources Canada (NRCan) |
| Peak Coincidence Factor [-]                                                                      | PCF            | 100%                                                          | Assumption that ASHPs operate continuously under peak demand conditions                                                                                                       |
| Unitary Peak Demand Savings [kW]                                                                 | $\Delta kW$    | Calculation based on specification data for each rebated unit | Calculated                                                                                                                                                                    |

## **(5) Air-source Heat Pumps Greater Than or Equal to 65,000 Btu/hr; Ground-source Heat Pumps; Water Source Heat Pumps; Air-to-water Heat Pumps; and Packaged Terminal Heat Pumps (PTHPs)**

### **Summary**

Table 187 presents a summary of the values used to calculate the savings for ASHPs greater than or equal to 65,000 Btu/h. The same methodology is used for ground-source heat pumps, water-source heat pumps, air-to-water heat pumps, and packaged terminal heat pumps. The detailed methodology follows.

**Table 187: Air-source Heat Pumps Greater Than 65,000 Btu/h, Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                                                                                                                     | SBES  | Reference |                                                           |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                                                                                                                            |       |           |                                                           |
| Measure                                            | Air-source heat pump greater than 65,000 Btu/h, ground-source heat pump, water source heat pump, air-to-water heat pump, or a PTHP used over the heating season which must be an AHRI certified matched system, rebated after installation |       | -         |                                                           |
| Baseline                                           | Existing electric resistance heating                                                                                                                                                                                                       |       | -         |                                                           |
| General Parameters                                 |                                                                                                                                                                                                                                            |       |           |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                                                                                                                              |       |           | -                                                         |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                                                                                                                                      | 0.980 |           | See Subsection 5.3.3                                      |
| Peak Demand Savings Adjustment Ratio               | 1.000                                                                                                                                                                                                                                      | 1.009 |           |                                                           |
| Effective Useful Life [years]                      | Dependent on equipment type                                                                                                                                                                                                                |       |           | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                                                                                                                                                            |       |           |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                                                                              |       |           | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 100%                                                                                                                                                                                                                                       |       |           | See details below under Unitary Peak Demand Savings       |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                                                                              |       |           | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                                                                          |       |           | See Subsection 5.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                                                                          |       |           | See Subsection 5.3.1                                      |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for ASHPs greater than 65,000 Btu/h calculated using the variables defined and listed in the equation<sup>241</sup> and Table 188 below.

$$\Delta kWh = \left( HC * \left[ \frac{1}{HEF_{base}} - \frac{1}{HEF_{ee}} \right] * FLH_h + CC * \left[ \frac{1}{CEF_{base}} * AC - \frac{1}{CEF_{ee}} \right] * FLH_c \right)$$

<sup>241</sup> Efficiency Vermont, *Technical Reference Manual (TRM) Program Year 2023*, p.90.

**Table 188: Electrical Unitary Energy Savings Values for  
Air-source Heat Pumps Greater Than 65,000 Btu/h**

| Parameter                                                                       | Symbol       | BER-AR, SBES                                                  | Reference                          |
|---------------------------------------------------------------------------------|--------------|---------------------------------------------------------------|------------------------------------|
| Heat Pump Rated Heating Capacity [kBtu/hr]                                      | $HC$         | Actual                                                        | Use information in TS              |
| Heating Efficiency Factor [Btu/W·h]                                             | $HEF_{base}$ | 3.412                                                         | Convention for electric resistance |
| Heating Efficiency Factor of the Energy Efficient Heat Pump Equipment [Btu/W·h] | $HEF_{ee}$   | Actual                                                        | Use information in TS              |
| Heat Pump Heating Full Load Hours [hours/year]                                  | $FLH_h$      | Based on building type                                        | See Table 189                      |
| Cooling Full Load Hours [hours/year]                                            | $FLH_c$      | Based on building type                                        | See Table 189 and Table 185        |
| Heat Pump Rated Cooling Capacity (kBtu/hr)                                      | $CC$         | Actual                                                        | Use information in TS              |
| Cooling Efficiency Factor [Btu/W·h]                                             | $CEF_{base}$ | Actual                                                        | Use information in TS              |
| Cooling Efficiency Factor of the Energy Efficient Cooling Equipment [Btu/W·h]   | $CEF_{ee}$   | Actual                                                        | Use information in TS              |
| Air Conditioning                                                                | $AC$         | Baseline = 1; no air-conditioning in baseline = 0             | Use information in TS              |
| Unitary Energy Savings [kWh/year]                                               | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculated                         |

The FLH for heating and cooling come from the Minnesota TRM,<sup>242</sup> which were calculated for Duluth Minnesota. It is in the 4b climate zone with an average HDD of 6,956.

<sup>242</sup> Minnesota Commerce Department, *State of Minnesota Technical Reference Manual, Version 4.1*, January 31, 2024, p.340.

**Table 189: Full Load Hours for Heating and Cooling for BER-AR and SBES**

| Facility Type                            | FLHh  | FLHc |
|------------------------------------------|-------|------|
| Convenience Store                        | 1,887 | 647  |
| Education - Community College/University | 1,972 | 682  |
| Education - Primary                      | 2,394 | 289  |
| Education - Secondary                    | 2,561 | 484  |
| Health/Medical - Clinic                  | 2,234 | 558  |
| Health/Medical - Hospital                | 2,508 | 663  |
| Lodging                                  | 2,361 | 401  |
| Manufacturing                            | 1,397 | 347  |
| Multi-Family                             | 2,280 | 228  |
| Office - Low Rise                        | 1,966 | 257  |
| Office - Mid Rise                        | 2,189 | 373  |
| Office - High Rise                       | 2,149 | 669  |
| Restaurant                               | 1,868 | 347  |
| Retail - Large Department Store          | 1,763 | 462  |
| Retail - Strip Mall                      | 1,701 | 307  |
| Warehouse                                | 1,872 | 164  |
| Other/Miscellaneous                      | 2,123 | 443  |

## Unitary Peak Demand Savings

The unitary peak demand savings for ASHP great than 65,000 Btu/h are calculated using the variables defined and listed in the equation and Table 190 below, as well as variables from Table 188 above. The equation is from the Vermont 2023 TRM<sup>243</sup> with the performance taken at -15°C, which is the estimated temperature during Nova Scotia Peak Demand. If the heat pump is not operational at -15°C, there are no peak demand savings.

$$\Delta kW = HC_{min} * \left[ 1 - \frac{1}{HEF_{ee,min}} \right] \times PCF$$

<sup>243</sup> Efficiency Vermont, *Technical Reference Manual (TRM) Program Year 2023*, p.90.

**Table 190: Unitary Peak Demand Savings Values for Air-source Heat Pumps Greater Than 65,000 Btu/h**

| Parameter                                                                                        | Symbol          | BER-AR, SBES                                                  | Reference                                                               |
|--------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------|-------------------------------------------------------------------------|
| Heat Pump Rated Heating Capacity at -15°C (estimated temperature during NS peak demand) [kBtu/h] | $HC_{min}$      | Actual                                                        | Use information in TS                                                   |
| Heating Efficiency Factor for Efficient Heat Pump Technology at -15°C                            | $HEF_{ee\_min}$ | Actual                                                        | Use information in TS                                                   |
| Peak Coincidence Factor [-]                                                                      | PCF             | 100%                                                          | Assumption that ASHPs operate continuously under peak demand conditions |
| Unitary Peak Demand Savings [kW]                                                                 | $\Delta kW$     | Calculation based on specification data for each rebated unit | Calculated                                                              |

## (6) Dual Enthalpy Economizer Controls

### Summary

Table 191 presents a summary of the values used to calculate dual enthalpy economizer control savings. The detailed methodology follows.

**Table 191: Dual Enthalpy Economizer Control Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                   | SBES  | Reference                                                 |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                          |       |                                                           |
| Measure                                            | Dual enthalpy economizer controls which must be installed on new equipment that is also eligible for rebates, rebated after installation |       | -                                                         |
| Baseline                                           | -                                                                                                                                        |       |                                                           |
| General Parameters                                 |                                                                                                                                          |       |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                            |       | -                                                         |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                                    | 0.980 | See Subsection 5.3.3                                      |
| Peak Demand Savings Adjustment Ratio               | 1.000                                                                                                                                    | 1.009 |                                                           |
| Effective Useful Life [years]                      | 10                                                                                                                                       |       | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                                                          |       |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                            |       | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | -                                                                                                                                        |       | See details below under Unitary Peak Demand Savings       |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                            |       | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                        |       | See Subsection 5.3.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                        |       | See Subsection 5.3.1                                      |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for dual enthalpy economizer controls are calculated using the variables defined and listed in the equation<sup>244</sup> and Table 192 below.

$$\Delta kWh = SF \times Tonnes \times \frac{OTF}{EER} \times Quantity$$

**Table 192: Electrical Unitary Savings Values for Dual Enthalpy Economizer Controls**

| Parameter                             | Symbol       | BER-AR, SBES                                                  | Reference                                                                                                                                                                                                                                                                        |
|---------------------------------------|--------------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Savings Factor                        | SF           | SF (<5.4 tonnes) = 4,576<br>SF (>5.4 tonnes) = 3,318          | Vermont TRM, 2015 <sup>245</sup><br>Annual kWh savings per tonne of cooling equipment at an EER of 1.0. Based on simulation modelling for Burlington, VT. For units less than 5.4 tonnes: SF = 4,576 (assume fixed damper baseline). For units of 5.4 tonnes or more: SF = 3,318 |
| Tonnage of Cooling Equipment [tonnes] | Tonnes       | Actual                                                        | Vermont TRM, 2015                                                                                                                                                                                                                                                                |
| Operational Testing Factor            | OTF          | OTF (non-comm) = 0.8<br>OTF (comm) = 1                        | (When the project undergoes operational testing of commissioning services)                                                                                                                                                                                                       |
| Energy Efficiency Ratio [kBtu/h]      | EER          | 10.3                                                          | Vermont TRM, 2015                                                                                                                                                                                                                                                                |
| Unitary Energy Savings [kWh/year]     | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculated                                                                                                                                                                                                                                                                       |

## Unitary Peak Demand Savings

The unitary peak demand savings for dual enthalpy economizer controls are assumed to be nil, because air conditioning loads are likely to be nil under peak conditions at -15°C.

## Installation Rates

Installation rates for dual enthalpy economizer controls are estimated at 100%.

## (7) HVAC Hotel Occupancy Sensors

### Summary

Table 193 presents a summary of the values used to calculate HVAC hotel occupancy sensor savings. The detailed methodology follows.

<sup>244</sup> Efficiency Vermont, *Technical Reference User Manual Measure Savings Algorithms and Cost Assumptions*, March 2015.

<sup>245</sup> Efficiency Vermont, *Technical reference User Manual*, March 16, 2015.



**Table 193: HVAC Hotel Occupancy Sensor Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                                        | SBES  | Reference                                                                     |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                                               |       |                                                                               |
| Measure                                            | Year-round HVAC hotel occupancy sensor which controls electric heating and which sets back temperature when space is not occupied, rebated after installation |       | -                                                                             |
| Baseline                                           | No occupancy sensor                                                                                                                                           |       | -                                                                             |
| General Parameters                                 |                                                                                                                                                               |       |                                                                               |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                                                 |       | -                                                                             |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                                                         | 0.980 | See Subsection 5.3.3                                                          |
| Peak Demand Savings Adjustment Ratio               | 1.000                                                                                                                                                         | 1.009 |                                                                               |
| Effective Useful Life [years]                      | 8                                                                                                                                                             |       | See Subsection 6.2                                                            |
| Electrical Savings Parameters                      |                                                                                                                                                               |       |                                                                               |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                 |       | See details below under Electrical Unitary Energy Savings                     |
| Peak Coincidence Factor                            | -                                                                                                                                                             |       | Peak demand savings are taken from a secondary source and do not consider PCF |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                 |       | See details below under Unitary Peak Demand Savings                           |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                             |       | See Subsection 5.3.1                                                          |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                             |       | See Subsection 5.3.1                                                          |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for HVAC hotel occupancy sensors are defined in Table 194 below.

**Table 194: Electrical Unitary Energy Savings Values for HVAC Hotel Occupancy Sensors**

| Parameter                         | Symbol | BER-AR, SBES | Reference                              |
|-----------------------------------|--------|--------------|----------------------------------------|
| Unitary Energy Savings [kWh/year] | -      | 438          | Massachusetts TRM, 2012 <sup>246</sup> |

## Unitary Peak Demand Savings

The unitary peak demand savings for HVAC hotel occupancy sensors are provided in Table 195 below, as well as variables from Table 194 above.

<sup>246</sup> Massachusetts, *Technical Reference User Manual (TRM) for Estimating Savings from Energy Efficiency Measures*, October 2012.

**Table 195: Unitary Peak Demand Savings Values for HVAC Hotel Occupancy Sensors**

| Parameter                        | Symbol | BER-AR, SBES | Reference               |
|----------------------------------|--------|--------------|-------------------------|
| Unitary Peak Demand Savings [kW] | -      | 0.09         | Massachusetts TRM, 2012 |

## Installation Rates

Installation rates for HVAC hotel occupancy sensor are estimated at 100%.

## 5.4 Water Heating

### 5.4.1 Interactive Effects

Interactive effects are assumed to be nil for all water heating measures except for hot water insulation measures.

### Hot Water Insulation Measures

For hot water insulation measures, namely pipe insulation and hot water tank wraps, the interactive effects factors are based on engineering calculations to account for the duration of the heating and cooling seasons, cooling and heating system efficiency, and percentage of heat generated inside the heated portion of the building envelope.

For SBES, since no information is currently available on the proportion of water heating systems that are located inside the heated portion of the building for small businesses, the Evaluator assumed that it is similar to those of single-family homes. As presented in the Residential Subsection 2.2.1, based on site visit results from the 2015 evaluation<sup>247</sup> and accounting for the proportion of DHW insulation measures installed in conditioned spaces, the average number of months during which heating interactive effects occur in a single-family home is 3.8 months. It is assumed that the impact of DHW on cooling loads is negligible since most measures are installed in a location that might be heated but not likely air-conditioned. Similar to lighting measures, it is assumed that 10% of the heat released by the pipes and DHW is lost through exterior walls and ceilings and does not contribute to the interactive effects, meaning 90% of heating contributes to interactive effects.

For buildings with heat pump heating, since the interactive effects factors are based on a heating system efficiency of 100%, some adjustments are necessary for buildings that use a heat pump as a primary heating system because the efficiency of such systems is superior to 100%. To do so, the interactive effects factor for heating (-28.5%) is divided by 1.8, the COP of a standard mini-split heat pump based on an HSPF2 Region V of 6.0, which is the value for a standard split heat pump as defined by the Federal Energy Efficiency Regulations.<sup>248</sup>

### Peak Demand

As for the impact on peak demand savings, it is assumed that all hot water tanks in a conditioned or semi-conditioned space create interactive effects. Therefore, similar to lighting products, the interactive effects factor for peak demand savings in electrically heated buildings is -90%.

<sup>247</sup> Econoler, *Residential Direct Install 2015 Evaluation*, March 3, 2016.

<sup>248</sup> Minister of Justice, Canada, *Energy Efficiency Regulations, 2016*, <http://laws-lois.justice.gc.ca/PDF/SOR-2016-311.pdf> (last accessed December 5, 2019).

Table 196 summarizes the interactive effects factors for water heating insulation measures.

**Table 196: Interactive Effects Factors for Pipe Insulation and Hot Water Tank Wraps**

| Space Heating         | Energy Interactive Effects During Heating Period | Energy Interactive Effects During Cooling Period | Total Energy Interactive Effects | Peak Demand Interactive Effects |
|-----------------------|--------------------------------------------------|--------------------------------------------------|----------------------------------|---------------------------------|
| Heat Pump Heating     | $-90\% \times 3.8/12 / 1.8 = -15.8\%$            | 0.0%                                             | -15.8%                           | -90%                            |
| Electrical Heating    | $-90\% \times 3.8/12 = -28.5\%$                  | 0.0%                                             | -28.5%                           | -90%                            |
| No Electrical Heating | 0.0%                                             | 0.0%                                             | 0.0%                             | 0%                              |

## Summary

Table 197 summarizes the interactive effects factors established for each water heating measure.

**Table 197: Interactive Effects Factors for Water Heating Measures**

| Measure                                 | Type of Space Heating | Interactive Effects Factors for Energy Savings | Interactive Effects Factors for Peak Demand Savings | Reference                                             |
|-----------------------------------------|-----------------------|------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|
| Low-flow Showerheads                    | -                     | 0%                                             | 0%                                                  | Assumption                                            |
| Faucet Aerators                         |                       |                                                |                                                     |                                                       |
| Thermostatic Shower Valves              |                       |                                                |                                                     |                                                       |
| Pipe Insulation<br>Hot Water Tank Wraps | Heat Pump Heating     | -15.8%                                         | -90%                                                | Calculation                                           |
|                                         | Electrical Heating    | -28.5%                                         | -90%                                                |                                                       |
|                                         | No Electrical Heating | 0%                                             | 0%                                                  |                                                       |
| Heat Pump Water Heaters                 | -                     | 0%                                             | 0%                                                  | IE are included in the energy and peak demand savings |

## 5.4.2 Peak Demand Savings Factors

For hot water tank wraps, energy savings are assumed to occur all the time since the tank always exchanges heat with the space around it. Therefore, peak demand savings for this measure correspond to the average demand savings throughout the year and were established by dividing the energy savings by 8,760 hours, which correspond to a peak demand-to-energy ratio of 0.114 W/kWh.

For other water heating measures, since commercial DHW was not an end use included in the peak demand-to-energy ratios developed by Navigant in the 2016-2018 Demand-side management (DSM) Plan, the Evaluator relied on load shapes from the Illinois TRM to establish a peak demand-to-energy ratio for this end use. Those load shapes rely on simulations to identify what portion of the energy savings is generated during the winter peak, which is defined for Illinois as between 8 a.m. and 11 p.m. on non-holiday weekdays from October to April. While that peak period differs from the one defined in Nova Scotia, those load shapes account for the fact that most water usage happens during the day on weekdays, thus providing a better estimate than spreading savings evenly throughout the year. Therefore, using those load shapes, the Evaluator established a peak demand-to-energy ratio by dividing the energy savings occurring during the peak period by the length of the peak period, as presented in the equations below.

$$\text{Peak Demand-to-energy Ratio} = \frac{\%kWh_{WP} \times 1,000 \text{ kW/W}}{Hours_{WP}}$$

$$Hours_{WP} = (Days_{WP} \times \%Weekdays - Holidays_{WP}) \times \text{Daily Peak Hours}$$

Table 198 lists the parameters and corresponding values applied in the above equations and the resulting peak demand-to-energy ratio.

**Table 198: Peak Demand-to-energy Ratio for Water Heating Measures**

| Parameter                                                    | Symbol                             | Value        | Reference                   |
|--------------------------------------------------------------|------------------------------------|--------------|-----------------------------|
| Portion of Energy Savings Occurring During Winter Peak Hours | $\%kWh_{WP}$                       | 40.5%        | Illinois TRM <sup>249</sup> |
| Number of Days During Winter Peak Season                     | $Days_{WP}$                        | 211          | Illinois TRM                |
| Portion of Weekdays in a Week                                | $\%Weekdays$                       | 71%          | Convention                  |
| Number of Holidays During Winter Peak Period                 | $Holidays_{WP}$                    | 10           | Assumption                  |
| Number of Peak Hours per Day                                 | Daily Peak Hours                   | 15           | Illinois TRM                |
| Number of Winter Peak Hours per Year                         | $Hours_{WP}$                       | 2,111        | Calculation                 |
| <b>Peak Demand-to-energy Ratio</b>                           | <b>Peak Demand-to-energy Ratio</b> | <b>0.192</b> | <b>Calculation</b>          |

Table 199 summarizes the peak demand-to-energy ratio for water heating measures.

**Table 199: Water Heating Measure Peak Demand-to-energy Ratio Summary**

| Measure                    | Peak Demand-to-energy Ratio (W/kWh) |
|----------------------------|-------------------------------------|
| Low-flow Showerheads       | 0.192                               |
| Faucet Aerators            |                                     |
| Thermostatic Shower Valves |                                     |
| Pipe Insulation            |                                     |
| Hot Water Tank Wraps       | 0.114                               |

### 5.4.3 Adjustment Ratios

For water heating measures, no adjustment ratios were calculated.

<sup>249</sup> Illinois Commerce Commission, Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 5.0. February 2016.

## 5.4.4 Water Heating Measures

### (1) Low-flow Showerheads

#### Summary

Table 200 presents a summary of the values used to calculate low-flow showerhead savings. The detailed methodology follows.

**Table 200: Low-flow Showerhead Measure Summary**

| Parameter                                          | SBES                                                      |                                 |                              | Reference                                                                              |
|----------------------------------------------------|-----------------------------------------------------------|---------------------------------|------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                           |                                 |                              |                                                                                        |
| Measure                                            | Low-flow showerheads of 1.5 GPM, with direct installation |                                 |                              | -                                                                                      |
| Baseline                                           | Standard flow showerhead                                  |                                 |                              | -                                                                                      |
| Measure Subcategory                                | Flow rate reduction of 0.5 gpm                            | Flow rate reduction of 0.75 gpm | Flow rate reduction of 1 gpm | -                                                                                      |
| General Parameters                                 |                                                           |                                 |                              |                                                                                        |
| Installation Rate                                  | 100%                                                      |                                 |                              | Assumption                                                                             |
| Effective Useful Life [years]                      | 10                                                        |                                 |                              | See Subsection 6.2                                                                     |
| Electrical Savings Parameters                      |                                                           |                                 |                              |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 212                                                       | 319                             | 425                          | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.192                                                     |                                 |                              | See Subsection 5.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 40.7                                                      | 61.2                            | 81.6                         | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                                        |                                 |                              | See Subsection 5.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                        |                                 |                              | See Subsection 5.4.1                                                                   |

#### Electrical Unitary Energy Savings

The equations below are used to determine the annual unitary savings values for low-flow showerheads. The reduction in hot water consumption is established by the difference between the base and efficient hot water consumption levels, as presented in the second equation.

$$Energy\ Savings\ \left[\frac{kWh}{year}\right] = \%ElectricDHW \times \Delta Gallons\ \left[\frac{gal}{year}\right] \times EPG_{electric}\ \left[\frac{kWh}{gal}\right]$$

$$\Delta Gallons\ \left[\frac{gal}{year}\right] = (GPM_{base} - GPM_{low})\ \left[\frac{gal}{min}\right] \times SH_{time}\ \left[\frac{min}{year}\right] \times \%_{DHW}$$

$$EPG_{Electric}\ \left[\frac{kWh}{gal}\right] = (\rho_{H2O}\ \left[\frac{lb}{ft^3}\right] \times Cp_{H2O}\ \left[\frac{BTU}{lb^{\circ}F}\right] \times \Delta T_{H2O}\ [^{\circ}F] \times UC1\ \left[\frac{kWh}{BTU}\right] \times UC2\ \left[\frac{ft^3}{gal}\right]) / \eta$$

Table 201 below lists the parameters and corresponding values applied in the above equations for low-flow showerheads and the resulting unitary savings values.

**Table 201: Electrical Unitary Energy Savings Values for Low-flow Showerheads**

| Parameter                                                                             | Symbol                                                           | Value      |            |            | Reference                                                                                     |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------|------------|------------|------------|-----------------------------------------------------------------------------------------------|
| Proportion of Water Heating Supplied by Electric Resistance Heating                   | %ElectricDHW                                                     | 100%       |            |            | Electrical energy savings will only be claimed for participants with electrical water heating |
| Baseline Flow Rate [gpm]                                                              | GPM <sub>base</sub>                                              | 2          | 2.25       | 2.5        | SBES tracking sheet                                                                           |
| Low-flow Rate [gpm]                                                                   | GPM <sub>low</sub>                                               | 1.5        |            |            | EPI Program Manual                                                                            |
| Annual Minutes per Showerhead [min/year]                                              | SH <sub>time</sub>                                               | 3,419      |            |            | See Table 202 below                                                                           |
| Percentage of Hot Water Used in Showers                                               | %DHW                                                             | 63%        |            |            | DeOreo et al. <sup>250</sup>                                                                  |
| Energy per Gallon of Hot Water Supplied by Electricity for Resistance Units [kWh/gal] | EPG <sub>Electric</sub>                                          | 0.19924    |            |            | Calculation                                                                                   |
| Electric Water Heater Efficiency                                                      | $\eta$                                                           | 98%        |            |            | Pennsylvania Public Utility Commission TRM <sup>251</sup>                                     |
| Temperature Rise in Electric Water Heater [°F]                                        | $\Delta T_{H2O}$                                                 | 79         |            |            | 2011 OPA <sup>252</sup>                                                                       |
| Specific Heat of Water [Btu/lb°F]                                                     | Cp <sub>H2O</sub>                                                | 1          |            |            | Convention                                                                                    |
| Density of Water [lb/ft³]                                                             | $\rho_{H2O}$                                                     | 62.43      |            |            | Convention                                                                                    |
| Unit Conversion #1 [kWh/Btu]                                                          | UC1                                                              | 0.00029308 |            |            | Convention                                                                                    |
| Unit Conversion #2 [ft³/gal]                                                          | UC2                                                              | 0.1337     |            |            | Convention                                                                                    |
| <b>Unitary Energy Savings [kWh/year]</b>                                              | <b>Energy Savings <math>\left[\frac{kWh}{year}\right]</math></b> | <b>212</b> | <b>319</b> | <b>425</b> | <b>Calculation</b>                                                                            |

Table 202 presents the annual minutes per showerhead by building type, the weight of each building type, and the resulting average annual minutes per showerhead for SBES.

<sup>250</sup> DeOreo et al. (2016). *Residential End Uses of Water*, Version 2: Executive Report, published by Water Research Foundation, <http://www.waterrf.org/PublicReportLibrary/4309A.pdf> (March 16, 2017), pp. 5-8.

<sup>251</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82.

<sup>252</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

**Table 202: Average Showerhead Usage**

| Building Type                          | Annual Minutes per Showerhead (SH <sub>time</sub> ) | Weight | Reference                                                                                                               |
|----------------------------------------|-----------------------------------------------------|--------|-------------------------------------------------------------------------------------------------------------------------|
| Hospitality                            | 3,509                                               | 86%    | Annual minutes per showerhead: Iowa Energy Efficiency TRM – 2021 <sup>253</sup><br><br>Weight: SBES 2021 tracking sheet |
| Health                                 | 2,528                                               | 0%     |                                                                                                                         |
| Education                              | 2,057                                               | 0%     |                                                                                                                         |
| Commercial - Employee Shower           | 1,894                                               | 2%     |                                                                                                                         |
| Other Commercial Except Fitness Center | 3,029                                               | 12%    |                                                                                                                         |
| Fitness Center                         | 56,893                                              | 0%     | Calculation                                                                                                             |
| Weighted Average [Min/year]            | 3,419                                               | -      |                                                                                                                         |

## Installation Rates

For SBES low-flow showerheads, an installation rate of 100% is assumed.

## (2) Faucet Aerators

### Summary

Table 203 presents a summary of the values used to calculate faucet aerator savings. The detailed methodology follows.

**Table 203: Faucet Aerator Measure Summary**

| Parameter                                          | SBES                                            | Reference                                                                              |
|----------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                 |                                                                                        |
| Measure                                            | Faucet aerators, with direct installation       | -                                                                                      |
| Baseline                                           | No faucet aerator on standard flow-rate faucets |                                                                                        |
| General Parameters                                 |                                                 |                                                                                        |
| Installation Rate                                  | 95%                                             | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 10                                              | See Subsection 6.2                                                                     |
| Electrical Savings Parameters                      |                                                 |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 266                                             | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.192                                           | See Subsection 5.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 51.1                                            | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | 0%                                              | See Subsection 5.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings | 0%                                              | See Subsection 5.4.1                                                                   |

<sup>253</sup> Iowa Energy Efficiency, *Iowa Energy Efficiency Statewide Technical Reference Manual Version 6.0*, July 23, 2021.

## Electrical Unitary Energy Savings

The equations below are used to calculate the annual unitary savings value for faucet aerators.

$$DHW\ Savings\ \left[\frac{L}{year}\right] = DHW_{base}\ \left[\frac{gal}{year}\right] \times \frac{(q_{base} - q_{low})}{q_{base}} \times UC1\ \left[\frac{L}{gal}\right]$$

$$Unitary\ Savings\ \left[\frac{kWh}{year}\right] = \frac{DHW\ Savings[L] \times Cp\ \left[\frac{lb}{ft^3}\right] \times \rho\ \left[\frac{btu}{lb^{\circ}F}\right] \times \Delta T[^{\circ}F] \times UC2\ \left[\frac{kWh}{btu} \times \frac{ft^3}{L}\right]}{\eta}$$

Table 204 below lists the parameters and values applied in the two above equations for faucet aerators and the resulting unitary savings values.

**Table 204: Electrical Unitary Energy Savings Values for Faucet Aerators**

| Parameter                                           | Symbol                                                              | Value      | Reference                                                                                                         |
|-----------------------------------------------------|---------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------|
| Baseline Flow Rate [gpm]                            | $q_{base}$                                                          | 1.39       | DeOreo et al. in <i>Residential End Uses of Water Study Update</i> , as cited in Illinois 2021 TRM <sup>254</sup> |
| Low-flow Rate [gpm]                                 | $q_{low}$                                                           | 0.94       |                                                                                                                   |
| Baseline Hot Water Consumption [US gallons/year]    | $DHW_{base}$                                                        | 4,163      | See Table 205 below                                                                                               |
| Specific Heat of Water [Btu/lb°F]                   | $Cp_{H_2O}$                                                         | 1          | Convention                                                                                                        |
| Density of Water [lb/ft <sup>3</sup> ]              | $\rho_{H_2O}$                                                       | 62.43      | Convention                                                                                                        |
| Temperature Rise in Electrical Water Heater [°F]    | $\Delta T_{H_2O}$                                                   | 79         | 2011 OPA <sup>255</sup>                                                                                           |
| Electrical Water Heater Efficiency                  | $\eta$                                                              | 98%        | Pennsylvania Public Utility Commission TRM <sup>256</sup>                                                         |
| Unit Conversion #1 [L/US gallon]                    | UC1                                                                 | 3.79       | Convention                                                                                                        |
| Unit Conversion #2 [(kWh/Btu)x(ft <sup>3</sup> /L)] | UC2                                                                 | 0.00001035 | Convention                                                                                                        |
| <b>Unitary Energy Savings [kWh/year]</b>            | <b><math>Unitary\ Savings\ \left[\frac{kWh}{year}\right]</math></b> | <b>266</b> | <b>Calculation</b>                                                                                                |

Table 205 presents the average hot water usage per faucet by building type, the weight of each building type, and the resulting average annual hot water usage per faucet for SBES.

<sup>254</sup> Illinois Energy Efficiency Stakeholder Advisory Group. *2021 Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 9.0 – Volume 2: Commercial and Industrial Measures*, p. 131.

<sup>255</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>256</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82..



**Table 205: Average Hot Water Usage per Faucet**

| Building Type               | DHW Consumption per Faucet (Gallons) | Weight | Reference                                                                                   |
|-----------------------------|--------------------------------------|--------|---------------------------------------------------------------------------------------------|
| Small Office                | 2,500                                | 12%    | Consumption: 2021 Illinois Statewide TRM <sup>257</sup><br>Weight: SBES 2021 tracking sheet |
| Restaurant                  | 15,768                               | 6%     |                                                                                             |
| Retail                      | 3,650                                | 3%     |                                                                                             |
| Lodging                     | 1,825                                | 36%    |                                                                                             |
| Other                       | 5,000                                | 43%    |                                                                                             |
| Weighted Average [Min/year] | 4,163                                | -      | Calculation                                                                                 |

## Installation Rates

For SBES faucet aerators, an installation rate of 95% is used based on the value in the 2021 Illinois Statewide TRM.

<sup>257</sup> Illinois Energy Efficiency, 2021 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 9.0, September 25, 2020.

### (3) Thermostatic Shower Valve

#### Summary

Table 206 presents a summary of the values used to calculate thermostatic shower valve savings. The detailed methodology follows.

**Table 206: Thermostatic Shower Valve Measure Summary**

| Parameter                                          |                                                                                                                      | SBES               |                     |                    |                                                                                        | Reference |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------------|---------------------|--------------------|----------------------------------------------------------------------------------------|-----------|
| Measure Description and Identification             |                                                                                                                      |                    |                     |                    |                                                                                        |           |
| Measure                                            | Thermostatic shower valves cutting off water after the target temperature has been reached, with direct installation |                    |                     |                    | -                                                                                      |           |
| Baseline                                           | No thermostatic shower valve                                                                                         |                    |                     |                    | -                                                                                      |           |
| Measure Subcategory                                | 1.5 gpm showerhead                                                                                                   | 2.0 gpm showerhead | 2.25 gpm showerhead | 2.5 gpm showerhead | -                                                                                      |           |
| General Parameters                                 |                                                                                                                      |                    |                     |                    |                                                                                        |           |
| Installation Rate                                  | 100%                                                                                                                 |                    |                     |                    | See details below under Installation Rates                                             |           |
| Effective Useful Life [years]                      | 10                                                                                                                   |                    |                     |                    | See Subsection 6.2                                                                     |           |
| Electrical Savings Parameters                      |                                                                                                                      |                    |                     |                    |                                                                                        |           |
| Unitary Energy Savings [kWh/year]                  | 80.1                                                                                                                 | 107                | 120                 | 133                | See details below under Electrical Unitary Energy Savings                              |           |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.192                                                                                                                |                    |                     |                    | See Subsection 5.4.2                                                                   |           |
| Unitary Peak Demand Savings [W]                    | 15.4                                                                                                                 | 20.5               | 23.5                | 25.5               | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |           |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                   |                    |                     |                    | See Subsection 5.4.1                                                                   |           |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                   |                    |                     |                    | See Subsection 5.4.1                                                                   |           |

#### Electrical Unitary Energy Savings

The equations below are used to determine the annual unitary savings values for thermostatic shower valves. Energy savings are established by calculating the reduction in hot water usage, as presented in the second equation below.

$$\text{Energy Savings} \left[ \frac{kWh}{\text{year}} \right] = \text{DHW Reduction} \left[ \frac{gal}{\text{year}} \right] \times EPG_{electric} \left[ \frac{kWh}{gal} \right]$$

$$\text{DHW Reduction} \left[ \frac{gal}{\text{year}} \right] = q \left[ \frac{gal}{min} \right] \times \%_{DHW} \times t_w \left[ \frac{min}{shower} \right] \times \frac{SH_{time} \left[ \frac{min}{year} \right]}{t_{shower} \left[ \frac{min}{shower} \right]}$$

$$EPG_{Electric} \left[ \frac{kWh}{gal} \right] = (\rho_{H2O} \left[ \frac{lb}{ft^3} \right] \times Cp_{H2O} \left[ \frac{BTU}{lb^{\circ}F} \right] \times \Delta T_{H2O} [^{\circ}F] \times UC1 \left[ \frac{kWh}{BTU} \right] \times UC2 \left[ \frac{ft^3}{gal} \right]) / \eta$$

Table 207 lists the parameters and corresponding values applied to the two above equations and the resulting unitary savings values for thermostatic shower valves.

**Table 207: Electrical Unitary Energy Savings Values for Thermostatic Shower Valves**

| Parameter                                      | Symbol                | SBES                                                                                 | Reference                                                                  |
|------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Flow Rate [gpm]                                | q                     | Variable (1.5 gpm for low-flow showerhead, otherwise: 2.0 gpm, 2.25 gpm, or 2.5 gpm) | SBES tracking sheet                                                        |
| Annual Minutes per Showerhead [min/year]       | SH <sub>time</sub>    | 3,419                                                                                | Value drawn from the low-flow showerhead measure; see Subsection 5.4.4 (1) |
| Average Shower Time per Person [min/shower]    | t <sub>shower</sub>   | 7.8                                                                                  | DeOreo et al. <sup>258</sup>                                               |
| Behavioural Waste Time [min/shower]            | t <sub>w</sub>        | 0.98                                                                                 | Pennsylvania Public Utility Commission TRM <sup>259</sup>                  |
| Percentage of Hot Water Used in Showers        | % <sub>DHW</sub>      | 63%                                                                                  | DeOreo et al.                                                              |
| Specific Heat of Water [Btu/lb°F]              | Cp <sub>H2O</sub>     | 1                                                                                    | Convention                                                                 |
| Density of Water [lb/ft³]                      | ρ <sub>H2O</sub>      | 62.43                                                                                | Convention                                                                 |
| Temperature Rise in Electric Water Heater [°F] | ΔT <sub>H2O</sub>     | 79                                                                                   | 2011 OPA <sup>260</sup>                                                    |
| Unit Conversion #1 [kWh/Btu]                   | UC1                   | 0.000293083                                                                          | Convention                                                                 |
| Unit Conversion #2 [ft³/gal]                   | UC2                   | 0.1337                                                                               | Convention                                                                 |
| Electric Water Heater Efficiency               | η                     | 98%                                                                                  | Pennsylvania Public Utility Commission TRM <sup>261</sup>                  |
| Unitary Energy Savings [kWh/year]              | Flow rate of 1.5 gpm  | 80.1                                                                                 | Calculation                                                                |
|                                                | Flow rate of 2.0 gpm  | 107                                                                                  | Calculation                                                                |
|                                                | Flow rate of 2.25 gpm | 120                                                                                  | Calculation                                                                |
|                                                | Flow rate of 2.5 gpm  | 133                                                                                  | Calculation                                                                |

## Installation Rates

For SBES thermostatic shower valves, an installation rate of 100% is assumed.

<sup>258</sup> DeOreo et al. (2016). *Residential End Uses of Water*, Version 2: Executive Report, published by Water Research Foundation, <http://www.waterrf.org/PublicReportLibrary/4309A.pdf> (March 16, 2017), pp. 5-8.

<sup>259</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual*, State of Pennsylvania, June 2013, p. 174.

<sup>260</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>261</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82

## (4) Pipe Insulation

### Summary

Table 208 presents a summary of the values used to calculate pipe insulation savings. The detailed methodology follows.

**Table 208: Pipe Insulation Measure Summary**

| Parameter                                          | SBES                                                                      | Reference                                                                              |
|----------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                           |                                                                                        |
| Measure                                            | Added pipe insulation to hot water copper pipes, with direct installation | -                                                                                      |
| Baseline                                           | No pipe insulation                                                        |                                                                                        |
| General Parameters                                 |                                                                           |                                                                                        |
| Installation Rate                                  | 100%                                                                      | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 13                                                                        | See Subsection 6.2                                                                     |
| Electrical Savings Parameters                      |                                                                           |                                                                                        |
| Unitary Energy Savings (per ft) [kWh/year]         | 12.7                                                                      | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.192                                                                     | See Subsection 5.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 2.44                                                                      | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | Calculation based on building heating systems for each installed unit     | See Subsection 5.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                           |                                                                                        |

### Electrical Unitary Energy Savings

As presented in Table 209, the annual unitary savings value for pipe insulation was identified through Ontario Power Authority (OPA) 2011<sup>262</sup> values and was established at 12.7 kWh per linear foot. While this value is for residential usage, it was assumed that water heating systems in small businesses would be used for a similar amount of time as a home.

**Table 209: Unitary Energy Savings Value for Pipe Insulation**

| Parameter                                  | SBES |
|--------------------------------------------|------|
| Unitary Energy Savings (per ft) [kWh/year] | 12.7 |

### Installation Rates

The installation rate for SBES pipe insulation is assumed at 100%.

<sup>262</sup> Ontario Power Authority (OPA), *OPA Prescriptive Measures and Assumptions List*, December 2010.

## (5) Hot Water Tank Wraps

### Summary

Table 210 presents a summary of the values used to calculate hot water tank wrap savings. The detailed methodology follows.

**Table 210: Hot Water Tank Wrap Measure Summary**

| Parameter                                          | SBES                                                                  | Reference                                                                              |
|----------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Measure Description and Identification             |                                                                       |                                                                                        |
| Measure                                            | Hot water tank wrap, with direct installation                         | -                                                                                      |
| Baseline                                           | No tank wrap                                                          |                                                                                        |
| General Parameters                                 |                                                                       |                                                                                        |
| Installation Rate                                  | 100%                                                                  | See details below under Installation Rates                                             |
| Effective Useful Life [years]                      | 7                                                                     | See Subsection 6.2                                                                     |
| Electrical Savings Parameters                      |                                                                       |                                                                                        |
| Unitary Energy Savings [kWh/year]                  | 157                                                                   | See details below under Electrical Unitary Energy Savings                              |
| Peak Demand-to-energy Ratio [W/kWh]                | 0.114                                                                 | See Subsection 5.4.2                                                                   |
| Unitary Peak Demand Savings [W]                    | 17.9                                                                  | Calculated by multiplying the unitary savings value by the peak demand-to-energy ratio |
| Interactive Effects Factor for Energy Savings      | Calculation based on building heating systems for each installed unit | See Subsection 5.4.1                                                                   |
| Interactive Effects Factor for Peak Demand Savings |                                                                       |                                                                                        |

## Electrical Unitary Energy Savings

The following equations are used to determine the annual unitary savings associated with hot water tank wraps. The energy savings are equal to the difference in heat losses associated with tank circumference ( $Q_{\text{tank}}$ ) before and after adding the tank wrap ( $Q_{\text{tank+RSI 1.21}}$ ). The heat losses are calculated using the following formulas of heat transfer in an insulated cylinder.

$$R_{\text{layer}} = \frac{\ln(r_e/r_i)}{2\pi k}$$

$$R_{\text{cyl}} = R_{\text{layer1}} + R_{\text{layer2}}$$

$$Q_{\text{cyl}} = \frac{T_i - T_e}{R_{\text{cyl}}} L$$

$$Q_{\text{top}} = \frac{A_{\text{top}} \times (T_i - T_e)}{R_{\text{top}}}$$

$$Q_{\text{total}} = Q_{\text{cyl}} + Q_{\text{top}}$$

$$\text{Energy Savings}_{\text{kWh}} = \frac{(Q_{\text{total}}) \cdot \text{HOU}}{\eta_{\text{heater}}}$$

It is assumed that small businesses use similar hot water tanks as single-family homes. Thus, the calculation considers a typical residential tank with a capacity of 60 imperial gallons and hot water tank wrap with a thermal resistance of 1.21 m<sup>2</sup>·°C/W.

Table 211 below lists the values applied in the above equations to obtain the unitary savings for tank wraps.

**Table 211: Electrical Unitary Energy Savings Values for Hot Water Tank Wraps**

| Parameter                                                                                                                | Symbol                 | Value      | Reference                                                                  |
|--------------------------------------------------------------------------------------------------------------------------|------------------------|------------|----------------------------------------------------------------------------|
| <b>Layer 1: Interior Insulation of Tank</b>                                                                              |                        |            |                                                                            |
| External Radius of the Layer [m]                                                                                         | $r_e$                  | 0.300      | Giant <sup>263</sup>                                                       |
| Internal Radius of the Layer [m]                                                                                         | $r_i$                  | 0.249      | Ibid                                                                       |
| Thermal Conductivity of the Layer [W/m·°C]                                                                               | $k$                    | 0.024      | Ibid                                                                       |
| Thermal Resistance of the Layer of Material in the Cylinder (e.g. insulation inside the tank and tank wrap) [m·°C/W]     | $R_{\text{layer}}$     | 1.228      | Calculation                                                                |
| Thermal Resistance of the Top of the Tank [m·°C/W]                                                                       | $R_{\text{Top}}$       | 2.113      | Giant <sup>264</sup>                                                       |
| <b>Layer 2: Tank Wrap</b>                                                                                                |                        |            |                                                                            |
| External Radius of the Layer [m]                                                                                         | $r_e$                  | 0.351      | Estimated from Frost King Insulation Blanket Specifications <sup>265</sup> |
| Internal Radius of the Layer [m]                                                                                         | $r_i$                  | 0.300      | Giant <sup>266</sup>                                                       |
| Thermal Conductivity of the Layer [W/m·°C]                                                                               | $k$                    | 0.042      | Estimated from Frost King Insulation Blanket Specifications                |
| Thermal Resistance of the Layer of Material Inside the Cylinder (e.g. insulation inside the tank and tank wrap) [m·°C/W] | $R_{\text{layer}}$     | 1.821      | Calculation                                                                |
| Thermal Resistance of the Top of the Tank [m·°C/W]                                                                       | $R_{\text{Top}}$       | 3.323      | Sum of R-values of the insulation inside the tank and tank wrap            |
| <b>Heat Transfer</b>                                                                                                     |                        |            |                                                                            |
| Length of the Cylinder [m]                                                                                               | $L$                    | 1.52       | Giant <sup>267</sup>                                                       |
| Area of the Top of the Tank [m <sup>2</sup> ]                                                                            | $A_{\text{top}}$       | 0.283      | Calculated from Giant tank dimensions                                      |
| Temperature at the External Radius of the Cylinder [°C]                                                                  | $T_e$                  | 21         | Assumption for standard ambient indoor temperature                         |
| Temperature at the Internal Radius of the Cylinder [°C]                                                                  | $T_i$                  | 60         | OPA Prescriptive Measures and Assumptions 2011 <sup>268</sup>              |
| Hours of Use [h/year]                                                                                                    | HOU                    | 8,760      | Assumption                                                                 |
| Thermal Efficiency of Heating Element                                                                                    | $\eta_{\text{heater}}$ | 98%        | Pennsylvania Public Utility Commission <sup>269</sup>                      |
| Heat Transfer Through the Tank [W]                                                                                       | $Q_{\text{total}}$     | 53.4       | Calculation                                                                |
| Heat Transfer Through the Insulated Tank [W]                                                                             | $Q_{\text{total}}$     | 35.8       | Calculation                                                                |
| <b>Unitary Energy Savings for Tank Wrap [kWh/year]</b>                                                                   | -                      | <b>157</b> | <b>Calculation</b>                                                         |

## Installation Rates

The installation rate for SBES hot water tank wraps is assumed at 100%.

<sup>263</sup> Giant Inc., *Engineering Submittal Data Sheet 172ETE Models*, <http://www.giantinc.com/tech-data/FT-172E-An.pdf> (last accessed February 18, 2015).

<sup>264</sup> Ibid.

<sup>265</sup> Frost King Weatherization Products, *Water Heater Insulation Blanket*, <http://www.frostking.com/water-heater-insulation-blanket/> (last accessed January 4, 2014).

## (6) Heat Pump Water Heaters

### Summary

Table 212 presents a summary of the values used to calculate DHW heat pump water heater savings. The detailed methodology follows.

**Table 212: DHW Heat Pump Water Heater Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                             |                                                           |
| Measure                                            | Heat pump water heater with an Energy factor greater than 2.3, rebated after installation                                                                                   | -                                                         |
| Baseline                                           | Existing electric resistance hot water system                                                                                                                               | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                             |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                        | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 10                                                                                                                                                                          | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                             |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                               | See details below under Electrical Unitary Energy Savings |
| Peak Demand-to-energy Ratio [W/kWh]                | If water heating not used during this peak, assume peak demand-to-energy ratio to be 0<br>If water heating fully utilized during this period utilize a ratio of 0.274 W/kWh | See details below under Unitary Peak Demand Savings       |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                               | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                           | See Subsection 5.4.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                           | See Subsection 5.4.1                                      |

<sup>266</sup> Giant Inc., *Engineering Submittal Data Sheet 172ETE Models*, 16.

<sup>267</sup> *Ibid.*, 16.

<sup>268</sup> Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

<sup>269</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 2: Residential Measures*, September 2024, p. 82.



## Electrical Unitary Energy Savings

The electrical unitary energy savings for heat pump water heaters are calculated based on the metering study used for residential HPWHs, with an adjustment to account for the difference in hot water consumption between residential and commercial buildings. The savings are calculated using the variables defined and listed in the equation and Table 213 below.

$$\Delta kWh = \frac{GPD}{GDP_{res}} \times kWh_{res}$$

$$GPD \text{ (if unknown)} = Capacity \times \frac{Consumption/cap}{365}$$

**Table 213: Electrical Unitary Energy Savings Values for DHW Heat Pump Water Heaters**

| Parameter                                                          | Symbol       | BER-AR, SBES                                                  |                                   |                         | Reference                        |
|--------------------------------------------------------------------|--------------|---------------------------------------------------------------|-----------------------------------|-------------------------|----------------------------------|
|                                                                    |              | Non-electric Space Heating or No Space Heating                | Electric Resistance Space Heating | Heat Pump Space Heating |                                  |
| Residential Unitary savings [kWh/year]                             | $kWh_{res}$  | 1,611                                                         | 1,179                             | 1,280                   | 2024-2025 DSM MA                 |
| Residential Gallons of Hot Water Used per Day [Gallon/day]         | $GDP_{res}$  | 42.93                                                         |                                   |                         | 2015 Ecotope inc. <sup>270</sup> |
| Capacity of HWHP [Gallon]                                          | Capacity     | Actual                                                        |                                   |                         | Use information in TS            |
| Commercial Gallons of Hot Water Used per Day per HWHP [Gallon/day] | GPD          | Actual or based on reference table below                      |                                   |                         | Illinois 2024 TRM <sup>271</sup> |
| Electrical Unitary Energy Savings [kWh/year]                       | $\Delta kWh$ | Calculation based on specification data for each rebated unit |                                   |                         | Calculation                      |

<sup>270</sup> Ecotope inc., *NEEA Heat Pump Water Heater Model Validation Study*, 2015, p. 72.

Average of 3 non-ducted models in heating zone 3 (most comparable to Nova Scotia). All water heaters are assumed to be in heated spaces since HEA tracking sheet shows that is the case for more than 98% of homes. Used Interior "EFAF" for electric resistance space heating, "interior HP" for heat pumps space heating and "interior gas" for non-electrical space heating.

<sup>271</sup> Illinois Commerce Commission, *2024 Illinois Statewide Technical Reference Manual for Energy Efficiency Version 12.0, Volume 2*, September 22, 2023, p. 214.

**Table 214: Consumption/cap by facility type<sup>272</sup>**

| Facility Type     | Consumption/cap |
|-------------------|-----------------|
| Other Commercial  | 341             |
| Education         | 568             |
| Healthcare        | 788             |
| Hospitality       | 788             |
| Office/Commercial | 511             |
| Residential       | 894             |
| Restaurant/Bar    | 622             |
| Retail            | 528             |
| Warehouse/Storage | 341             |

## Unitary Peak Demand Savings

The unitary peak demand savings for DHW heat pump water heaters are calculated using the variables defined and listed in the equation and Table 215 below, as well as variables from Table 213 above.

$$\Delta kW = \Delta kWh \times PDTER$$

**Table 215: Unitary Peak Demand Savings Values for DHW Heat Pump Water Heaters**

| Parameter                        | Symbol      | BER-AR, SBES                                                                                                                                                                | Reference                            |
|----------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Peak Demand-to-Energy Ratio      | PDTER       | If water heating not used during this peak, assume peak demand-to-energy ratio to be 0<br>If water heating fully utilized during this period utilize a ratio of 0.274 W/kWh | Unavailable reference <sup>273</sup> |
| Unitary Peak Demand Savings [kW] | $\Delta kW$ | Calculation based on specification data for each rebated unit                                                                                                               | Calculation                          |

## Installation Rates

Installation rates for DHW heat pump water heaters are estimated at 100%.

<sup>272</sup> Ibid.

<sup>273</sup> [http://interchange.puc.state.tx.us/WebApp/Interchange/Documents/40891\\_20\\_871637.PDF](http://interchange.puc.state.tx.us/WebApp/Interchange/Documents/40891_20_871637.PDF). Accessed: Feb 18, 2016.

## 5.5 Compressed Air

### 5.5.1 Interactive Effects

Interactive effects are assumed to be nil for compressed air projects since compressors are usually in non-conditioned spaces.

### 5.5.2 Peak Demand Savings Factors

For compressed air measures, the peak demand savings factor is assumed to be 77% where it is unknown for the specific project.

### 5.5.3 Adjustment Ratios

For compressed air measures, no adjustment ratios were calculated.

### 5.5.4 Compressed Air Measures

#### (1) Compressed Air Leak Repairs

##### Summary

Table 216 presents a summary of the values used to calculate compressed air leak repair savings. The detailed methodology follows.

**Table 216: Compressed Air Leak Repair Measure Summary**

| Parameter                                          | Custom                                                | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                       |                                                           |
| Measure                                            | Repair leaks in compressed air systems                | -                                                         |
| Baseline                                           | -                                                     |                                                           |
| General Parameters                                 |                                                       |                                                           |
| Installation Rate                                  | 100%                                                  | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 2                                                     | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                       |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on performance data for each system | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | Actual                                                | Use information in TS                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on performance data for each system | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                    | See Subsection 5.5.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                    | See Subsection 5.5.1                                      |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for compressed air leak repairs are calculated using the variables defined and listed in the equation and tables below.

$$\text{Unitary Savings [kWh/yr]} = \text{Size of Leak [cfm]} \times \text{Plant Efficiency[kW/(100 cfm)]} \times \text{HOU [h/yr]}$$

**Table 217: Electrical Unitary Energy Savings Values for Compressed Air Leak Repairs**

| Parameter                         | Symbol                             | Value                                                            | Reference                                          |
|-----------------------------------|------------------------------------|------------------------------------------------------------------|----------------------------------------------------|
| Size of Leak [cfm]                | -                                  | Actual                                                           | Project documentation                              |
| Plant Efficiency [kW/100 cfm]     | -                                  | Actual<br>(If unknown, use 19.7 kWh/100 cfm)                     | Project documentation<br>(UE Systems Calculations) |
| Hours of Use [h/yr]               | HOU                                | Actual                                                           | Project documentation                              |
| Unitary Energy Savings [kWh/year] | <i>Unitary Savings</i><br>[kWh/yr] | Calculated based on specification data for each installed system | Calculation                                        |

## Unitary Peak Demand Savings

Unitary peak demand savings for compressed air leak repairs are calculated using the equation below and the variables defined and listed in Table 217 above.

$$\text{Unitary Savings [kW]} = \text{Size of Leak [cfm]} \times \text{Plant Efficiency[kW/(100 cfm)]} \times \text{PCF}$$

**Table 218: Electrical Unitary Peak Demand Values for Compressed Air Leak Repairs**

| Parameter                         | Symbol                         | Value                                                            | Reference             |
|-----------------------------------|--------------------------------|------------------------------------------------------------------|-----------------------|
| Peak Coincidence Factor           | PCF                            | Actual                                                           | Project Documentation |
| Unitary Energy Savings [kWh/year] | <i>Unitary Savings</i><br>[kW] | Calculated based on specification data for each installed system | Calculation           |

## Installation Rates

For Custom measures, the installation rate is assumed to be 100%.

## (2) Cycling Air Dryers

### Summary

Table 219 presents a summary of the values used to calculate cycling air dryer savings. The detailed methodology follows.

**Table 219: Cycling Air Dryer Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                   | Reference                                                 |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                |                                                           |
| Measure                                            | Cycling refrigerated dryers up to 300 cubic feet per minute (CFM) capacity which automatically turn on and off in response to load, rebated after installation | -                                                         |
| Baseline                                           | Refrigerated dryers that run continuously                                                                                                                      | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                           | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 10                                                                                                                                                             | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                  | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | Actual or 0.77                                                                                                                                                 | As per Subsection 5.5.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                  | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                              | See Subsection 5.5.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                              | See Subsection 5.5.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for cycling air dryers are calculated using the variables defined and listed in the equation<sup>274</sup> and Table 220 below.

$$\Delta kWh = 4 \times hp_{comp} \times 0.0087 \times HOU \times (1 - APC) \times RTD$$

<sup>274</sup> Efficiency Vermont, *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumption*, March 2015.

**Table 220: Electrical Unitary Energy Savings Values for Cycling Air Dryers**

| Parameter                                                    | Symbol             | BER-AR, SBES                                                                                                                                                | Reference                         |
|--------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Compressor Motor Nominal Horsepower [HP]                     | hp <sub>comp</sub> | Actual                                                                                                                                                      | Use information in TS             |
| Hours of Use [hours/year]                                    | HOU                | Actual or<br>1-shift (8/5) – 2,080 hours<br>2-shift (16/5) – 4,160 hours<br>3-shift (24/5) – 6,240<br>4-shift (24/7) – 8,320 hours<br>Blended – 3,952 hours | Use information in TS             |
| Average % Capacity; Average Operating Capacity of Compressor | APC                | 0.65                                                                                                                                                        | Vermont TRM (2015) <sup>275</sup> |
| Chilled Coil Response Time Derate                            | RTD                | 0.925                                                                                                                                                       | Vermont TRM (2015)                |
| Unitary Energy Savings [kWh/year]                            | $\Delta kWh$       | Calculation based on specification data for each rebated unit                                                                                               | Calculation                       |

## Unitary Peak Demand Savings

The unitary peak demand savings for cycling air dryers are calculated using the variables defined and listed in the equation and Table 221 below, as well as variables from Table 220 above.

$$\Delta kW = \Delta kWh \times PCF / HOU$$

**Table 221: Unitary Peak Demand Savings Values for Cycling Air Dryers**

| Parameter                        | Symbol      | BER-AR, SBES                                                                                                                                                | Reference               |
|----------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor          | PCF         | Actual or 0.77                                                                                                                                              | As per Subsection 5.5.2 |
| Hours of Use [hours/year]        | HOU         | Actual or<br>1-shift (8/5) – 2,080 hours<br>2-shift (16/5) – 4,160 hours<br>3-shift (24/5) – 6,240<br>4-shift (24/7) – 8,320 hours<br>Blended – 3,952 hours | Use information in TS   |
| Unitary Peak Demand Savings [kW] | $\Delta kW$ | Calculation based on specification data for each rebated unit                                                                                               | Calculation             |

## Installation Rates

Installation rates for cycling air dryers are estimated at 100%.

<sup>275</sup> Efficiency Vermont, *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumption*, March 2015.

### (3) Air-entraining Air Nozzles

#### Summary

Table 222 presents a summary of the values used to calculate air-entraining air nozzle savings. The detailed methodology follows.

**Table 222: Air-entraining Air Nozzle Measure Summary**

| Parameter                                          | BER-AR, SBES                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |                                                           |
| Measure                                            | Air-entraining air nozzles under 14 CFM at 100 psi            | -                                                         |
| Baseline                                           | Hand-held or fixed air nozzles                                | -                                                         |
| <b>General Parameters</b>                          |                                                               |                                                           |
| Installation Rate                                  | 100%                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                            | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | Actual or 0.77                                                | As per Subsection 5.5.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                             | See Subsection 5.5.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             | See Subsection 5.5.1                                      |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for air-entraining air nozzles are calculated using the variables defined and listed in the equation<sup>276</sup> and Table 223 below.

$$\Delta kWh = (CFM_b - CFM_e) \times COMP \times HRS \times \%USE \times QTY$$

<sup>276</sup> Efficiency Vermont, *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumption*, March 2015.

**Table 223: Electrical Unitary Energy Savings Values for Air-entraining Air Nozzles**

| Parameter                                                             | Symbol       | BER-AR, SBES                                                                                                                                                                                | Reference                                                |
|-----------------------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Compressor kW/CFM                                                     | COMP         | Modulating w/ BD = 0.32<br>Load/No Load w/ 1 gal/CFM = 0.32<br>Load/No Load w/ 3 gal/CFM = 0.30<br>Load/No Load w/ 5 gal/CFM = 0.28<br>Variable Speed w/ Unloading = 0.23<br>Blended = 0.29 | Vermont TRM (2015) <sup>277</sup>                        |
| Percent of Compressor Total Operating Hours that the Nozzle Is in Use | %USE         | 0.05                                                                                                                                                                                        | Vermont TRM (2015)<br>5% for 3 seconds of use per minute |
| Baseline Nozzle [CFM]                                                 | CFMb         | 26                                                                                                                                                                                          | Vermont TRM (2015)<br>assumes 1/8" diameter orifice      |
| Efficient Nozzle [CFM]                                                | CFMe         | 14                                                                                                                                                                                          | Vermont TRM (2015)                                       |
| Hours of Use [h/year]                                                 | HOU          | Actual<br>1-shift (8/5) – 2,080 hours<br>2-shift (16/5) – 4,160 hours<br>3-shift (24/5) – 6,240 hours<br>4-shift (24/7) – 8,320 hours<br>Blended – 3,952 hours                              | Use information in TS                                    |
| Unitary Energy Savings [kWh/year]                                     | $\Delta kWh$ | Calculation based on specification data for each rebated unit                                                                                                                               | Calculation                                              |

## Unitary Peak Demand Savings

The unitary peak demand savings for air-entraining air nozzles are calculated using the variables defined and listed in the equation and Table 224 below, as well as variables from Table 223 above.

$$\Delta kW = \Delta kWh \times PCF / HOU$$

**Table 224: Unitary Peak Demand Savings Values for Air-entraining Air Nozzles**

| Parameter                        | Symbol      | BER-AR, SBES                                                                                                                                                   | Reference               |
|----------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor          | PCF         | Actual or 0.77                                                                                                                                                 | As per Subsection 5.5.2 |
| Hours of Use [hours/year]        | HOU         | Actual<br>1-shift (8/5) – 2,080 hours<br>2-shift (16/5) – 4,160 hours<br>3-shift (24/5) – 6,240 hours<br>4-shift (24/7) – 8,320 hours<br>Blended – 3,952 hours | Use information in TS   |
| Unitary Peak Demand Savings [kW] | $\Delta kW$ | Calculation based on specification data for each rebated unit                                                                                                  | Calculation             |

## Installation Rates

Installation rates for air-entraining air nozzles are estimated at 100%.

<sup>277</sup> Efficiency Vermont, *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumption*, March 2015.



## (4) No-loss Drains

### Summary

Table 225 presents a summary of the values used to calculate no-loss drain savings. The detailed methodology follows.

**Table 225: No-loss Drain Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                    | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                 |                                                           |
| Measure                                            | A no-loss drain opens the valve only when signaled by a condensate-level controller, rebated after installation | -                                                         |
| Baseline                                           | Timed drains which use a timer to set a local lower limit of condensation in the system                         | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                 |                                                           |
| Installation Rate                                  | 100%                                                                                                            | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                                                                              | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                 |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                   | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | Actual or 0.77                                                                                                  | As per Subsection 5.5.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                   | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                               | See Subsection 5.5.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                               | See Subsection 5.5.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for no-loss drains are calculated using the variables defined and listed in the equation<sup>278</sup> and Table 226 below.

$$\Delta kWh = ALR \times COMP \times OPEN \times AF \times PNC \times QTY$$

<sup>278</sup> Efficiency Vermont, *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumption*, March 2015.

**Table 226: Electrical Unitary Energy Savings Values for No-loss Drains**

| Parameter                              | Symbol       | BER-AR, SBES                                                                                                                                                                                | Reference                         |
|----------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Air Loss Rate [CFM]                    | ALR          | See Table 227                                                                                                                                                                               | Vermont TRM (2015) <sup>279</sup> |
| Compressor Efficiency [kW/CFM]         | COMP         | Modulating w/ BD = 0.32<br>Load/No Load w/ 1 gal/CFM = 0.32<br>Load/No Load w/ 3 gal/CFM = 0.30<br>Load/No Load w/ 5 gal/CFM = 0.28<br>Variable Speed w/ Unloading = 0.23<br>Blended = 0.29 | Vermont TRM (2015) <sup>280</sup> |
| Hours per Year the Timed Drain Is Open | OPEN         | 146                                                                                                                                                                                         | Vermont TRM (2015) <sup>281</sup> |
| Adjustment Factor                      | AF           | 1-Shift – 2,080 Hours = 0.62<br>2-Shift – 4,160 Hours = 0.74<br>3-Shift – 6,240 Hours = 0.86<br>4-Shift – 8,320 Hours = 0.97<br>Blended = 0.80                                              | Use information in TS             |
| % Not Condensate                       | PNC          | 0.75                                                                                                                                                                                        | Vermont TRM (2015) <sup>282</sup> |
| Hours of Use [h/year]                  | HOU          | Actual<br>1-Shift (8/5) – 2,080 hours<br>2-Shift (16/5) – 4,160 hours<br>3-Shift (24/5) – 6,240 hours<br>4-Shift (24/7) – 8,320 hours<br>Blended – 3,952 hours                              | Use information in TS             |
| Unitary Energy Savings [kWh/year]      | $\Delta kWh$ | Calculation based on specification data for each rebated unit                                                                                                                               | <b>Calculation</b>                |

**Table 227: Average Air Loss Rates (CFM)**

| P (psig) | Orifice Diameter (inches) |      |      |       |       |       |
|----------|---------------------------|------|------|-------|-------|-------|
|          | 1/64                      | 1/32 | 1/16 | 1/8   | 1 / 4 | 3/8   |
| 70       | 0.29                      | 1.16 | 4.66 | 18.62 | 74.4  | 167.8 |
| 80       | 0.32                      | 1.26 | 5.24 | 20.76 | 83.1  | 187.2 |
| 90       | 0.36                      | 1.46 | 5.72 | 23.10 | 92    | 206.6 |
| 95       | 0.38                      | 1.51 | 6.02 | 24.16 | 96.5  | 216.8 |
| 100      | 0.40                      | 1.55 | 6.31 | 25.22 | 100.9 | 227   |
| 105      | 0.42                      | 1.63 | 6.58 | 26.31 | 105.2 | 236.7 |
| 110      | 0.43                      | 1.71 | 6.85 | 27.39 | 109.4 | 246.4 |
| 115      | 0.45                      | 1.78 | 7.12 | 28.48 | 113.7 | 256.1 |
| 120      | 0.46                      | 1.86 | 7.39 | 29.56 | 117.9 | 265.8 |
| 125      | 0.48                      | 1.94 | 7.66 | 30.65 | 122.2 | 275.5 |

<sup>279</sup> Efficiency Vermont, *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumption*, March 2015.

<sup>280</sup> Ibid.

<sup>281</sup> Ibid.

<sup>282</sup> Ibid.

## Unitary Peak Demand Savings

The unitary peak demand savings for no-loss drains are calculated using the variables defined and listed in the equation and Table 228 below, as well as variables from Table 227 above.

$$\Delta kW = \Delta kWh \times PCF / HOU$$

**Table 228: Unitary Peak Demand Savings Values for No-loss Drains**

| Parameter                        | Symbol      | BER-AR, SBES                                                                                                                                                   | Reference               |
|----------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor          | PCF         | Actual or 0.77                                                                                                                                                 | As per Subsection 5.5.2 |
| Hours of Use [hours/year]        | HOU         | Actual<br>1-Shift (8/5) – 2,080 hours<br>2-Shift (16/5) – 4,160 hours<br>3-Shift (24/5) – 6,240 hours<br>4-Shift (24/7) – 8,320 hours<br>Blended – 3,952 hours | Use information in TS   |
| Unitary Peak Demand Savings [kW] | $\Delta kW$ | Calculation based on specification data for each rebated unit                                                                                                  | Calculation             |

## Installation Rates

Installation rates for no-loss drains are estimated at 100%.

## 5.6 Variable Frequency Drives

### 5.6.1 Interactive Effects

Interactive effects are assumed to be nil for variable frequency drive (VFD) projects since this measure is implemented on equipment that is usually in non-conditioned spaces.

### 5.6.2 Peak Demand Savings Factors

For variable frequency drives measures, the methodology used to determine peak demand savings is detailed in the measure-specific subsections below.

### 5.6.3 Adjustment Ratios

For variable frequency drive measures, no adjustment ratios were calculated.

## 5.6.4 Variable Frequency Drive (VFD) Measure

### (1) Variable Frequency Drives for non-HVAC Applications

#### Summary

Table 229 presents a summary of the values used to calculate savings for VFDs installed in non-HVAC applications. The detailed methodology follows.

**Table 229: VFD Measure Summary**

| Parameter                                          | BER-AR                                                                           | Reference                                                 |
|----------------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                  |                                                           |
| Measure                                            | Variable frequency drive for non-HVAC applications, installed after installation | -                                                         |
| Baseline                                           | No VFD                                                                           |                                                           |
| General Parameters                                 |                                                                                  |                                                           |
| Installation Rate                                  | 100%                                                                             | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                                               | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                  |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each installed system                | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | Actual                                                                           | See details below under Unitary Peak Demand Savings       |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each installed system                | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                               | See Subsection 5.6.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                               | See Subsection 5.6.1                                      |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for VFD for non-HVAC applications are calculated using the variables defined and listed in the equations and tables below.

$$Unitary\ Savings\left[\frac{kWh}{yr}\right] = \left(0.746\left[\frac{kW}{hp}\right] \times HP[hp] \times \frac{LF[\%]}{Eff[\%]}\right) \times HOU\left[\frac{h}{yr}\right] \times ESF[\%]$$

$$ESF = \sum_{0\%}^{100\%} (DutyCycle \times PLR_{Baseline}) - \sum_{0\%}^{100\%} (DutyCycle \times PLR_{Eff})$$

**Table 230: Electrical Unitary Energy Savings Values for VFD Pumps and Fans**

| Parameter                                         | Symbol                                                  | Value                                                                           | Reference                                                |
|---------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------------------------------------|
| Rated Horsepower of the Motor [HP]                | HP                                                      | Varies per project                                                              | Project documentation                                    |
| Motor Load Factor [%]                             | LF                                                      | Varies per project<br>(If unknown, use 75%)                                     | Project documentation, 2022 Minnesota TRM <sup>283</sup> |
| Efficiency of Motor [%]                           | Eff                                                     | Varies per project                                                              | Project documentation                                    |
| Annual Operating Hours [h/yr]                     | HOU                                                     |                                                                                 |                                                          |
| Percent of Motor Runtime at Each Flow Rate        | DutyCycle                                               | Varies per project<br>(If unknown for each flow rate, use an average flow rate) | Project documentation                                    |
| Part Load Ratio for the Baseline Control Strategy | PLRBaseline                                             | Based on baseline controls and flow rate profile                                | See Table 231 below                                      |
| Part Load Ratio for the VFD                       | PLREff                                                  | Based on VFD controls and flow rate profile                                     | See Table 231 below                                      |
| Energy Savings Factor                             | ESF                                                     | Calculation based on data from project documentation                            | Calculation                                              |
| Conversion Factor [kW/hp]                         | -                                                       | 0.746                                                                           | Convention                                               |
| Unitary Energy Savings [kWh/year]                 | <i>Unitary Savings</i><br>$\left[\frac{kWh}{yr}\right]$ | Calculated based on specification data for each installed system                | Calculation                                              |

<sup>283</sup> Minnesota Commerce Department, *State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs*, January 31, 2021.

Table 231: Part Load Ratio for Flow Rate Based on Control Types<sup>284</sup>

| Control Type                                         | Flow Rate (percentage of design flow) |            |            |            |            |            |            |            |            |             |
|------------------------------------------------------|---------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|
|                                                      | 0% to 10%                             | 10% to 20% | 20% to 30% | 30% to 40% | 40% to 50% | 50% to 60% | 60% to 70% | 70% to 80% | 80% to 90% | 90% to 100% |
| <b>Pump Baseline Values (PLR<sub>Baseline</sub>)</b> |                                       |            |            |            |            |            |            |            |            |             |
| No Control                                           | 1.00                                  |            |            |            |            |            |            |            |            |             |
| Bypass Valve                                         | 0.90                                  | 0.90       | 0.91       | 0.91       | 0.93       | 0.93       | 0.95       | 0.96       | 0.98       | 1.00        |
| Throttling Valve                                     | 0.80                                  | 0.81       | 0.82       | 0.83       | 0.85       | 0.87       | 0.90       | 0.93       | 0.96       | 1.00        |
| Unknown Control Type                                 | 0.90                                  | 0.90       | 0.91       | 0.91       | 0.93       | 0.93       | 0.95       | 0.96       | 0.98       | 1.00        |
| <b>Pump VFD Value (PLR<sub>Eff</sub>)</b>            |                                       |            |            |            |            |            |            |            |            |             |
| Pump VFD                                             | 0.05                                  | 0.06       | 0.09       | 0.12       | 0.18       | 0.27       | 0.39       | 0.55       | 0.75       | 1.00        |
| <b>Fan Baseline Values (PLR<sub>Baseline</sub>)</b>  |                                       |            |            |            |            |            |            |            |            |             |
| No Control or Bypass Damper                          | 1.00                                  |            |            |            |            |            |            |            |            |             |
| Discharge Dampers                                    | 0.46                                  | 0.55       | 0.63       | 0.70       | 0.77       | 0.83       | 0.88       | 0.93       | 0.97       | 1.00        |
| Outlet Damper, Backward Inclined & Airfoil Fans      | 0.53                                  | 0.53       | 0.57       | 0.64       | 0.72       | 0.80       | 0.89       | 0.96       | 1.02       | 1.05        |
| Inlet Damper Box                                     | 0.56                                  | 0.60       | 0.62       | 0.64       | 0.66       | 0.69       | 0.74       | 0.81       | 0.92       | 1.07        |
| Inlet Guide Vane, Backward Inclined & Airfoil Fans   | 0.53                                  | 0.56       | 0.57       | 0.59       | 0.60       | 0.62       | 0.67       | 0.74       | 0.85       | 1.00        |
| Inlet Vane Dampers                                   | 0.38                                  | 0.40       | 0.42       | 0.44       | 0.48       | 0.53       | 0.60       | 0.70       | 0.83       | 0.99        |
| Outlet Damper, Forward Curved Fans                   | 0.22                                  | 0.26       | 0.3        | 0.37       | 0.45       | 0.54       | 0.65       | 0.77       | 0.91       | 1.06        |
| Eddy Current Drives                                  | 0.17                                  | 0.2        | 0.25       | 0.32       | 0.41       | 0.51       | 0.63       | 0.76       | 0.90       | 1.04        |
| Inlet Guide Vane, Forward Curved Fans                | 0.21                                  | 0.22       | 0.23       | 0.26       | 0.31       | 0.39       | 0.49       | 0.63       | 0.81       | 1.04        |
| Unknown Control Type                                 | 0.45                                  | 0.48       | 0.51       | 0.55       | 0.60       | 0.66       | 0.73       | 0.81       | 0.91       | 1.03        |
| <b>Fan VFD Value (PLR<sub>Eff</sub>)</b>             |                                       |            |            |            |            |            |            |            |            |             |
| Fan VFD                                              | 0.09                                  | 0.10       | 0.11       | 0.15       | 0.20       | 0.29       | 0.41       | 0.57       | 0.76       | 1.01        |

<sup>284</sup> Minnesota Department of Commerce Division of Energy Resources, *State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 3.1*, January 2020, pp. 691-692.

Example: A process fan with discharge damper controls operates 85% of the time at 75% flow fraction, 5% of the time at 80% flow fraction, and 10% of the time at 95% flow fraction:

$$\sum_{0\%}^{100\%} (DutyCycle \times PLR) = (0.85 \times 0.93) + (0.05 \times 0.97) + (0.10 \times 1.00) = 0.939$$

## Unitary Peak Demand Savings

The unitary peak demand savings for VFD for pumps and fans are calculated using the variables defined and listed in the equation and Table 232 as well as variables from Table 231 above.

$$\begin{aligned} \text{Unitary Peak Demand Savings} \left[ \frac{W}{yr} \right] \\ = \left( 746 \left[ \frac{W}{hp} \right] \times HP[hp] \times \frac{LF[\%]}{Eff[\%]} \right) \times (PLR_{Baseline,FFpeak} - PLR_{Eff,FFpeak}) \end{aligned}$$

In situations where the part load ratio during the peak demand period is unknown, unitary peak demand savings are calculated by multiplying the average demand savings by a peak coincidence factor of 0 or 1 based on business hours and using the equation below.

$$\text{Unitary Peak Demand Savings}[kW] = \left( 0.746 \left[ \frac{kW}{hp} \right] \times HP[hp] \times \frac{LF[\%]}{Eff[\%]} \right) \times ESF[\%] \times PCF$$

**Table 232: Electrical Unitary Peak Demand Values for VFDs for non-HVAC Applications**

| Parameter                                                                         | Symbol                             | Value                                                            | Reference             |
|-----------------------------------------------------------------------------------|------------------------------------|------------------------------------------------------------------|-----------------------|
| Part Load Ratio for the Average Flow Fraction During the Weekday Peak Time Period | $PLR_{Baseline,FFpeak}$            | Based on baseline control and flow fraction                      | Project documentation |
| Part Load Ratio for the Average Flow Fraction During Peak Time Period             | $PLR_{Eff,FFpeak}$                 | Based on VFD control                                             | Project documentation |
| Peak Coincidence Factor                                                           | PCF                                | If business is open during peak period: 1<br>Otherwise: 0        | Project documentation |
| Unitary Peak Demand Savings [W or kWh]                                            | <i>Unitary Peak Demand Savings</i> | Calculated based on specification data for each installed system | Calculation           |

## Installation Rates

Installation rates for VFD for non-HVAC applications are estimated at 100%.

## 5.7 Pool Pumps

### 5.7.1 Interactive Effects

Interactive effects are assumed to be nil for pool pumps projects since this measure is usually implemented in non-conditioned spaces.

## 5.7.2 Peak Demand Savings Factors

For pool pump measures, peak demand savings factors are assumed to be nil since most pumps are installed on outdoor pools that do not operate during the winter peak.

## 5.7.3 Adjustment Ratios

For pool pump measures, no adjustment ratios were calculated.

## 5.7.4 Pool Pump Measure

### (2) ENERGY STAR Pool Pumps

#### Summary

Table 233 presents a summary of the values used to calculate pool pump savings. The detailed methodology follows.

**Table 233: Pool Pump Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                           | Reference                                                 |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                        |                                                           |
| Measure                                            | ENERGY STAR® multi-speed and variable frequency drive (VFD) commercial inground pool pumps, rebated after installation | -                                                         |
| Baseline                                           | Conventional pool pumps, with only one speed                                                                           | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                        |                                                           |
| Installation Rate                                  | 100%                                                                                                                   | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 10                                                                                                                     | See Subsection 3.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                        |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                          | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | -                                                                                                                      | -                                                         |
| Unitary Peak Demand Savings [W]                    | 0                                                                                                                      | Assumption                                                |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                      | See Subsection 5.7.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                      | See Subsection 5.7.1                                      |



## Electrical Unitary Energy Savings

The electrical unitary energy savings for pool pumps are calculated using the ENERGY STAR Pool Pump Calculator.<sup>285</sup>

### Installation Rates

Installation rates for pool pumps are assumed to be 100%.

## 5.8 Solar

### 5.8.1 Interactive Effects

Interactive effects are assumed to be nil for solar projects since the equipment involved in such systems is typically installed outdoors.

### 5.8.2 Peak Demand Savings Factors

For solar PV projects, peak demand savings are nil since the solar energy production from those systems coinciding with the peak period is negligible.

### 5.8.3 Adjustment Ratios

For solar measures, no adjustment ratios were calculated.

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<sup>285</sup> ENERGY STAR Pool Pump Calculator,  
[https://www.energystar.gov/productfinder/downloads/Pool\\_Pump\\_Calculator\\_2020.05.05\\_FINAL.xlsx](https://www.energystar.gov/productfinder/downloads/Pool_Pump_Calculator_2020.05.05_FINAL.xlsx).

## 5.8.4 Solar Measures

### (1) Solar Photovoltaic (PV) Systems

#### Summary

Table 234 presents a summary of the values used to calculate savings for solar PV projects. The detailed methodology follows.

**Table 234: Solar PV Measure Summary**

| Parameter                                          | Custom Retrofit, BER-AR                                                                             | Reference                                         |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Measure Description and Identification             |                                                                                                     |                                                   |
| Measure                                            | Solar PV systems for commercial, industrial, and agricultural facilities rebated after installation | -                                                 |
| Baseline                                           | Facilities without solar PV systems                                                                 |                                                   |
| General Parameters                                 |                                                                                                     |                                                   |
| Installation Rate                                  | 100%                                                                                                | See details below under Installation Rates        |
| Effective Useful Life [years]                      | 30                                                                                                  | See Subsection 6.2                                |
| Electrical Savings Parameters                      |                                                                                                     |                                                   |
| Unitary Energy Savings [kWh/year]                  | Calculation based on data for each installed system                                                 | See details below under Electrical Energy Savings |
| Peak Coincidence Factor                            | 0                                                                                                   | See Subsection 5.8.2                              |
| Unitary Peak Demand Savings [W]                    | 0                                                                                                   | See Subsection 5.8.2                              |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                  | See Subsection 2.7                                |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                  | See Subsection 2.7                                |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for solar PV systems installed in commercial, industrial, and agricultural applications are calculated using the variables defined and listed in the equations and tables below. For each solar PV project, modelled energy production should be obtained either with PV Watts or RETScreen Expert and should include 14% of miscellaneous losses as pre-defined in both modelling tools. Due to inverter capacity, the solar PV systems can only be 100 kW or less.

$$\begin{aligned} \text{Energy Savings per Project [kWh]} \\ = \text{Modelled Energy Production [kWh]} * (1 - \text{Snow Loss Factor}) * \text{Adj. Ratio} \end{aligned}$$

**Table 235: Electrical Unitary Energy Savings Values for Solar PV Systems**

| Parameter                         | Symbol     | Value                                              | Reference                                               |
|-----------------------------------|------------|----------------------------------------------------|---------------------------------------------------------|
| Modelled Energy Production [kWh]  | -          | Actual                                             | Project documentation                                   |
| Snow Loss Factor [%]              | -          | For panel tilt angles $\geq 25^\circ$ : 1%         | Northern Alberta Institute of Technology <sup>286</sup> |
|                                   |            | For panel tilt angles $< 25^\circ$ : 4%            |                                                         |
| Adjustment Ratio                  | Adj. Ratio | Projects modelled with PV Watts: 1.101             | Custom Retrofit evaluation results (2023)               |
|                                   |            | Projects modelled with RETScreen Expert: 0.942     |                                                         |
| Unitary Energy Savings [kWh/year] | -          | Calculated based on data for each installed system | Calculation                                             |

## Installation Rates

For solar photovoltaic systems, the installation rate is assumed to be 100%.

## (2) Solar Domestic Hot Water

### Summary

Table 236 presents a summary of the values used to calculate solar domestic hot water (DHW) savings. The detailed methodology follows.

**Table 236: Solar Domestic Hot Water Measure Summary**

| Parameter                                          | BER-AR                                                                   | Reference                                                 |
|----------------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                          |                                                           |
| Measure                                            | CSA approved Solar domestic hot water heating rebated after installation | -                                                         |
| Baseline                                           | Existing conventional electric water heater                              |                                                           |
| General Parameters                                 |                                                                          |                                                           |
| Installation Rate                                  | 100%                                                                     | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 20                                                                       | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                          |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculated using RETScreen                                               | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 0                                                                        | See Subsection 5.8.2                                      |
| Unitary Peak Demand Savings [W]                    | 0                                                                        | See Subsection 5.8.2                                      |
| Interactive Effects Factor for Energy Savings      | 0%                                                                       | See Subsection 5.8.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                       | See Subsection 5.8.1                                      |

<sup>286</sup> Northern Alberta Institute of Technology, *Solar Photovoltaic Array Reference Array Report*, March 31, 2016.

## Electrical Unitary Energy Savings

The unitary savings value for solar DHW systems installed through BER-AR is calculated for each system using a custom RETScreen model.

## Unitary Peak Demand Savings

Solar DHW systems provide no peak demand savings because the sun has set during the peak demand period.

## Installation Rates

Installation rates for solar DHW systems are estimated at 100%.

## (3) Solar Air Heating

### Summary

Table 237 presents a summary of the values used to calculate solar air heating savings. The detailed methodology follows.

**Table 237: Solar Air Heating Measure Summary**

| Parameter                                          | BER-AR                                                            | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                   |                                                           |
| Measure                                            | CSA approved Solar air heating systems rebated after installation | -                                                         |
| Baseline                                           | Electric space heating (resistance or heat pump)                  |                                                           |
| General Parameters                                 |                                                                   |                                                           |
| Installation Rate                                  | 100%                                                              | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 20                                                                | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculated using RETScreen                                        | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 0                                                                 | See Subsection 5.8.2                                      |
| Unitary Peak Demand Savings [W]                    | 0                                                                 | See Subsection 5.8.2                                      |
| Interactive Effects Factor for Energy Savings      | 0%                                                                | See Subsection 5.8.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                | See Subsection 5.8.1                                      |

## Electrical Unitary Energy Savings

The unitary savings value for solar air heating systems installed through BER-AR is calculated for each system.



## Installation Rates

Installation rates for solar air heating are estimated at 100%.

## 5.9 Refrigeration

### 5.9.1 Interactive Effects

For refrigeration measures, interactive effects are considered when reduced heat rejection occurs within the refrigerated space, which in turns reduces the electricity consumption of the refrigeration compressor. They are taken into consideration in the unitary electrical energy and peak demand savings equation in the form of a bonus factor, for measures where that applies.

### 5.9.2 Peak Demand Savings Factor

For refrigeration measures, the peak coincidence factor (PCF) is assumed to be 100%, since all equipment is expected to be running continuously, with minor downtime that is addressed in the duty cycle variables, where applicable.

### 5.9.3 Adjustment Ratios

For refrigeration measures, no adjustment ratios were calculated.

## 5.9.4 Refrigeration Measures

### (1) Cooler Night Covers and Display Case Strip Curtains

#### Summary

Table 238 presents a summary of the values used to calculate electrical cooler night cover and display strip curtain savings. The detailed methodology follows.

**Table 238: Cooler Night Cover and Display Strip Curtain Measure Summary**

| Parameter                                          |                                                                                 | BER-AR, SBES                                              | Reference |
|----------------------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------|-----------|
| <b>Measure Description and Identification</b>      |                                                                                 |                                                           |           |
| Measure                                            | Night cover or strip curtain for refrigerated cases, rebated after installation | -                                                         |           |
| Baseline                                           | No night cover or strip curtain                                                 | -                                                         |           |
| <b>General Parameters</b>                          |                                                                                 |                                                           |           |
| Installation Rate                                  | 100%                                                                            | See details below under Installation Rates                |           |
| Effective Useful Life [years]                      | 4                                                                               | See Subsection 6.2                                        |           |
| <b>Electrical Savings Parameters</b>               |                                                                                 |                                                           |           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                   | See details below under Electrical Unitary Energy Savings |           |
| Peak Coincidence Factor                            | 1.0                                                                             | As per Subsection 5.9.2                                   |           |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                   | See details below under Electrical Unitary Energy Savings |           |
| Interactive Effects Factor for Energy Savings      | 0                                                                               | See Subsection 5.9.1                                      |           |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                               | See Subsection 5.9.1                                      |           |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for cooler night covers and display strip curtains are calculated using the variables defined and listed in the equation and Table 239 below.<sup>287</sup>

$$Energy\ Savings_{kWh} = (HG \times EF \times CL \times DF) / (EER \times 1,000) \times Usage \times 365$$

<sup>287</sup> Under the 2.8 "Refrigeration" section, if not saying otherwise, the equation comes from Efficiency Vermont, *Technical Reference User Manual (TRM) Measure Savings Algorithms and Cost Assumptions*, March 16, 2015.

**Table 239: Electrical Unitary Savings Values for Cooler Night Covers and Display Strip Curtains**

| Parameter                                                                              | Symbol                              | BER-AR R, SBES                                                                    |                        | Reference                        |
|----------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------|------------------------|----------------------------------|
|                                                                                        |                                     | Cooler Night Covers                                                               | Display Strip Curtains |                                  |
| Loss of Cold Air or Heat Gain for Refrigerated Cases with no Cover [Btu/hr-ft opening] | HG                                  | Medium Temp (10 - 40F) = 760<br>High Temp (45 - 65F) = 610<br>Average = 685       |                        | Vermont TRM, 2015 <sup>288</sup> |
| Efficiency Factor                                                                      | EF                                  | 0.8                                                                               | 0.65                   |                                  |
| Refrigerated Case Length in Feet [ft]                                                  | CL                                  | Actual if case length is open length of refrigerated box                          |                        | Use information in TS            |
| Disabling Factor                                                                       | DF                                  | 100%                                                                              | 80%                    | Vermont TRM, 2015 <sup>289</sup> |
| Compressor Efficiency [Btu/hr-watt]                                                    | EER                                 | Medium Temp (10 - 40F) = 11.95<br>High Temp (45 - 65F) = 18.5<br>Average = 15.225 |                        |                                  |
| Conversion Factor [W/kW]                                                               | 1,000                               | 1,000                                                                             |                        | Convention                       |
| Average Hours per Day that Case Cover Is in Place [hrs/day]                            | Usage                               | 8                                                                                 | 24                     | Vermont TRM, 2015 <sup>290</sup> |
| Unitary Energy Savings [kWh/year]                                                      | <i>Energy Savings<sub>kWh</sub></i> | Calculation based on specification data for each rebated unit                     |                        | Calculation                      |

## Unitary Peak Demand Savings

The unitary peak demand savings for cooler night covers and display strip curtains are calculated using the variables defined and listed in the equation and Table 240 below, as well as variables from Table 239 above.

$$Peak\ Demand\ Savings_W = (HG \times EF \times CL \times DF \times PCF) / (EER \times 1000)$$

**Table 240: Unitary Peak Demand Savings Values for Cooler Night Covers and Display Strip Curtains**

| Parameter                       | Symbol                                 | BER-AR, SBES                                                  |                        | Reference               |
|---------------------------------|----------------------------------------|---------------------------------------------------------------|------------------------|-------------------------|
|                                 |                                        | Cooler Night Covers                                           | Display Strip Curtains |                         |
| Peak Coincidence Factor         | PCF                                    | 1                                                             |                        | As per Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | <i>Peak Demand Savings<sub>W</sub></i> | Calculation based on specification data for each rebated unit |                        | Calculation             |

## Installation Rates

Installation rates for cooler night covers and display strip curtains are assumed to be 100%.

<sup>288</sup> Efficiency Vermont, *Technical reference User Manual*, March 16, 2015.

<sup>289</sup> Ibid.

<sup>290</sup> Ibid.

## (2) Zero-energy Doors

### Summary

Table 241 presents a summary of the values used to calculate zero-energy door savings. The detailed methodology follows.

**Table 241: Zero-energy Door Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                                                                                                                      | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                                                                                                                                   |                                                           |
| Measure                                            | Zero-energy doors, without electric resistance heating in the door or frame, for Reach-in Coolers. Reach-in display case doors must be highly insulated, double or triple pane units with low-E glass coatings or low-conductivity filler gas (argon). Rebated after installation | -                                                         |
| Baseline                                           | Standard cooler door                                                                                                                                                                                                                                                              | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                                                                                                                                   |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                                                                                                                              | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                                                                                                                                                                                                                                                | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                                                                                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                     | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                                                                                                                                                                               | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                     | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                                                                                                                 | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                                                                                                                 | See Subsection 5.9.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for zero-energy doors are calculated using the variables defined and listed in the equation and Table 242 below.

$$\Delta kWh = kW_{door} \times BF \times HOU$$



**Table 242: Electrical Unitary Energy Savings Values for Zero-energy Doors**

| Parameter                                                                             | Symbol             | BER, SBES                                                                      | Reference                        |
|---------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------|----------------------------------|
| Connected Load of a Typical Reach-in Cooler Door and Frame with Electric Heaters [kW] | kW <sub>door</sub> | 0.131                                                                          | Vermont TRM, 2015 <sup>291</sup> |
| Bonus Factor                                                                          | BF                 | Medium temp (10 - 40F) = 1.22<br>High temp (45 - 65F) = 1.15<br>Average = 1.19 |                                  |
| Hours of Use [h/year]                                                                 | HOU                | 8,760                                                                          |                                  |
| Unitary Energy Savings [kWh/year]                                                     | $\Delta kWh$       | Calculation based on specification data for each rebated unit                  | Calculation                      |

## Unitary Peak Demand Savings

The unitary peak demand savings for zero-energy doors are calculated using the variables defined and listed in the equation and Table 243 below, as well as variables from Table 242 above.

$$\Delta kW = kW_{door} \times BF \times PCF$$

**Table 243: Unitary Peak Demand Savings Values for Zero-energy Doors**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference               |
|---------------------------------|-------------|---------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | As per Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation             |

## Installation Rates

Installation rates for zero-energy doors are assumed to be 100%.

<sup>291</sup> Efficiency Vermont, *Technical reference User Manual*, March 16, 2015.

### (3) Door Heater Controls

#### Summary

Table 244 presents a summary of the values used to calculate electrical door heater control savings. The detailed methodology follows.

**Table 244: Door Heater Control Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                      | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                                   |                                                           |
| Measure                                            | Humidity or conductivity-based heater controls that limit heater operation to periods of high relative humidity (when condensation is likely to form), rebated after installation | -                                                         |
| Baseline                                           | Standard cooler door with no control                                                                                                                                              | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                                   |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                              | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                                                                                                                                                | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                     | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                                                                               | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                     | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                 | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                 | See Subsection 5.9.1                                      |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for door heater controls are calculated using the variables defined and listed in the equation and Table 245 below.

$$\Delta kWh = kW_{door} \times N_{door} \times ES \times BF \times HOU$$

**Table 245: Electrical Unitary Energy Savings Values for Door Heater Controls**

| Parameter                                                                             | Symbol             | BER-AR, SBES                                                                   | Reference                        |
|---------------------------------------------------------------------------------------|--------------------|--------------------------------------------------------------------------------|----------------------------------|
| Connected Load of a Typical Reach-in Cooler Door and Frame with Electric Heaters [kW] | kW <sub>door</sub> | Coolers = 0.131<br>Freezer = 0.245                                             | Vermont TRM, 2013 <sup>292</sup> |
| Number of Doors Controlled by Sensor                                                  | N <sub>door</sub>  | Actual                                                                         | Use information in TS            |
| Percent Annual Energy Savings                                                         | ES                 | Humidity-based control = 55%<br>Conductivity -based control = 70%              | Vermont TRM, 2013                |
| Bonus Factor                                                                          | BF                 | Medium temp (10 - 40F) = 1.22<br>High temp (45 - 65F) = 1.15<br>Average = 1.19 | Vermont TRM, 2013                |
| Hours of Use [h/year]                                                                 | HOU                | 8760                                                                           | Vermont TRM, 2013                |
| Unitary Energy Savings [kWh/year]                                                     | $\Delta kWh$       | Calculation based on specification data for each rebated unit                  | Calculation                      |

## Unitary Peak Demand Savings

The unitary peak demand savings for door heater controls are calculated using the variables defined and listed in the equation and Table 246 below, as well as variables from Table 245 above.

$$\Delta kW = kW_{door} \times N_{door} \times ES \times BF \times PCF$$

**Table 246: Unitary Peak Demand Savings Values for Door Heater Controls**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference               |
|---------------------------------|-------------|---------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | As per Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation             |

## Installation Rates

Installation rates for door heater controls are assumed to be 100%.

<sup>292</sup> Efficiency Vermont, *Technical Reference Manual (TRM): Program Year 2013*.

## (4) Evaporator Fan Motor Controls

### Summary

Table 247 presents a summary of the values used to calculate electrical evaporator fan motor control savings. The detailed methodology follows.

**Table 247: Evaporator Fan Motor Control Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                                                                                                                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                                                                                                                                                               |                                                           |
| Measure                                            | The control system rebated after installation: <ul style="list-style-type: none"> <li>Controls a minimum of 300 Watts or four evaporator fans</li> <li>Reduces evaporator fan air flow by at least 50% when the compressor is not running or when no refrigerant is flowing through the evaporator</li> </ul> | -                                                         |
| Baseline                                           | No control                                                                                                                                                                                                                                                                                                    | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                                                                                                                                                               |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                                                                                                                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 10                                                                                                                                                                                                                                                                                                            | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                                                                                                                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                                 | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                                                                                                                                                                                                           | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                                 | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                                                                                                                                             | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                                                                                                                                             | See Subsection 5.9.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for evaporator fan motor controls are calculated using the variables defined and listed in the equation and Table 248 below.

$$\Delta kWh = \left( (kW_{evap} \times n_{fans} \times DC_{evap}) - kW_{circ} \right) \times (1 - DC_{comp}) \times BF \times HOU$$

**Table 248: Electrical Unitary Energy Savings Values for Evaporator Fan Motor Controls**

| Parameter                                     | Symbol             | BER-AR, SBES                                                  | Reference                                                                                                                                                                                             |
|-----------------------------------------------|--------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Connected Load kW of Each Evaporator Fan [kW] | kW <sub>evap</sub> | 0.11                                                          | Based on weighted average of 60% shaded pole at 132 Watts, and 20% PSC motors at 88 Watts, and 20% EC-motors at 62 Watts. This is based on Vermont's assumptions, with some adjustments for NS market |
| Number of Evaporator Fans                     | nfans              | Actual                                                        | Use information in TS                                                                                                                                                                                 |
| Connected Load kW of the Circulating Fan      | kW <sub>circ</sub> | 0.035                                                         | Vermont TRM, 2013 <sup>293</sup>                                                                                                                                                                      |
| Duty Cycle of the Compressor                  | DC <sub>comp</sub> | 50%                                                           | Vermont TRM, 2013                                                                                                                                                                                     |
| Duty Cycle of the Evaporator Fan              | DC <sub>evap</sub> | 100% for cooler, 94% for freezer                              | Vermont TRM, 2013                                                                                                                                                                                     |
| Bonus Factor                                  | BF                 | 1.5 for low temp, 1.3 for med temp, 1.2 for high temp         | Vermont TRM, 2013                                                                                                                                                                                     |
| Hours of Use [h/year]                         | HOU                | 8,760                                                         | -                                                                                                                                                                                                     |
| Unitary Energy Savings [kWh/year]             | $\Delta kWh$       | Calculation based on specification data for each rebated unit | Calculation                                                                                                                                                                                           |

## Unitary Peak Demand Savings

The unitary peak demand savings for evaporator fan motor controls are calculated using the variables defined and listed in the equation and Table 249 below, as well as variables from Table 248 above.

$$\Delta kW = \left( (kW_{evap} \times n_{fans} \times DC_{evap}) - kW_{circ} \right) \times (1 - DC_{comp}) \times BF \times PCF$$

**Table 249: Unitary Peak Demand Savings Values for Cooler Night Covers and Display Strip Curtains**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference               |
|---------------------------------|-------------|---------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | As per Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation             |

## Installation Rates

Installation rates for evaporator fan motor controls are estimated at 100%.

<sup>293</sup> Efficiency Vermont, *Technical Reference Manual (TRM): Program Year 2013*.

## (5) Intelligent Freezer Defrost Controls

### Summary

Table 250 presents a summary of the values used to calculate electrical intelligent freezer defrost control savings. The detailed methodology follows.

**Table 250: Intelligent Freezer Defrost Control Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                                                                                                                                                                                                                                                                                 | Reference                                                 |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                           |
| Measure                                            | Control system which contains temperature and pressure sensors to monitor system operation and determine if there is a need to run a defrost cycle, rebated after installation:<br><ul style="list-style-type: none"> <li>› Each controller controls the defrost cycle of three or more evaporator fans</li> <li>› Walk-in freezer evaporator coils with electric defrost only (medium and high temperature coolers not eligible)</li> </ul> | -                                                         |
| Baseline                                           | No control                                                                                                                                                                                                                                                                                                                                                                                                                                   | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                                                                                                                                                                                                                                                                                         | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 10                                                                                                                                                                                                                                                                                                                                                                                                                                           | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                                                                                                                                                                | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                          | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                                                                                                                                                                | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                            | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                                                                                                                                                                                                                                                                            | See Subsection 5.9.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for intelligent freezer defrost control are calculated using the variables defined and listed in the equation and Table 251 below.

$$\Delta kWh = n_{fans} \times kW_{DE} \times SVG \times BF \times FLH$$

**Table 251: Electrical Unitary Energy Savings Values for Intelligent Freezer Defrost Controls**

| Parameter                                 | Symbol       | BER-AR, SBES                                                  | Reference                        |
|-------------------------------------------|--------------|---------------------------------------------------------------|----------------------------------|
| Number of Evaporator Fans                 | nfans        | Actual                                                        | Use information in TS            |
| kW of Defrost Element per Evaporator Fan  | kWDE         | 0.9                                                           | Vermont TRM, 2015 <sup>294</sup> |
| Percent of Defrost Cycle Saved by Control | SVG          | 30%                                                           | Vermont TRM, 2015                |
| Bonus Factor                              | BF           | 1.5 for low temp                                              | Vermont TRM, 2015                |
| Average Full Load Defrost Hours           | FLH          | 487                                                           | Vermont TRM, 2015                |
| Unitary Energy Savings [kWh/year]         | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculation                      |

## Unitary Peak Demand Savings

The unitary peak demand savings for intelligent freezer defrost control are calculated using the variables defined and listed in the equation and Table 252 below, as well as variables from Table 251 above.

$$\Delta kW = n_{fans} \times kW_{DE} \times SVG \times BF \times PCF$$

**Table 252: Unitary Peak Demand Savings Values for Intelligent Freezer Defrost Controls**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference            |
|---------------------------------|-------------|---------------------------------------------------------------|----------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | See Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation          |

## Installation Rates

Installation rates for intelligent freezer defrost control are estimated at 100%.

<sup>294</sup> Efficiency Vermont, *Technical reference User Manual*, March 16, 2015.

## (6) Vertical Refrigeration Open-to-closed Cooler Conversion

### Summary

Table 253 presents a summary of the values used to calculate vertical refrigeration open-to-closed cooler conversion savings. The detailed methodology follows.

**Table 253: Vertical Refrigeration Open-to-closed Cooler Conversion Measure Summary**

| Parameter                                          | BER-AR, SBES                                                    | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                 |                                                           |
| Measure                                            | Doored vertical refrigeration units, rebated after installation | -                                                         |
| Baseline                                           | Open multi-deck coolers                                         | -                                                         |
| <b>General Parameters</b>                          |                                                                 |                                                           |
| Installation Rate                                  | 100%                                                            | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                              | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                 |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit   | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                             | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit   | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                               | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                               | See Subsection 5.9.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for vertical refrigeration open to closed cooler conversion are calculated using the variables defined and listed in the equation<sup>295</sup> and Table 254 below.

$$\Delta kWh = OCSF \times DAYS \times L_{case}$$

<sup>295</sup> Fricke, Brian, Becker, Bryan, "Energy use of doored and open vertical refrigerated display cases". International Refrigeration and Air Conditioning Conference. Paper 1154, 2010.



**Table 254: Electrical Unitary Energy Savings Values for Vertical Refrigeration  
Open-to-closed Cooler Conversion**

| Parameter                                           | Symbol       | BER-AR, SBES                                                                                | Reference                                                                  |
|-----------------------------------------------------|--------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Open-to-closed Case Savings Factor [kWh/(day*feet)] | OCSF         | With anti-sweat heaters = 0.5 kWh/(day*ft)<br>Without anti-sweat heaters = 1.5 kWh/(day*ft) | International Refrigeration and Air Conditioning Conference <sup>296</sup> |
| Days Cooler Is Operational per Year [days]          | DAYS         | Actual                                                                                      | Use information in TS                                                      |
| Length of Refrigerated [feet]                       | Lcase        | Actual                                                                                      | Use information in TS                                                      |
| Unitary Energy Savings [kWh]                        | $\Delta kWh$ | Calculation based on specification data for each rebated unit                               | Calculation                                                                |

## Unitary Peak Demand Savings

The unitary peak demand savings for vertical refrigeration open to closed cooler conversion are calculated using the variables defined and listed in the equation and Table 255 below, as well as variables from Table 254 above.

$$\Delta kW = OCSF \times DAYS \times L_{case} \times PCF / HOU$$

**Table 255: Unitary Peak Demand Savings Values for Vertical Refrigeration  
Open-to-closed Cooler Conversion**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference             |
|---------------------------------|-------------|---------------------------------------------------------------|-----------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | See Subsection 5.9.2  |
| Hours of Use [h/year]           | HOU         | Actual                                                        | Use information in TS |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation           |

## Installation Rates

Installation rates for vertical refrigeration open to closed cooler conversion are estimated at 100%.

<sup>296</sup> Fricke, Brian, Becker, Bryan, *Energy use of doored and open vertical refrigerated display cases*, 2010. International Refrigeration and Air Conditioning Conference. Paper 1154.

## (7) Efficient Refrigeration Compressors (Scroll Refrigeration Compressor)

### Summary

Table 256 presents a summary of the values used to calculate efficient refrigeration compressor savings. The detailed methodology follows.

**Table 256: Efficient Refrigeration Compressor Measure Summary**

| Parameter                                          | BER-AR, SBES                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |                                                           |
| Measure                                            | Efficient scroll compressor, rebated after installation       | -                                                         |
| Baseline                                           | Hermetic or semihermetic compressor                           | -                                                         |
| <b>General Parameters</b>                          |                                                               |                                                           |
| Installation Rate                                  | 100%                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                            | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                           | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                             | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             | See Subsection 5.9.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for efficient refrigeration compressor are calculated using the variables defined and listed in the equation<sup>297</sup> and Table 257 below.

$$\Delta kWh = (CAP_{avg,ee}) \times \left[ \left( \frac{1}{EER_{avg,base}} \right) - \left( \frac{1}{EER_{avg,ee}} \right) \right] \times FLH/1,000$$

<sup>297</sup> Iowa Energy, Iowa Energy Efficiency Statewide Technical Reference Manual, July 31, 2023, pp.405-408.

**Table 257: Electrical Unitary Energy Savings Values for Efficient Refrigeration Compressors**

| Parameter                                                                                     | Symbol           | BER-AR, SBES                                                                       | Reference                     |
|-----------------------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------|-------------------------------|
| Compressor Capacity at Standard Rating Conditions [Btu/h]                                     | $CAP_{avg,ee}$   | Actual                                                                             | Use information in TS         |
| Energy Efficiency Ratio of the Baseline Compressor at non-standard Rating Conditions [Btu/Wh] | $EER_{avg,base}$ | See Table 258 for low temperature cases and Table 259 for medium temperature cases | Iowa TRM, 2023 <sup>298</sup> |
| Energy Efficiency Ratio of the Efficient Compressor at Standard Rating Conditions [Btu/Wh]    | $EER_{avg,ee}$   | Actual                                                                             | Use information in TS         |
| Full Load Hours from DPS Commercial Refrigeration Load Shape [h]                              | $FLH$            | Medium temperature = 3,910<br>Low temperature = 4,139                              | Iowa TRM, 2023                |
| Unitary Energy Savings [kWh/year]                                                             | $\Delta kWh$     | Calculation based on specification data for each rebated unit                      | Calculation                   |

**Table 258: Low Temperature (Condensing temp 90°F, Evap Temp -25°F) Baseline and Efficient EER**

| Capacity Bins in Btu/h | $EER_{avg,base}$ | $EER_{avg,ee}$ |
|------------------------|------------------|----------------|
| 0-4,200                | 3.85             | 4.39           |
| 4,200-8,399            | 4.83             | 5.21           |
| 8,400-12,599           | 5.06             | 5.37           |
| 12,600-16,799          | 5.26             | 5.59           |
| 16,800-20,999          | 5.36             | 5.80           |
| 21,000-25,199          | 5.69             | 6.06           |
| 25,200-29,399          | 5.71             | 6.15           |
| 29,400-33,599          | 6.14             | 6.39           |
| 33,600-37,800          | 5.64             | 6.06           |
| 37,800-42,000          | 5.73             | 6.06           |

**Table 259: Medium Temperature (Condensing temp 90°F, Evap Temp 20°F) Baseline and Efficient EER**

| Capacity Bins in Btu/h | $EER_{avg,base}$ | $EER_{avg,ee}$ |
|------------------------|------------------|----------------|
| 0-7,500                | 8.14             | 9.03           |
| 7,500-14,999           | 9.28             | 10.86          |
| 15,000-22,499          | 10.64            | 11.83          |
| 22,500-29,999          | 11.18            | 12.15          |
| 30,000-37,499          | 11.12            | 12.39          |
| 37,500-44,999          | 11.74            | 12.70          |
| 45,000-52,499          | 11.68            | 12.52          |
| 52,500-59,999          | 12.54            | 13.12          |
| 60,000-67,499          | 12.46            | 13.13          |
| 67,500-75,000          | 11.44            | 12.37          |

<sup>298</sup> Iowa Energy, Iowa Energy Efficiency Statewide Technical Reference Manual, July 31, 2023, pp.405-408.

## Unitary Peak Demand Savings

The unitary peak demand savings for efficient refrigerator compressors are calculated using the variables defined and listed in the equation and Table 260 below, as well as variables from Table 257 above.

$$\Delta kW = \Delta kWh \times PCF / FLH$$

**Table 260: Unitary Peak Demand Savings Values for Refrigeration Economizers**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference            |
|---------------------------------|-------------|---------------------------------------------------------------|----------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | See Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation          |

## Installation Rates

Installation rates for refrigeration economizer are estimated at 100%.

## (8) Refrigeration Economizers

### Summary

Table 261 presents a summary of the values used to calculate refrigeration economizer savings. The detailed methodology follows.

**Table 261: Refrigeration Economizer Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                                                           | Reference                                                 |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                                                                        |                                                           |
| Measure                                            | Coolers capable of drawing in outdoor air when it is sufficiently cool (temperatures less than 34°F or 1°C), rebated after installation. Outdoor air and exhaust dampers must close automatically for summer isolation | -                                                         |
| Baseline                                           | No economizer                                                                                                                                                                                                          | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                                                                        |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                                                                   | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                                                                                                                                                                                     | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                                                                        |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                                                          | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                                                                                                                    | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                                                          | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                                                      | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                                                      | See Subsection 5.9.1                                      |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for refrigeration economizer are calculated using the variables defined and listed in the equation and Table 262 below.

With fan control installed

$$\Delta kWh = (HP \times kWh_{cond}) + \left( (kW_{evap} \times n_{fans}) - kW_{circ} \right) \times HRS \times DC_{comp} \times BF - (kW_{econ} \times DC_{econ} \times HOU)$$

Without fan control installed

$$\Delta kWh = (HP \times kWh_{cond}) + (kW_{econ} \times DC_{econ} \times HOU)$$

**Table 262: Electrical Unitary Energy Savings Values for Refrigeration Economizers**

| Parameter                                                                                      | Symbol       | BER-AR, SBES                                                         | Reference                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------|--------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power of Compressor [HP]                                                                       | HP           | Actual                                                               | Use information in TS                                                                                                                                                                                 |
| Condensing Unit Savings, per hp [kWh]                                                          | kWhcond      | Hermetic / Semi-hermetic = 1,256<br>Scroll = 1,108<br>Discus = 1,051 | Vermont TRM, 2015 <sup>299</sup>                                                                                                                                                                      |
| Hours of Use [h/year]                                                                          | HOU          | 2,996                                                                | hrs based on 38F cooler setpoint, Burlington VT weather data, and 5 degree economizer deadband                                                                                                        |
| Duty Cycle of Compressor                                                                       | DCcomp       | 0.5                                                                  | Vermont TRM, 2015 <sup>300</sup>                                                                                                                                                                      |
| Connected Load of Each Evaporator Fan                                                          | kWevap       | 0.11                                                                 | Based on weighted average of 60% shaded pole at 132 Watts, and 20% PSC motors at 88 Watts, and 20% EC-motors at 62 Watts. This is based on Vermont's assumptions, with some adjustments for NS market |
| Connected Load of the Circulating Fan [kW]                                                     | kWcirc       | 0.035                                                                | Vermont TRM, 2015 <sup>301</sup>                                                                                                                                                                      |
| Number of Evaporator Fans                                                                      | nfans        | Actual                                                               | Use information in TS                                                                                                                                                                                 |
| Duty Cycle of the Economizer Fan on Days that Are Cool Enough for the Economizer to Be Working | DCecon       | 0.63                                                                 | Vermont TRM, 2015 <sup>302</sup>                                                                                                                                                                      |
| Bonus Factor for Reduced Cooling Load from Running the Evaporator Fan Less                     | BF           | 1.3                                                                  |                                                                                                                                                                                                       |
| Connected Load of the Circulating Fan [kW]                                                     | kWecon       | 0.227                                                                |                                                                                                                                                                                                       |
| Unitary Energy Savings [kWh/year]                                                              | $\Delta kWh$ | Calculation based on specification data for each rebated unit        | Calculation                                                                                                                                                                                           |

<sup>299</sup> Efficiency Vermont, *Technical reference User Manual*, March 16, 2015.

<sup>300</sup> Ibid.

<sup>301</sup> Ibid.

<sup>302</sup> Ibid.

## Unitary Peak Demand Savings

The unitary peak demand savings for refrigeration economizer are calculated using the variables defined and listed in the equation and Table 263 below, as well as variables from Table 262 above.

$$\Delta kW = \Delta kWh \times PCF / HOU$$

**Table 263: Unitary Peak Demand Savings Values for Refrigeration Economizers**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference            |
|---------------------------------|-------------|---------------------------------------------------------------|----------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | See Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation          |

## Installation Rates

Installation rates for refrigeration economizer are estimated at 100%.

## (9) Brushless DC Motors

### Summary

Table 264 presents a summary of the values used to calculate brushless DC motor savings for refrigeration applications. The detailed methodology follows.

**Table 264: Brushless DC Motor Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                   | Reference                                                 |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                |                                                           |
| Measure                                            | Brushless DC motors (or electrically commutated motors – ECM) for cooler of freezer evaporator fan, rebated after installation | -                                                         |
| Baseline                                           | Existing conventional shaded-pole motors                                                                                       |                                                           |
| General Parameters                                 |                                                                                                                                |                                                           |
| Installation Rate                                  | 100%                                                                                                                           | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                                                                                             | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                                                |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                  | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                            | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [kW]                   | Calculation based on specification data for each rebated unit                                                                  | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0%                                                                                                                             | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0%                                                                                                                             |                                                           |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for brushless DC motors are calculated using the variables defined and listed in the equation<sup>303</sup> and Table 265 below.

$$\Delta kWh = \left( \frac{kW_{output}}{\eta_{base}} - \frac{kW_{output}}{\eta_{ee}} \right) \times HOU \times DC \times LF \times \left( 1 + \frac{1}{COP} \right)$$

**Table 265: Electrical Unitary Energy Savings Values for Brushless DC Motors**

| Parameter                         | Symbol        | Value for BER-AR and SBES                                          | Reference                                |
|-----------------------------------|---------------|--------------------------------------------------------------------|------------------------------------------|
| Motor Output [kW]                 | kWoutput      | 0.015 for cases and 0.042 for walk-ins                             | Iowa TRM, 2023                           |
| Baseline Motor Efficiency [-]     | $\eta_{base}$ | Actual or 29%                                                      | DOE EERE, 2022 <sup>304</sup>            |
| Efficient Motor Efficiency [-]    | $\eta_{ee}$   | Actual or 66%                                                      | Iowa TRM, 2023                           |
| Hours of Use [hrs/year]           | HOU           | 8,760                                                              | Assumption based on continuous operation |
| Duty Cycle of a Fan Motor [-]     | DC            | 97.8%                                                              | The Cadmus Group, 2015 <sup>305</sup>    |
| Load Factor [-]                   | LF            | 90%                                                                | Iowa TRM, 2023                           |
| Coefficient of Performance [-]    | COP           | 3.5 for coolers<br>2.0 for freezers<br>2.5 for unknown cooler type | Iowa TRM, 2023                           |
| Unitary Energy Savings [kWh/year] | $\Delta kWh$  | Calculation based on specification data for each rebated unit      | Calculation                              |

## Unitary Peak Demand Savings

The unitary peak demand savings for brushless DC motors are calculated using the variables defined and listed in the equation and Table 266 below, as well as variables from Table 265 above.

$$\Delta kW = \left( \frac{kW_{output}}{\eta_{base}} - \frac{kW_{output}}{\eta_{ee}} \right) \times DC \times LF \times \left( 1 + \frac{1}{COP} \right) \times PCF$$

**Table 266: Unitary Peak Demand Savings Values for Brushless DC Motors**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference               |
|---------------------------------|-------------|---------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | As per Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation             |

<sup>303</sup> Iowa Utilities Board, Iowa Energy Efficiency Statewide Technical Reference Manual Version 8.0, Volume 3, July 2023, p. 388.

<sup>304</sup> Department of Energy – Office of Energy Efficiency and Renewable Energy, Technical Support Document: Energy Efficiency Program for Consumer Products and Commercial and Industrial Equipment: Commercial Refrigeration Equipment, June 2022, pp. 5-16.

<sup>305</sup> The Cadmus Group, Commercial Refrigeration Load Shape Project Final Report, Northeast Energy Efficiency Partnerships, Regional Evaluation, Measurement, and Verification Forum, Lexington, MA 2015, page 67, Table 34.

## (10) Refrigerated Vending Machine Controllers

### Summary

Table 267 presents a summary of the values used to calculate refrigerated vending machine controller savings. The detailed methodology follows.

**Table 267: Refrigerated Vending Machine Controller Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                       | Reference                                                 |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                    |                                                           |
| Measure                                            | Controller uses occupancy sensor based controls to de-energize refrigerated vending machines when the surrounding area is not occupied, rebated after installation | -                                                         |
| Baseline                                           | No occupancy sensor on refrigeration vending machine                                                                                                               | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                    |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                               | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 5                                                                                                                                                                  | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                    |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 1.0                                                                                                                                                                | As per Subsection 5.9.2                                   |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                  | See Subsection 5.9.1                                      |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                  | See Subsection 5.9.1                                      |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for refrigerated vending machine controllers are calculated using the variables defined and listed in the equation<sup>306</sup> and Table 268 below.

$$\Delta kWh = kW_{rated} \times HOU \times SAVE \times QTY$$

<sup>306</sup> Massachusetts, *Technical Reference User Manual (TRM) for Estimating Savings from Energy Efficiency Measures*, October 2012.



**Table 268: Electrical Unitary Energy Savings Values for Refrigerated Vending Machine Controllers**

| Parameter                                          | Symbol              | BER-AR, SBES                                                                             | Reference                              |
|----------------------------------------------------|---------------------|------------------------------------------------------------------------------------------|----------------------------------------|
| Rated Power of Connected Equipment [kW]            | kW <sub>rated</sub> | Actual                                                                                   | Use information in TS                  |
| Hours of Use [h/year]                              | HOU                 | Actual or 8,760                                                                          | Use information in TS                  |
| Percent Savings Factor for the Connected Equipment | SAVE                | Refrigerated beverage vending machines = 0.40<br>Glass front refrigerated coolers = 0.46 | Massachusetts TRM, 2012 <sup>307</sup> |
| Quantity of Vending Machines                       | QTY                 | Actual                                                                                   | Use information in TS                  |
| Unitary Energy Savings [kWh/year]                  | $\Delta kWh$        | Calculation based on specification data for each rebated unit                            | Calculation                            |

## Unitary Peak Demand Savings

The unitary peak demand savings for refrigerated vending machine controllers are calculated using the variables defined and listed in the equation and Table 269 below, as well as variables from Table 268 above.

$$\Delta kW = kW_{rated} \times SAVE \times QTY \times PCF$$

**Table 269: Unitary Peak Demand Savings Values for Refrigerated Vending Machine Controllers**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference               |
|---------------------------------|-------------|---------------------------------------------------------------|-------------------------|
| Peak Coincidence Factor         | PCF         | 1                                                             | As per Subsection 5.9.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation             |

## Installation Rates

Installation rates for refrigerated vending machine controllers are estimated at 100%.

## 5.10 Agriculture

### 5.10.1 Interactive Effects

Interactive effects are assumed to be nil for agriculture measures since they are usually located in spaces that are not heated or cooled electrically.

### 5.10.2 Peak Demand Savings Factors

For agriculture measures, peak demand savings are determined by multiplying the wattage by a PCF value of 84%, which was established as part of the 2015 evaluation of BER.<sup>308</sup>

<sup>307</sup> Mass Save, *Massachusetts Technical Reference Manual*, 2012.

<sup>308</sup> Econoler, *Business Energy Rebates 2015 DSM Evaluation*, Report presented to Efficiency Nova Scotia, 2016.

### 5.10.3 Adjustment Ratios

The adjustment ratios in Table 270 for were established as part of the 2022 can be extrapolated for all Agricultural measures in BER-AR. No adjustment ratios were calculated for SBES.

**Table 270: Agriculture Gross Savings Adjustments**

| Path and Measure Category                  | Energy Savings   |                 | Peak Demand Savings |                 |
|--------------------------------------------|------------------|-----------------|---------------------|-----------------|
|                                            | Adjustment Ratio | Margin of Error | Adjustment Ratio    | Margin of Error |
| <b>Projects Sampled in Project Reviews</b> |                  |                 |                     |                 |
| BER-AR Agriculture Measures                | 1.002            | 0.2%            | 1.039               | 4.0%            |

### 5.10.4 Agriculture Measures

#### (1) High Volume Low Speed Fans

##### Summary

Table 271 presents a summary of the values used to calculate high volume low speed fan savings. The detailed methodology follows.

**Table 271: High Volume Low Speed Fan Measure Summary**

| Parameter                                          | BER-AR                                                                                                    | SBES | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                           |      |                                                           |
| Measure                                            | CSA / cUL rated High Volume Low Speed (HVLS) fans for agricultural facilities, rebated after installation | -    |                                                           |
| Baseline                                           | Must replace existing circulation fans (unless building is new construction)                              | -    |                                                           |
| General Parameters                                 |                                                                                                           |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                             | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                     | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                                                     | -    |                                                           |
| Effective Useful Life [years]                      | 15                                                                                                        |      | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                           |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                             |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                                                                       |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                             |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                         |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                         |      | See Subsection 5.10.1                                     |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for high volume low speed fans are calculated using the variables defined and listed in the equation<sup>309</sup> and Table 272 below.

$$\Delta kWh = (P_b \times QTY_b - P_e \times QTY_e) \times HOU / 1,000$$

**Table 272: Electrical Unitary Energy Savings Values for High Volume Low Speed Fans**

| Parameter                         | Symbol           | BER-AR, SBES                                                                                                                 | Reference                                                                          |
|-----------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Power of the Baseline Fans [W]    | P <sub>b</sub>   | Actual or based on fan size (ft)<br>>= 16 and <18 = 4,497<br>>= 18 and <20 = 5,026<br>>= 20 and <24 = 5,555<br>>= 24 = 6,613 | Use information in TS<br>Default values from Pennsylvania TRM, 2019 <sup>310</sup> |
| Quantity of Baseline Fans         | QTY <sub>b</sub> | Actual or if not using actual fan power, assume QTY <sub>b</sub> is equal to QTY <sub>e</sub>                                | Use information in TS                                                              |
| HVLS Power Consumption, [W]       | P <sub>e</sub>   | Actual or based on fan size (ft)<br>>= 16 and <18 = 761<br>>= 18 and <20 = 850<br>>= 20 and <24 = 940<br>>= 24 = 1,119       | Use information in TS<br>Default values from Pennsylvania TRM, 2019                |
| Total Quantity of New HVLS Fans   | QTY <sub>e</sub> | Actual or if not using actual fan power, assume QTY <sub>b</sub> is equal to QTY <sub>e</sub>                                | Use information in TS                                                              |
| Hours of Use [h/year]             | HOU              | Actual or 2928                                                                                                               | Use information in TS                                                              |
| Unitary Energy Savings [kWh/year] | ΔkWh             | Calculation based on specification data for each rebated unit                                                                | Calculation                                                                        |

## Unitary Peak Demand Savings

The unitary peak demand savings for high volume low speed fans are calculated using the variables defined and listed in the equation and Table 273 below, as well as variables from Table 272 above.

$$\Delta kW = (P_b \times QTY_b - P_e \times QTY_e) \times PCF / 1000$$

**Table 273: Unitary Peak Demand Savings Values for High Volume Low Speed Fans**

| Parameter                       | Symbol | BER-AR, SBES                                                  | Reference                |
|---------------------------------|--------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF    | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | ΔkW    | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for high volume low speed fans in SBES are estimated at 100%.

<sup>309</sup> Pennsylvania PUC, *Technical Reference Manual (TRM) Volume 3*, August 2019.

<sup>310</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual Volume 3: Commercial and Industrial Measures*, April 2019, p.308.

## (2) Energy Efficient Ventilation and Circulation Fans

### Summary

Table 274 presents a summary of the values used to calculate energy efficient ventilation and circulation fan savings. The detailed methodology follows.

**Table 274: Energy Efficient Ventilation and Circulation Fan Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | SBES | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                                                           |
| Measure                                            | Ventilation Fan: BESS or AMCA listed rated High Efficiency Ventilation Fan (Exhaust or Supply Fan), rebated after installation, meeting minimum Efficiency:<br>14-23 inches = 11 Cfm/Watt<br>24-35 inches = 13 Cfm/Watt<br>36-47 inches = 18 Cfm/Watt<br>48+ inches = 21 Cfm/Watt<br><br>Circulation Fan: BESS or AMCA listed rated High Efficiency Circulation Fan, rebated after installation, meeting minimum Efficiency:<br>Diameter (Inches) Minimum Efficiency (Cfm/Watt)<br>18-35 inches = 13 Cfm/Watt<br>36-47 inches = 19 Cfm/Watt<br>48+ inches = 23 Cfm/Watt | -    |                                                           |
| Baseline                                           | Existing fan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -    |                                                           |
| General Parameters                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | -    |                                                           |
| Effective Useful Life [years]                      | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |      | See Subsection 6.2                                        |
| Electrical Savings Parameters                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      | See Subsection 5.10.1                                     |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for energy efficient ventilation & circulation fans are calculated using the variables defined and listed in the equation and Table 275 below.

$$\Delta kWh = \left( \frac{AF_b}{ER_b} \times Qty_b - \frac{AF_e}{ER_e} \times Qty_e \right) \times HOU / 1,000$$

**Table 275: Electrical Unitary Energy Savings Values for Energy Efficient Ventilation and Circulation Fans**

| Parameter                               | Symbol           | BER-AR, SBES                                                                            |                                                                                         | Reference                                                      |
|-----------------------------------------|------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------|
|                                         |                  | Ventilation Fan                                                                         | Circulation Fan                                                                         |                                                                |
| Airflow Produced by Baseline Fan [CFM]  | AF <sub>b</sub>  | Actual or assume same airflow as efficient measure                                      |                                                                                         | -                                                              |
| Airflow Produced by Efficient Fan [CFM] | AF <sub>e</sub>  | Actual                                                                                  |                                                                                         | Use information in TS                                          |
| Baseline Efficacy Ratio [CFM/W]         | ER <sub>b</sub>  | 14" = 9.07<br>16" = 9.26<br>20" = 9.59<br>24" = 10.71<br>36" = 15.05<br>≥48" = 18.36    | 18" = 9.08<br>20" = 10.33<br>24" = 11.14<br>30" = 11.75<br>36" = 16.39<br>≥48" = 19.96  | 2021 BESS Fan Performance Data <sup>311</sup>                  |
| Efficient Efficacy Ratio [CFM/W]        | ER <sub>e</sub>  | 14" = 11.30<br>16" = 12.27<br>20" = 12.43<br>24" = 15.12<br>36" = 20.20<br>≥48" = 24.44 | 18" = 15.97<br>20" = 16.14<br>24" = 14.76<br>30" = 14.59<br>36" = 21.58<br>≥48" = 25.67 | 2021 BESS Fan Performance Data <sup>312</sup>                  |
| Baseline Quantity                       | Qty <sub>b</sub> | Actual                                                                                  |                                                                                         | Use information in TS                                          |
| Efficient Quantity                      | Qty <sub>e</sub> | Actual                                                                                  |                                                                                         | Use information in TS                                          |
| Hours of Use [h/year]                   | HOU              | 12" - 16" = 8760<br>18" - 30" = 2804<br>36" - 54" = 2928                                |                                                                                         | IESO Prescriptive Measures and Assumptions 2024 <sup>313</sup> |
| Unitary Energy Savings [kWh/year]       | ΔkWh             | Calculation based on specification data for each rebated unit                           |                                                                                         | Calculation                                                    |

<sup>311</sup> Bioenvironmental and Structural Systems Laboratory, Agricultural Ventilation Fans, Performance and Efficiencies data, 2021. Retrieved from: <http://www.bess.illinois.edu/type.asp>

<sup>312</sup> Ibid.

<sup>313</sup> Independent Electrical System Operator, *IESO Prescriptive Measures and Assumptions List*, February 2024.

## Unitary Peak Demand Savings

The unitary peak demand savings for energy efficient ventilation & circulation fans are calculated using the variables defined and listed in the equation and Table 276 below, as well as variables from Table 275 above.

$$\Delta kW = \left( \frac{AF_b}{ER_b} \times Qty_b - \frac{AF_e}{ER_e} \times Qty_e \right) \times PCF / 1,000$$

**Table 276: Unitary Peak Demand Savings Values  
for Energy Efficient Ventilation and Circulation Fans**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for energy efficient ventilation & circulation fans in SBES are assumed to be 100%.

## (3) Dual and Natural Ventilation

### Summary

Table 277 presents a summary of the values used to calculate dual and natural ventilation savings. The detailed methodology follows.

**Table 277: Dual and Natural Ventilation Measure Summary**

| Parameter                              | BER-AR                                                                                                                                                                                                                                                                                                                                                                                                                                                 | SBES | Reference                                  |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------------------------|
| Measure Description and Identification |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                                            |
| Measure                                | Both natural and dual ventilation systems that meet the following criteria are eligible, rebated after installation:<br>- Natural Ventilation – No mechanical ventilation present. All ventilation provided by chimneys and sidewall openings (with curtains or panels)<br>- Dual Ventilation – Mechanical ventilation to modulate exhaust in winter months only<br>- Eligible facility types: dairy cows, swine, layers, broilers, turkeys, and sheep | -    |                                            |
| Baseline                               | No dual or natural ventilation                                                                                                                                                                                                                                                                                                                                                                                                                         | -    |                                            |
| General Parameters                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |      |                                            |
| Installation Rate                      | None, included in the adjustment ratios below                                                                                                                                                                                                                                                                                                                                                                                                          | 100% | See details below under Installation Rates |
| Energy Savings Adjustment Ratio        | 1.002                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -    | See Subsection 5.10.3                      |
| Peak Demand Savings Adjustment Ratio   | 1.039                                                                                                                                                                                                                                                                                                                                                                                                                                                  | -    |                                            |
| Effective Useful Life [years]          | 15                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      | See Subsection 6.2                         |

| Parameter                                          | BER-AR                                                        | SBES | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Electrical Savings Parameters</b>               |                                                               |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                           |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                             |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             |      | See Subsection 5.10.1                                     |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for dual & natural ventilation are calculated using the variables defined and listed in the equation and Table 278 below.

$$\Delta kWh = LC \times ARL \times \frac{1}{ER} \times SF \times HOU \times QTY / 1,000$$

**Table 278: Electrical Unitary Energy Savings Values for Dual and Natural Ventilation**

| Parameter                                                       | Symbol       | BER-AR, SBES                                                                                                                                                | Reference                                                                                                                                                      |
|-----------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Livestock Capacity (number of animals the barn is designed for) | LC           | Actual                                                                                                                                                      | Use information in TS                                                                                                                                          |
| Airflow Requirement per Livestock [cfm / livestock]             | ARL          | Dairy Year Round: 143<br>Dairy Winter Only: 62<br>Swine: 30.5<br>Broilers Layers: 4.275<br>Broilers Breeders: 5.4<br>Broilers Turkeys: 7.35<br>Sheep: 78.75 | Reference: Adapted from OPA TRM<br><a href="http://www.extension.purdue.edu/extmedia/ae/AE-96.html">http://www.extension.purdue.edu/extmedia/ae/AE-96.html</a> |
| Efficiency Ratio [cfm / Watt]                                   | ER           | 14                                                                                                                                                          | IESO Prescriptive Measures and Assumptions 2024 <sup>314</sup>                                                                                                 |
| Savings Factor                                                  | SF           | Natural ventilation SF = 1 and w/<br>Dual ventilation SF = 0.8                                                                                              |                                                                                                                                                                |
| Hours of Use [h/year]                                           | HOU          | Dairy Year Round: 8,760<br>Dairy Winter Only: 4,380<br>Swine: 8,760<br>Broilers: 8,760                                                                      |                                                                                                                                                                |
| Quantity                                                        | QTY          | Actual                                                                                                                                                      | Use information in TS                                                                                                                                          |
| Unitary Energy Savings [kWh/year]                               | $\Delta kWh$ | Calculation based on specification data for each rebated unit                                                                                               | Calculation                                                                                                                                                    |

<sup>314</sup>Independent Electrical System Operator, *IESO Prescriptive Measures and Assumptions List*, February 2024.

## Unitary Peak Demand Savings

The unitary peak demand savings for dual & natural ventilation are calculated using the variables defined and listed in the equation and Table 279 below, as well as variables from Table 278 above.

$$\Delta kW = LC \times ARL \times \frac{1}{ER} \times SF \times PCF \times QTY / 1,000$$

**Table 279: Unitary Peak Demand Savings Values for Dual and Natural Ventilation**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for dual & natural ventilation in SBES are assumed to be 100%.



## (4) Zero-energy and Low-energy Livestock Waterers

### Summary

Table 280 presents a summary of the values used to calculate zero-energy and low-energy livestock waterer savings. The detailed methodology follows.

**Table 280: Zero-energy and Low-energy Livestock Waterer Measure Summary**

| Parameter                                          | BER-AR                                                                                                                        | SBES | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                               |      |                                                           |
| Measure                                            | Must contain a minimum of 2 inches insulation and an adjustable thermostat and be CSA / cUL rated, rebated after installation | -    |                                                           |
| Baseline                                           | Existing waterer                                                                                                              | -    |                                                           |
| <b>General Parameters</b>                          |                                                                                                                               |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                 | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                         | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                                                                         | -    |                                                           |
| Effective Useful Life [years]                      | 10                                                                                                                            |      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                               |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                 |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                                                                                           |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                 |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                             |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                             |      | See Subsection 5.10.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for zero-energy & low-energy livestock waterers are calculated using the variables defined and listed in the equation and Table 281 below.

$$\Delta kWh = (P_b - P_e) * Qty * HOU / 1,000$$

**Table 281: Electrical Unitary Energy Savings Values for Zero-energy and Low-energy Livestock Waterers**

| Parameter                                          | Symbol         | BER-AR, SBES                                                  | Reference                                                                                                                         |
|----------------------------------------------------|----------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Wattage of the Heater in the Old Waterer           | P <sub>b</sub> | Actual or 800                                                 | Use information in TS<br><u>Default:</u> IESO Prescriptive Measures and Assumptions 2024 <sup>315</sup>                           |
| Wattage of the Heater in the New Efficient Waterer | P <sub>e</sub> | Actual<br>If no heater = 0                                    | Use information in TS                                                                                                             |
| Quantity                                           | Qty            | Actual                                                        | Use information in TS                                                                                                             |
| Hours of Use [h/year]                              | HOU            | Actual or 2,000                                               | Use information in TS<br><u>Default:</u> Conservative estimate for the number of hours where temperature is below 0 °C in Halifax |
| Unitary Energy Savings [kWh/year]                  | ΔkWh           | Calculation based on specification data for each rebated unit | Calculation                                                                                                                       |

## Unitary Peak Demand Savings

The unitary peak demand savings for zero-energy & low-energy livestock waterers are calculated using the variables defined and listed in the equation and Table 282 below, as well as variables from Table 281 above.

$$\Delta kW = (P_b - P_e) * Qty * PCF / 1,000$$

**Table 282: Unitary Peak Demand Savings Values for Zero-energy and Low-energy Livestock Waterers**

| Parameter                       | Symbol | BER-AR, SBES                                                  | Reference                |
|---------------------------------|--------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF    | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | ΔkW    | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for zero-energy and low-energy livestock waterers in SBES are assumed to be 100%.

<sup>315</sup>Independent Electrical System Operator, *IESO Prescriptive Measures and Assumptions List*, February 2024.

## (5) Agriculture Heat Pads

### Summary

Table 283 presents a summary of the values used to calculate agriculture heat pad savings. The detailed methodology follows.

**Table 283: Agriculture Heat Pad Measure Summary**

| Parameter                                          | BER-AR                                                            | SBES | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                   |      |                                                           |
| Measure                                            | CSA / cUL rated agricultural heat pad, rebated after installation | -    |                                                           |
| Baseline                                           | Incandescent heat lamps                                           | -    |                                                           |
| <b>General Parameters</b>                          |                                                                   |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                     | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                             | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                             | -    |                                                           |
| Effective Useful Life [years]                      | 10                                                                |      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                   |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit     |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                               |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit     |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                 |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                 |      | See Subsection 5.10.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for agriculture heat pads are calculated using the variables defined and listed in the equation and Table 284 below.

$$\Delta kWh = (P_b \times Qty_b - P_e \times Qty_e) \times HOU / 1,000$$

**Table 284: Electrical Unitary Energy Savings Values for Agriculture Heat Pads**

| Parameter                         | Symbol       | BER-AR, SBES                                                  | Reference                                                                                                                   |
|-----------------------------------|--------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Wattage of Inefficient Heat Lamps | Pb           | Actual or 175                                                 | Use information in TS<br><u>Default:</u> IESO Prescriptive Measures and Assumptions 2024 <sup>316</sup>                     |
| Baseline Quantity                 | Qtyb         | Actual                                                        | Use information in TS                                                                                                       |
| Wattage of Efficient Heat Pads    | Pe           | Actual or approximately 80 W for single heat pad              | Use information in TS<br><u>Default:</u> Assumption based on IESO Prescriptive Measures and Assumptions 2024 <sup>317</sup> |
| Efficient Quantity                | Qtye         | Actual                                                        | Use information in TS                                                                                                       |
| Hours of Use [h/year]             | HOU          | Actual or 6,900                                               | Use information in TS<br><u>Default:</u> IESO Prescriptive Measures and Assumptions 2024 <sup>318</sup>                     |
| Unitary Energy Savings [kWh/year] | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculation                                                                                                                 |

## Unitary Peak Demand Savings

The unitary peak demand savings for agriculture heat pads are calculated using the variables defined and listed in the equation and Table 285 below, as well as variables from Table 284 above.

$$\Delta kW = (P_b \times Qty_b - P_e \times Qty_e) \times PCF / 1,000$$

**Table 285: Unitary Peak Demand Savings Values for Agriculture Heat Pads**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for agriculture heat pads in SBES are assumed to be 100%.

<sup>316</sup>Independent Electrical System Operator, *IESO Prescriptive Measures and Assumptions List*, February 2024.

<sup>317</sup>Ibid.

<sup>318</sup>Ibid.

## (6) Tractor Engine Block Heater Timers

### Summary

Table 286 presents a summary of the values used to calculate tractor engine block heater timer savings. The detailed methodology follows.

**Table 286: Tractor Engine Block Heater Timer Measure Summary**

| Parameter                                          | BER-AR                                                                                                                                      | SBES | Reference                                                |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------|
| Measure Description and Identification             |                                                                                                                                             |      |                                                          |
| Measure                                            | Tractor engine block heater timer that controls an engine block heater of at least 400 W and is CSA / cUL rated, rebated after installation | -    |                                                          |
| Baseline                                           | No existing heater timer                                                                                                                    | -    |                                                          |
| General Parameters                                 |                                                                                                                                             |      |                                                          |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                                               | 100% | See details below under Installation Rates               |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                                                       | -    | See Subsection 5.10.3                                    |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                                                                                       | -    |                                                          |
| Effective Useful Life [years]                      | 5                                                                                                                                           |      | See Subsection 6.2                                       |
| Electrical Savings Parameters                      |                                                                                                                                             |      |                                                          |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                               |      | See details below under Electrical Unitary Energy Saving |
| Peak Coincidence Factor                            | 84%                                                                                                                                         |      | See Subsection 5.10.2                                    |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                               |      | See details below under Unitary Peak Demand Savings      |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                           |      | See Subsection 5.10.1                                    |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                           |      | See Subsection 5.10.1                                    |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for tractor engine block heater timers are calculated using the variables defined and listed in the equation and Table 287 below.

$$\Delta kWh = P_{heater} \times (HOU_b - HOU_e) \times DAYS / 1,000$$

**Table 287: Electrical Unitary Energy Savings Values for Tractor Engine Block Heater Timers**

| Parameter                                    | Symbol       | BER-AR, SBES                                                  | Reference                                                                 |
|----------------------------------------------|--------------|---------------------------------------------------------------|---------------------------------------------------------------------------|
| Power Consumption of Engine Block Heater [W] | $P_{heater}$ | Actual                                                        | Use information in TS                                                     |
| Baseline Hours of Use [h/day]                | $HOU_b$      | Actual or 10                                                  | Use information in TS<br><u>Default:</u> New York 2024 TRM <sup>319</sup> |
| Efficient Hours of Use [h/day]               | $HOU_e$      | Actual or 2                                                   | Use information in TS<br><u>Default:</u> New York 2024 TRM <sup>320</sup> |
| Days per Year that Heater Is Used            | DAYS         | Actual or 120                                                 | Use information in TS<br><u>Default:</u> No reference                     |
| Unitary Energy Savings [kWh/year]            | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculation                                                               |

## Unitary Peak Demand Savings

The unitary peak demand savings for tractor engine block heater timer are calculated using the variables defined and listed in the equation and Table 288 below, as well as variables from Table 287 above.

$$\Delta kW = P_{heater} \times PCF / 1,000$$

**Table 288: Unitary Peak Demand Savings Values for Tractor Engine Block Heater Timers**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for tractor engine block heater timer in SBES are assumed to be 100%.

<sup>319</sup> New York Department of Public Service, *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs - Residential, Multi-Family, and Commercial/Industrial Measures*, October 6, 2023, p. 429.

<sup>320</sup> New York Department of Public Service, *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs - Residential, Multi-Family, and Commercial/Industrial Measures*, October 6, 2023, p. 430.

## (7) Dairy Scroll Compressors

### Summary

Table 289 presents a summary of the values used to calculate dairy scroll compressor unit savings. The detailed methodology follows.

**Table 289: Dairy Scroll Compressor Measure Summary**

| Parameter                                          | BER-AR                                                                     | SBES | Reference                                                 |
|----------------------------------------------------|----------------------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                            |      |                                                           |
| Measure                                            | Dairy scroll compressor for milk refrigeration, rebated after installation | -    |                                                           |
| Baseline                                           | Reciprocating compressor                                                   | -    |                                                           |
| <b>General Parameters</b>                          |                                                                            |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                              | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                                      | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                      | -    |                                                           |
| Effective Useful Life [years]                      | 15                                                                         |      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                            |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit              |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                                        |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit              |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                          |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                          |      | See Subsection 5.10.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for dairy scroll compressors are calculated using the variables defined and listed in the equation<sup>321</sup> and Table 290 below.

$$\Delta kWh = \frac{\left( \frac{1}{EER_b} - \frac{1}{EER_e} \right) \times HOU \times DAYS \times COWS \times Lb_{milk} \times c_{p,milk} \times \Delta T}{1,000}$$

<sup>321</sup> Illinois Energy Efficiency, *Illinois Statewide Technical Reference Manual – Volume 2: Commercial and Industrial Measure*, September 22, 2023.

**Table 290: Electrical Unitary Energy Savings Values for Dairy Scroll Compressors**

| Parameter                                                  | Symbol       | BER-AR, SBES                                                    | Reference                                                                                        |
|------------------------------------------------------------|--------------|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Efficiency of Existing Compressor [Btu/h/W]                | $EER_b$      | Actual or 8.4                                                   | Use information in TS<br><u>Default:</u> Illinois TRM V12 <sup>322</sup>                         |
| Efficiency of Installed Compressor [Btu/h/W]               | $EER_e$      | Actual                                                          | Use information in TS                                                                            |
| Hours of Use [h/year]                                      | HOU          | Actual                                                          | Use information in TS                                                                            |
| Days per Year                                              | DAYS         | Actual                                                          | Use information in TS                                                                            |
| Average Number of Cows Milked per Day (excluding dry cows) | COWS         | Actual                                                          | Use information in TS                                                                            |
| Milk Weight [lb/cow/day]                                   | $Lb_{milk}$  | 52.2                                                            | Pennsylvania TRM 2021, <sup>323</sup> based on 6 gal per day per cow and a density of 8.7 lb/gal |
| Specific Heat of Milk [Btu/lb.°F]                          | $c_{p,milk}$ | 0.93                                                            | Convention                                                                                       |
| Change in Milk Temperature [°F]                            | $\Delta T$   | 59 = system with no pre-cooler<br>19 = system with a pre-cooler | Iowa 2023 TRM <sup>324</sup>                                                                     |
| Unitary Energy Savings [kWh/year]                          | $\Delta kWh$ | Calculation based on specification data for each rebated unit   | Calculation                                                                                      |

## Unitary Peak Demand Savings

The unitary peak demand savings for dairy scroll compressors are calculated using the variables defined and listed in the equation and Table 291 below, as well as variables from Table 290 above.

$$\Delta kW = (\Delta kWh / HOU) \times PCF$$

**Table 291: Unitary Peak Demand Savings Values for Dairy Scroll Compressors**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF         | Actual                                                        | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for dairy scroll compressors for SBES are assumed to be 100%.

<sup>322</sup> Illinois Energy Efficiency, *Illinois Statewide Technical Reference Manual – Volume 2: Commercial and Industrial Measure*, September 22, 2023.

<sup>323</sup> Pennsylvania PUC, *Technical Reference Manual Volume 3: Commercial and Industrial Measures*, February 2021.

<sup>324</sup> Iowa Energy Efficiency, *Iowa Energy Efficiency Statewide Technical Reference Manual Version 8.0 Volume 3*, July 31, 2023.



## (8) Heat Reclaimer Units

### Summary

Table 292 presents a summary of the values used to calculate heat reclaimer unit savings. The detailed methodology follows.

**Table 292: Heat Reclaimer Unit Measure Summary**

| Parameter                                          | BER-AR                                                                        | SBES | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                               |      |                                                           |
| Measure                                            | Heat reclaimer unit that electrically heats water, rebated after installation | -    |                                                           |
| Baseline                                           | No heat reclaimer                                                             | -    |                                                           |
| <b>General Parameters</b>                          |                                                                               |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                 | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                                         | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                         | -    |                                                           |
| Effective Useful Life [years]                      | 15                                                                            |      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                               |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                 |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                                           |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                 |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                             |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                             |      | See Subsection 5.10.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for heat reclaimer units are calculated using the variables defined and listed in the equation and Table 293 below.

$$\Delta kWh = COWS \times \frac{MILK}{COW} \times (U_{warm} - U_{cold}) \times \frac{1}{3,600} \times \frac{EFF_{hx}}{EFF_{wh}} * 1.0989$$

**Table 293: Electrical Unitary Energy Savings Values for Heat Reclaimer Units**

| Parameter                                                                               | Symbol       | BER-AR, SBES                                                                                                                                                                      | Reference                                                                                        |
|-----------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Average Number of Cows Milked per Day                                                   | COWS         | Actual                                                                                                                                                                            | Use information in TS                                                                            |
| Average Amount of Milk Yielded per Cow Annually [L/cow/year]                            | MILK/COW     | 8,030                                                                                                                                                                             | Agriculture and Agri-Food Canada <sup>325</sup><br>Massachusetts Farm Energy 2012 <sup>326</sup> |
| Internal Energy of Warm Milk                                                            | Uwarm        | Actual or<br>No pre-cooler and VSD milk transfer pump:<br>1,259.21<br>Pre-cooler but no VSD milk transfer pump:<br>1,178.53<br>Pre-cooler and VSD milk transfer pump:<br>1,150.29 |                                                                                                  |
| Internal Energy of Cooled Milk                                                          | Ucold        | 1,118.02                                                                                                                                                                          |                                                                                                  |
| kWh-to-kJ Conversion Factor (kWh/kJ)                                                    | -            | 1/3,600                                                                                                                                                                           | Convention                                                                                       |
| Efficiency of Heat Exchanger                                                            | EFFhx        | 0.4                                                                                                                                                                               | Massachusetts Farm Energy 2012 <sup>327</sup>                                                    |
| Efficiency of Water Heater                                                              | EFFwh        | Standard electric tank water heater = 0.908<br>High efficiency electric tank water heater = 0.93<br>Heat pump water heater = 2.0                                                  |                                                                                                  |
| Estimate of Additional Energy Savings Derived from Reduced Load on Refrigeration System | -            | 1.0989                                                                                                                                                                            |                                                                                                  |
| Hours of Use [h/year]                                                                   | HOU          | Actual or 2,920                                                                                                                                                                   | Use information in TS<br><u>Default:</u> New Jersey 2024 TRM <sup>328</sup>                      |
| Unitary Energy Savings [kWh/year]                                                       | $\Delta kWh$ | Calculation based on specification data for each rebated unit                                                                                                                     | Calculation                                                                                      |

## Unitary Peak Demand Savings

The unitary peak demand savings for heat reclaimer units are calculated using the variables defined and listed in the equation and Table 294 below, as well as variables from Table 293 above.

$$\Delta kW = (\Delta kWh / HOU) \times PCF$$

<sup>325</sup> Assuming 8,030 L based on Agriculture and Agri-Food Canada table. Government of Canada. *Average production per cow and breed for selected countries*. Retrieved from: <https://agriculture.canada.ca/en/sector/animal-industry/canadian-dairy-information-centre/statistics-market-information/dairy-animal-genetics/production-breed/per-cow> (last modified June 18, 2024).

<sup>326</sup> Massachusetts Farm Energy. *Best Management Practices for Dairy Farms*. (2012). Retrieved from: <https://massfarmenergy.com/wp-content/uploads/2014/03/Dairy%20Farms%20Best%20Practices.pdf>.

<sup>327</sup> Ibid.

<sup>328</sup> New Jersey's Clean Energy Program. *New Jersey 2023 Triennial Technical Reference Manual For 2024 Filings*, May 22, 2023, p. 260.

**Table 294: Unitary Peak Demand Savings Values for Heat Reclaimer Units**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-------------|---------------------------------------------------------------|--------------------------|
| Hours of Use [h/year]           | HOU         | Actual or 2,920                                               | Use information in TS    |
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for heat reclaimer units in SBES are assumed to be 100%.

## (9) Milk Pre-coolers

### Summary

Table 295 presents a summary of the values used to calculate milk pre-cooler savings. The detailed methodology follows.

**Table 295: Milk Pre-cooler Measure Summary**

| Parameter                                          | BER-AR                                                        | SBES | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |      |                                                           |
| Measure                                            | Milk pre-cooler, rebated after installation                   | -    |                                                           |
| Baseline                                           | No existing milk pre-cooler                                   | -    |                                                           |
| <b>General Parameters</b>                          |                                                               |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                 | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                         | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                         | -    |                                                           |
| Effective Useful Life [years]                      | 15                                                            |      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                           |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                             |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             |      | See Subsection 5.10.1                                     |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for milk pre-cooler are calculated using the variables defined and listed in the equation and Table 296 below.

$$\Delta kWh = COWS \times \frac{MILK}{COW} \times (T_{warm} - T_{cold}) \times \frac{1}{3,600} \times c \times \left(\frac{\rho}{COP}\right) \times QTY$$

**Table 296: Electrical Unitary Energy Savings Values for Milk Pre-Coolers**

| Parameter                                                    | Symbol       | BER-AR, SBES                                                                                                                              | Reference                                                                                                    |
|--------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Average Number of Cows Milked per Day                        | COWS         | Actual                                                                                                                                    | Use information in TS                                                                                        |
| Average Amount of Milk Yielded per Cow Annually [L/cow/year] | MILK/COW     | Actual or 8,030                                                                                                                           | Use information in TS<br>Default: Agriculture and Agri-Food Canada <sup>329</sup>                            |
| Temperature of Warm Milk [°C]                                | Twarm        | No pre-cooler and VSD milk transfer pump: 39<br>Pre-cooler but no VSD milk transfer pump: 19<br>Pre-cooler and VSD milk transfer pump: 12 | West et al. <sup>330</sup> , Farm Energy Nova Scotia <sup>331</sup> and Government of Alberta <sup>332</sup> |
| Temperature of Cooled Milk [°C]                              | Tcold        | Actual or 4                                                                                                                               | Use information in TS                                                                                        |
| kWh-to-kJ Conversion Factor [kWh/kJ]                         | -            | 1/3,600                                                                                                                                   | Convention                                                                                                   |
| Specific Heat Capacity of Milk [kg/kg.K]                     | c            | 3.9356                                                                                                                                    | Convention                                                                                                   |
| Density of Milk [kg/L]                                       | p            | 1.029                                                                                                                                     | Convention <sup>333</sup>                                                                                    |
| Coefficient of Performance for Refrigeration System          | COP          | Actual or 2.17                                                                                                                            | Use information in TS                                                                                        |
| Quantity                                                     | QTY          | Actual                                                                                                                                    | Use information in TS                                                                                        |
| Unitary Energy Savings [kWh/year]                            | $\Delta kWh$ | Calculation based on specification data for each rebated unit                                                                             | Calculation                                                                                                  |

## Unitary Peak Demand Savings

The unitary peak demand savings for milk pre-cooler are calculated using the variables defined and listed in the equation and Table 297 below, as well as variables from Table 296 above.

$$\Delta kW = (\Delta kWh/HOU) \times PCF$$

<sup>329</sup> Assuming 8,030 L based on Agriculture and Agri-Food Canada table. Government of Canada. *Average production per cow and breed for selected countries*. Retrieved from: <https://agriculture.canada.ca/en/sector/animal-industry/canadian-dairy-information-centre/statistics-market-information/dairy-animal-genetics/production-breed/per-cow> (last modified June 18, 2024).

<sup>330</sup> Assuming 39 °C as the start temperature. West, J.W., Mullinix, B.G., Bernard, J.K. (2003). *Effects of Hot, Humid Weather on Milk Temperature, Dry Matter Intake, and Milk Yield of Lactating Dairy Cows*. Retrieved from: <https://www.sciencedirect.com/science/article/pii/S0022030203736029>.

<sup>331</sup> Farm Energy Nova Scotia states a 65% drop in temperature when using a pre-cooler and VFD milk transfer pump, assuming a start temperature of 39 °C.

<sup>332</sup> Government of Alberta states a VFD milk transfer pump further decreases milk temperature by 8 to 11 °C. Government of Alberta. *Energy Efficiency on Dairy Farms*. Retrieved from: <https://open.alberta.ca/dataset/9f69749b-6b62-4474-8dfe-25e78986918a/resource/24dcf621-f817-460b-a7c1-760a0ef16e43/download/af-energy-efficiency-on-dairy-farms.pdf>.

<sup>333</sup> Based on conditions established in this study: Parmar, P., Lopez-Vallalobos, N., Tobin, J. T., Murphy, E., McDonagh, A., Crowley, S. V., Kelly, A. L., Shalloo, L. *The Effect of Compositional Changes Due to Seasonal Variation on Milk Density and the Determination of Season-Based Density Conversion Factors for Use in the Dairy Industry*. July 27, 2020. Retrieved from: <https://pubmed.ncbi.nlm.nih.gov/32726926/>.

**Table 297: Unitary Peak Demand Savings Values for Milk Pre-coolers**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                                                           |
|---------------------------------|-------------|---------------------------------------------------------------|---------------------------------------------------------------------|
| Hours of Use [h/year]           | HOU         | Actual or 2,920                                               | Use information in TS<br>Default: Minnesota 2025 TRM <sup>334</sup> |
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2                                            |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation                                                         |

## Installation Rates

Installation rates for milk pre-cooler in SBES are assumed to be 100%.

## (10) VFDs for Milk Vacuum Pumps

### Summary

Table 298 presents a summary of the values used to calculate VFD for milk vacuum pump savings. The detailed methodology follows.

**Table 298: VFD for Milk Vacuum Pump Measure Summary**

| Parameter                                          | BER-AR                                                                                | SBES | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                       |      |                                                           |
| Measure                                            | VFD for milk vacuum pump which must milk at least 50 cows, rebated after installation | -    |                                                           |
| Baseline                                           | No existing VFD                                                                       | -    |                                                           |
| <b>General Parameters</b>                          |                                                                                       |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                         | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                 | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                                 | -    |                                                           |
| Effective Useful Life [years]                      | 15                                                                                    |      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                       |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                         |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                                                   |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                         |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                     |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                     |      | See Subsection 5.10.1                                     |

<sup>334</sup> Minnesota Department of Commerce Division of Energy Resources, *State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 4.1*, January 31, 2024, p. 659.

## Electrical Unitary Energy Savings

The electrical unitary energy savings for VFD for milk vacuum pump are calculated using the variables defined and listed in the equation and Table 299 below.

$$\Delta kWh = \left( HP \times 0.746 \times \frac{1}{EFF_{motor}} \times LF \right) \times (1 - MSF) \times HOU$$

**Table 299: Electrical Unitary Energy Savings Values for Milk Vacuum Pumps**

| Parameter                          | Symbol               | BER-AR, SBES                                                                   | Reference             |
|------------------------------------|----------------------|--------------------------------------------------------------------------------|-----------------------|
| Horsepower of Connected Pump Motor | HP                   | Actual                                                                         | Use information in TS |
| Conversion from hp to kW           | -                    | 0.746                                                                          | Convention            |
| Efficiency of Connected Motor      | EFF <sub>motor</sub> | Actual or 0.91                                                                 | Use information in TS |
| Load Factor                        | LF                   | 1. Rotary vane (LF = 0.88)<br>2. Blower (LF = 0.92)                            | No reference          |
| Milking System Factor              | MSF                  | 1. Stanchion (MSF = 0.6)<br>2. Tie stall (MSF = 0.6)<br>3. Parlor (MSF = 0.45) | No reference          |
| Quantity                           | QTY                  | Actual                                                                         | Use information in TS |
| Hours of Use [h/year]              | HOU                  | Actual or 3,000                                                                | Use information in TS |
| Unitary Energy Savings [kWh/year]  | $\Delta kWh$         | Calculation based on specification data for each rebated unit                  | Calculation           |

## Unitary Peak Demand Savings

The unitary peak demand savings for VFD for milk vacuum pump are calculated using the variables defined and listed in the equation and Table 300 below, as well as variables from Table 299 above.

$$\Delta kW = \left( HP \times 0.746 \times \frac{1}{EFF_{motor}} \times LF \right) \times (1 - MSF) \times PCF$$

**Table 300: Unitary Peak Demand Savings Values for Milk Vacuum Pumps**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for VFD for milk vacuum pumps in SBES are assumed to be 100%.

## (11) VFD Milk Transfer Pumps

### Summary

Table 301 presents a summary of the values used to calculate VFD milk transfer pump savings. The detailed methodology follows.

**Table 301: VFD Milk Transfer Pump Measure Summary**

| Parameter                                          | BER-AR                                                                                                            | SBES | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                   |      |                                                           |
| Measure                                            | VFD for milk transfer pump with pre-cooler installed which must milk at least 75 cows, rebated after installation | -    |                                                           |
| Baseline                                           | No existing VFD                                                                                                   | -    |                                                           |
| <b>General Parameters</b>                          |                                                                                                                   |      |                                                           |
| Installation Rate                                  | None, included in the adjustment ratios below                                                                     | 100% | See details below under Installation Rates                |
| Energy Savings Adjustment Ratio                    | 1.002                                                                                                             | -    | See Subsection 5.10.3                                     |
| Peak Demand Savings Adjustment Ratio               | 1.039                                                                                                             | -    |                                                           |
| Effective Useful Life [years]                      | 15                                                                                                                |      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                   |      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                     |      | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 84%                                                                                                               |      | See Subsection 5.10.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                     |      | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                 |      | See Subsection 5.10.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                 |      | See Subsection 5.10.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for VFD milk transfer pump are calculated using the variables defined and listed in the equation and Table 302 below.

$$\Delta kWh = EF \times COWS$$

**Table 302: Electrical Unitary Energy Savings Values for VFD Milk Transfer Pumps**

| Parameter                                                                                | Symbol       | BER-AR, SBES                                                  | Reference                         |
|------------------------------------------------------------------------------------------|--------------|---------------------------------------------------------------|-----------------------------------|
| Energy Factor - Estimate of Energy Offset by Using VFD Milk Transfer Pump per Cow Milked | EF           | 33.945                                                        | Massachusetts Farm Energy Program |
| Average Number of Cows Milked per Day                                                    | COWS         | Actual                                                        | Use information in TS             |
| Unitary Energy Savings [kWh/year]                                                        | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculation                       |

## Unitary Peak Demand Savings

The unitary peak demand savings for VFD milk transfer pump are calculated using the variables defined and listed in the equation and Table 303 below, as well as variables from Table 302 above.

$$\Delta kW = (EF \times COWS \times PCF) / HOU$$

**Table 303: Unitary Peak Demand Savings Values for VFD Milk Transfer Pumps**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference                                                                  |
|---------------------------------|-------------|---------------------------------------------------------------|----------------------------------------------------------------------------|
| Peak Coincidence Factor         | PCF         | 0.84                                                          | As per Subsection 5.10.2                                                   |
| Hours of Use [h/year]           | HOU         | Actual or 2,920                                               | Use information in TS<br><u>Default:</u> Minnesota 2025 TRM <sup>335</sup> |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation                                                                |

## Installation Rates

Installation rates for VFD milk transfer pumps in SBES are assumed to be 100%.

### 5.11 Commercial Kitchen Equipment

#### 5.11.1 Interactive Effects

Interactive effects are assumed to be nil for kitchen measures since they are usually located in spaces that are not heated or cooled electrically.

#### 5.11.2 Peak Demand Savings Factor

For kitchen measures, peak demand savings are determined by multiplying the wattage by a PCF value of 68%, which was established as part of the 2015 evaluation of BER.<sup>336</sup> Freezers and refrigerators have a PCF of 100%

#### 5.11.3 Adjustment Ratios

For kitchen measures, no adjustment ratios were calculated.

<sup>335</sup> Minnesota Department of Commerce Division of Energy Resources, *State of Minnesota Technical Reference Manual for Energy Conservation Improvement Programs Version 4.1*, January 31, 2024, p. 667.

<sup>336</sup> Econoler, Business Energy Rebates 2015 DSM Evaluation, Report presented to Efficiency Nova Scotia, 2016.



## 5.11.4 Commercial Kitchen Measures

### (1) Dishwasher

#### Summary

Table 304 presents a summary of the values used to calculate electrical dishwasher savings. The detailed methodology follows.

**Table 304: Dishwasher Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                      | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                   |                                                           |
| Measure                                            | Low or high temperature ENERGY STAR® rated dishwasher, rebated after installation | -                                                         |
| Baseline                                           | Standard dishwasher                                                               | -                                                         |
| <b>General Parameters</b>                          |                                                                                   |                                                           |
| Installation Rate                                  | 100%                                                                              | See details below under Installation Rates                |
| Effective Useful Life [years]                      | Under-counter: 10<br>Door-type: 15<br>Conveyor: 20                                | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                     | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 68%                                                                               | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                     | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                                                 | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                 | See Subsection 5.11.1                                     |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for dishwashers are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 305 below.

**Table 305: Electrical Unitary Energy Savings Values for Dishwashers**

| Parameter                                                   | Symbol | BER-AR R, SBES                                                 | Reference                                 |
|-------------------------------------------------------------|--------|----------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                        | DAYS   | Actual                                                         | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                         | HOU    | Actual                                                         | Measure specific - use information in TS  |
| Racks Washed per Day                                        | -      | Actual                                                         | Measure specific - use information in TS  |
| Idle Energy Rate of Efficient Equipment [kW]                | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Water Use of Efficient Equipment [gallons/rack]             | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Typical Total Wash Time in Minutes                          | -      | Actual                                                         | Measure specific - use information in TS  |
| Water Heating Energy for Building Water Heater [kWh/gallon] | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Water Heating Energy for Booster Water Heater [kWh/gallon]  | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Savings [kWh]                                        | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator | ENERGY STAR Commercial Kitchen Calculator |

## Unitary Peak Demand Savings

The unitary peak demand savings for dishwashers are calculated using the variables defined and listed in the equation and Table 306 below, as well as variables from Table 305 above.

$$Peak\ Demand\ Savings_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 306: Unitary Peak Demand Savings Values for Dishwashers**

| Parameter                       | Symbol                       | BER-AR, SBES                                                  | Reference                |
|---------------------------------|------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                          | Actual or 0.68                                                | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | $Peak\ Demand\ Savings_{kW}$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for dishwashers are assumed to be 100%.

## (2) Freezers/Refrigerators

### Summary

Table 307 presents a summary of the values used to calculate electrical freezer/refrigerator savings. The detailed methodology follows.

**Table 307: Freezer/Refrigerator Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                      | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                   |                                                           |
| Measure                                            | ENERGY STAR® rated standalone refrigerator or freezer, rebated after installation | -                                                         |
| Baseline                                           | Standard refrigerator or freezer                                                  | -                                                         |
| <b>General Parameters</b>                          |                                                                                   |                                                           |
| Installation Rate                                  | 100%                                                                              | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                                                | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                     | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 100%                                                                              | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                     | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                                                 | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                 | See Subsection 5.11.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for freezers and refrigerators are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 308 below.

**Table 308: Electrical Unitary Energy Savings Values for Freezers/Refrigerators**

| Parameter                                                                  | Symbol | BER-AR R, SBES                                                 | Reference                                 |
|----------------------------------------------------------------------------|--------|----------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                                       | DAYS   | Actual                                                         | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                                        | HOU    | Actual                                                         | Measure specific - use information in TS  |
| Interior Volume [ft3]                                                      | -      | Actual                                                         | Measure specific - use information in TS  |
| Energy Use (or daily energy consumption) for Efficient Equipment [kWh/day] | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Savings [kWh]                                                       | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator | ENERGY STAR Commercial Kitchen Calculator |

## Unitary Peak Demand Savings

The unitary peak demand savings for freezer/refrigerator are calculated using the variables defined and listed in the equation and Table 309 below, as well as variables from Table 308 above.

$$\text{Peak Demand Savings}_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 309: Unitary Peak Demand Savings Values for Freezers/Refrigerators**

| Parameter                       | Symbol                                  | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-----------------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                                     | 1                                                             | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | <i>Peak Demand Savings<sub>kW</sub></i> | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for freezers/refrigerators are assumed to be 100%.

### (3) Fryer

#### Summary

Table 310 presents a summary of the values used to calculate electrical fryer savings. The detailed methodology follows.

**Table 310: Fryer Measure Summary**

| Parameter                                          | BER-AR, SBES                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |                                                           |
| Measure                                            | ENERGY STAR® rated fryer, rebated after installation          | -                                                         |
| Baseline                                           | Standard electric fryer                                       | -                                                         |
| <b>General Parameters</b>                          |                                                               |                                                           |
| Installation Rate                                  | 100%                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                            | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 68%                                                           | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                             | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             | See Subsection 5.11.1                                     |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for fryers are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 311 below.

**Table 311: Electrical Unitary Energy Savings Values for Fryers**

| Parameter                                                                      | Symbol | BER-AR R, SBES                                                 | Reference                                 |
|--------------------------------------------------------------------------------|--------|----------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                                           | DAYS   | Actual                                                         | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                                            | HOU    | Actual                                                         | Measure specific - use information in TS  |
| Size of Fryer                                                                  | -      | Actual (options are standard or large)                         | Measure specific - use information in TS  |
| Food Cooked per Day [pounds]<br>Pro-rate Based on HRS (if HRS do not equal 16) | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Shortening Capacity [lbs]                                                      | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Cooking Energy Efficiency of Efficient Fryer [%]                               | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Use (or idle energy rate) of Efficient Fryer [Btu/hr]                   | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Savings [kWh]                                                           | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator | ENERGY STAR Commercial Kitchen Calculator |

## Unitary Peak Demand Savings

The unitary peak demand savings for fryers are calculated using the variables defined and listed in the equation and Table 312 below, as well as variables from Table 311 above.

$$Peak\ Demand\ Savings_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 312: Unitary Peak Demand Savings Values for Fryers**

| Parameter                       | Symbol                       | BER-AR, SBES                                                  | Reference                |
|---------------------------------|------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                          | Actual or 0.68                                                | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | $Peak\ Demand\ Savings_{kW}$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for fryers are assumed to be 100%.

## (4) Griddles

### Summary

Table 313 presents a summary of the values used to calculate electrical griddles savings. The detailed methodology follows.

**Table 313: Griddle Measure Summary**

| Parameter                                          | BER-AR, SBES                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |                                                           |
| Measure                                            | ENERGY STAR® rated griddle, rebated after installation        | -                                                         |
| Baseline                                           | Standard electric griddle                                     | -                                                         |
| <b>General Parameters</b>                          |                                                               |                                                           |
| Installation Rate                                  | 100%                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                            | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 68%                                                           | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                             | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             | See Subsection 5.11.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for griddles are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 314 below.

**Table 314: Electrical Unitary Energy Savings Values for Griddles**

| Parameter                                                                      | Symbol | BER-AR R, SBES                                                 | Reference                                 |
|--------------------------------------------------------------------------------|--------|----------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                                           | DAYS   | Actual                                                         | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                                            | HOU    | Actual                                                         | Measure specific - use information in TS  |
| Width of Griddle [ft]                                                          | -      | Actual                                                         | Measure specific - use information in TS  |
| Depth of Griddle [ft]                                                          | -      | Actual                                                         | Measure specific - use information in TS  |
| Food Cooked per Day [pounds]<br>Pro-rate Based on HRS (if HRS do not equal 12) | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Cooking Energy Efficiency of Efficient Griddle [%]                             | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Use (or normalized idle energy) of Efficient Griddle [Btu/hr/sqft]      | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Savings [kWh]                                                           | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator | ENERGY STAR Commercial Kitchen Calculator |

## Unitary Peak Demand Savings

The unitary peak demand savings for griddles are calculated using the variables defined and listed in the equation and Table 315 below, as well as variables from Table 314 above.

$$Peak\ Demand\ Savings_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 315: Unitary Peak Demand Savings Values for Griddles**

| Parameter                       | Symbol                                  | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-----------------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                                     | Actual or 0.68                                                | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | <i>Peak Demand Savings<sub>kW</sub></i> | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for griddles are assumed to be 100%.

## (5) Hot Food Holding Cabinets

### Summary

Table 316 presents a summary of the values used to calculate electrical hot food holding cabinets savings. The detailed methodology follows.

**Table 316: Hot Food Holding Cabinet Measure Summary**

| Parameter                                          | BER-AR, SBES                                                            | Reference                                                 |
|----------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                         |                                                           |
| Measure                                            | ENERGY STAR® rated hot food holding cabinet, rebated after installation | -                                                         |
| Baseline                                           | Standard hot food holding cabinet                                       | -                                                         |
| <b>General Parameters</b>                          |                                                                         |                                                           |
| Installation Rate                                  | 100%                                                                    | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                                      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                         |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit           | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 68%                                                                     | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit           | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                                       | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                       | See Subsection 5.11.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for hot food holding cabinets are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 317 below.

**Table 317: Electrical Unitary Energy Savings Values for Hot Food Holding Cabinets**

| Parameter                                                                                                                                | Symbol | BER-AR R, SBES                                                 | Reference                                 |
|------------------------------------------------------------------------------------------------------------------------------------------|--------|----------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                                                                                                     | DAYS   | Actual                                                         | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                                                                                                      | HOU    | Actual                                                         | Measure specific - use information in TS  |
| Interior Volume [ft³]                                                                                                                    | -      | Actual                                                         | Measure specific - use information in TS  |
| The Rate of Energy Consumption While it Is Maintaining or Holding at the Control Setpoint Without Using a Humidity-generating Device [W] | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Savings [kWh]                                                                                                                     | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator | ENERGY STAR Commercial Kitchen Calculator |



## Unitary Peak Demand Savings

The unitary peak demand savings for hot food holding cabinets are calculated using the variables defined and listed in the equation and Table 318 below, as well as variables from Table 317 above.

$$\text{Peak Demand Savings}_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 318: Unitary Peak Demand Savings Values for Hot Food Holding Cabinets**

| Parameter                       | Symbol                                  | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-----------------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                                     | Actual or 0.68                                                | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | <i>Peak Demand Savings<sub>kW</sub></i> | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for hot food holding cabinets are assumed to be 100%.

## (6) Ice Machines

### Summary

Table 319 presents a summary of the values used to calculate electrical ice machines savings. The detailed methodology follows.

**Table 319: Ice Machine Measure Summary**

| Parameter                                          | BER-AR, SBES                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |                                                           |
| Measure                                            | ENERGY STAR® rated ice machine, rebated after installation    | -                                                         |
| Baseline                                           | Standard ice machine                                          | -                                                         |
| <b>General Parameters</b>                          |                                                               |                                                           |
| Installation Rate                                  | 100%                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 10                                                            | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 68%                                                           | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                             | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             | See Subsection 5.11.1                                     |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for ice machines are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 320 below.

**Table 320: Electrical Unitary Energy Savings Values for Ice Machines**

| Parameter                                                                                                  | Symbol | BER-AR R, SBES                                                                                                                                | Reference                                 |
|------------------------------------------------------------------------------------------------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                                                                       | DAYS   | Actual                                                                                                                                        | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                                                                        | HOU    | Actual                                                                                                                                        | Measure specific - use information in TS  |
| The Type of Equipment Category the Ice Maker Falls into                                                    | -      | Actual<br>The three categories are:<br>Ice-making heat (IMH)<br>Remote condensing unit (RCU)<br>Split system unit / self-contained unit (SCU) | Measure specific - use information in TS  |
| The Type of Ice the Ice Maker Produces                                                                     | -      | Actual (Options: batch or continuous)                                                                                                         | Measure specific - use information in TS  |
| Harvest Rate - the Gross Weight of Ice Harvested in a 24-hour Period for Efficient Ice Maker [lbs ice/day] | -      | Actual or ENERGY STAR default                                                                                                                 | Measure specific - use information in TS  |
| The Measured Energy Use (or energy consumption rate) for the Efficient Ice Maker [kWh / 100 lbs]           | -      | Actual or ENERGY STAR default                                                                                                                 | Measure specific - use information in TS  |
| Energy Savings [kWh]                                                                                       | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator                                                                                | ENERGY STAR Commercial Kitchen Calculator |

## Unitary Peak Demand Savings

The unitary peak demand savings for ice machines are calculated using the variables defined and listed in the equation and Table 321 below, as well as variables from Table 320 above.

$$Peak\ Demand\ Savings_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 321: Unitary Peak Demand Savings Values for Ice Machines**

| Parameter                       | Symbol                       | BER-AR, SBES                                                  | Reference                |
|---------------------------------|------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                          | Actual or 0.68                                                | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | $Peak\ Demand\ Savings_{kW}$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for ice machines are assumed to be 100%.

## (7) Ovens

### Summary

Table 322 presents a summary of the values used to calculate electrical ovens savings. The detailed methodology follows.

**Table 322: Oven Measure Summary**

| Parameter                                          | BER-AR, SBES                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |                                                           |
| Measure                                            | ENERGY STAR® rated oven, rebated after installation           | -                                                         |
| Baseline                                           | Standard oven                                                 | -                                                         |
| <b>General Parameters</b>                          |                                                               |                                                           |
| Installation Rate                                  | 100%                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                            | See Subsection 3.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 68%                                                           | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                             | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             | See Subsection 5.11.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for ovens are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 323 below.

**Table 323: Electrical Unitary Energy Savings Values for Ovens**

| Parameter                                                                       | Symbol | BER-AR R, SBES                                                 | Reference                                 |
|---------------------------------------------------------------------------------|--------|----------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                                            | DAYS   | Actual                                                         | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                                             | HOU    | Actual                                                         | Measure specific - use information in TS  |
| Size                                                                            | -      | Actual (FULL size or HALF size)                                | Measure specific - use information in TS  |
| The Number of Pans a Combination Oven Can Accommodate                           | -      | Actual or ENERGY STAR default (N/A for convection ovens)       | Measure specific - use information in TS  |
| Food Cooked per Day [pounds]<br>Pro-rate Based on HRS (if HRS do not equal 12). | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Cooking Energy Efficiency of Efficient Oven (CEE)                               | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Production Capacity of Efficient Oven [lbs/hr]                                  | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Idle Energy Rate of Efficient Oven [Watts]                                      | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Savings [kWh]                                                            | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator | ENERGY STAR Commercial Kitchen Calculator |

## Unitary Peak Demand Savings

The unitary peak demand savings for ovens are calculated using the variables defined and listed in the equation and Table 324 below, as well as variables from Table 323 above.

$$Peak\ Demand\ Savings_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 324: Unitary Peak Demand Savings Values for Ovens**

| Parameter                       | Symbol                       | BER-AR, SBES                                                  | Reference                |
|---------------------------------|------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                          | Actual or 0.68                                                | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | $Peak\ Demand\ Savings_{kW}$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for ovens are assumed to be 100%.

## (8) Steam Cookers

### Summary

Table 325 presents a summary of the values used to calculate electrical steam cooker savings. The detailed methodology follows.

**Table 325: Steam Cooker Measure Summary**

| Parameter                                          | BER-AR, SBES                                                  | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                               |                                                           |
| Measure                                            | ENERGY STAR® rated steam cooker, rebated after installation   | -                                                         |
| Baseline                                           | Standard steam cooker                                         | -                                                         |
| <b>General Parameters</b>                          |                                                               |                                                           |
| Installation Rate                                  | 100%                                                          | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                            | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                               |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 68%                                                           | See Subsection 5.11.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                             | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                             | See Subsection 5.11.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for steam cookers are calculated using the ENERGY STAR Commercial Kitchen Calculator using the parameters in Table 326 below.

**Table 326: Electrical Unitary Savings Values for Steam Cookers**

| Parameter                                                                       | Symbol | BER-AR R, SBES                                                 | Reference                                 |
|---------------------------------------------------------------------------------|--------|----------------------------------------------------------------|-------------------------------------------|
| Annual Days of Operation [days/year]                                            | DAYS   | Actual                                                         | Measure specific - use information in TS  |
| Average Daily Operation [hours/day]                                             | HOU    | Actual                                                         | Measure specific - use information in TS  |
| Type of Steam                                                                   | -      | Actual (steam generator, boilerless, boiler based)             | Measure specific - use information in TS  |
| The Maximum Number of Full-sized Pans                                           | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Food Cooked per Day [pounds]<br>Pro-rate Based on HRS (if HRS do not equal 12). | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Cooking Energy Efficiency of Efficient Steam Cooker (CEE)                       | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Idle Energy Rate of Efficient Oven [Watts]                                      | -      | Actual or ENERGY STAR default                                  | Measure specific - use information in TS  |
| Energy Savings [kWh]                                                            | ES     | Calculated using the ENERGY STAR Commercial Kitchen Calculator | ENERGY STAR Commercial Kitchen Calculator |

## Unitary Peak Demand Savings

The unitary peak demand savings for steam cookers are calculated using the variables defined and listed in the equation and Table 327 below, as well as variables from Table 326 above.

$$Peak\ Demand\ Savings_{kW} = (ES \times PCF) / (HOU \times DAYS)$$

**Table 327: Unitary Peak Demand Savings Values for Steam Cookers**

| Parameter                       | Symbol                                  | BER-AR, SBES                                                  | Reference                |
|---------------------------------|-----------------------------------------|---------------------------------------------------------------|--------------------------|
| Peak Coincidence Factor         | PCF                                     | Actual or 0.68                                                | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | <i>Peak Demand Savings<sub>kW</sub></i> | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for steam cookers are assumed to be 100%.

## 5.12 Commercial Laundry Equipment

### 5.12.1 Interactive Effects

Interactive effects are assumed to be nil for laundry measures since they usually exhaust heat through outdoor vents and drain water.

## 5.12.2 Peak Demand Savings Factor

For laundry measures, peak demand savings are determined by multiplying the wattage by a PCF value of 34%, which was established as part of the 2015 evaluation of BER.<sup>337</sup>

## 5.12.3 Adjustment Ratios

For laundry measures, no adjustment ratios were calculated.

## 5.12.4 Commercial Laundry Measures

### (9) Commercial Washing Machines

#### Summary

Table 328 presents a summary of the values used to calculate commercial washing machine savings. The detailed methodology follows.

**Table 328: Commercial Washing Machine Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                            | Reference                                                 |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                         |                                                           |
| Measure                                            | ENERGY STAR® rated commercial washing machine used for commercial purposes, rebated after installation<br>• Building must use electrically heated water | -                                                         |
| Baseline                                           | Washing machine meeting Canadian minimum standards                                                                                                      | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                         |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                    | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 11                                                                                                                                                      | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                         |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                           | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 34%                                                                                                                                                     | See Subsection 5.12.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                           | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                       | See Subsection 5.12.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                       | See Subsection 5.12.1                                     |

<sup>337</sup> Econoler, Business Energy Rebates 2015 DSM Evaluation, Report presented to Efficiency Nova Scotia, 2016.

## Electrical Unitary Energy Savings

The electrical unitary energy savings for commercial washing machine are calculated using the variables defined and listed in the equation and Table 329 below.

$$\Delta kWh = \left( \frac{1}{MEF_b} - \frac{1}{MEF_e} \right) \times CAP \times LOADS \times QTY$$

**Table 329: Electrical Unitary Energy Savings Values for Commercial Washing Machines**

| Parameter                                               | Symbol           | BER-AR, SBES                                                                               | Reference                                                       |
|---------------------------------------------------------|------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| Modified Energy Factor of Baseline Equipment [ft3/kWh]  | MEF <sub>b</sub> | 1.26                                                                                       | Canadian Min. Efficiency per EEA, compliance date - Jan 1, 2007 |
| Modified Energy Factor of Efficient Equipment [ft3/kWh] | MEF <sub>e</sub> | CEE Tier MEF <sub>e</sub><br>Tier 1 1.8<br>Tier 2 2.0<br>Tier 3 2.2                        | ENERGY STAR Commercial Clothes Washer Savings Calculator        |
| Equipment Capacity [ft3]                                | CAP              | Actual or 3                                                                                | Use information in TS<br>Based on manufacturer research         |
| Number of Loads Run per Year                            | LOADS            | Multi-unit Residential 1,095 <sup>338</sup><br>Laundromats 2,190<br>Weighted Average 1,314 | ENERGY STAR Commercial Clothes Washer Savings Calculator        |
| Quantity of Washing Machines                            | QTY              | Actual                                                                                     | Use information in TS                                           |
| Unitary Energy Savings [kWh/year]                       | $\Delta kWh$     | Calculation based on specification data for each rebated unit                              | Calculation                                                     |

## Unitary Peak Demand Savings

The unitary peak demand savings for commercial washing machine are calculated using the variables defined and listed in the equation and Table 330 below, as well as variables from Table 329 above.

$$\Delta kW = \left( \frac{1}{MEF_b} - \frac{1}{MEF_e} \right) \times CAP \times LOADS \times QTY \times RUNTIME \times \frac{1}{LOADS} \times PCF$$

**Table 330: Unitary Peak Demand Savings Values for Commercial Washing Machines**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference             |
|---------------------------------|-------------|---------------------------------------------------------------|-----------------------|
| Length of Average Cycle [h]     | RUNTIME     | Actual or 1                                                   | Use information in TS |
| Peak Coincidence Factor         | PCF         | 0.34                                                          | See Subsection 5.12.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation           |

## Installation Rates

Installation rates for commercial washing machine are assumed to be 100%.

<sup>338</sup> According to E1's current version of the ENERGY STAR Commercial Clothes Washer Savings Calculator, the default number of loads for Multi-unit Residential is now 1,241.



## (10) Commercial Heat Pump Clothes Dryers

### Summary

Table 331 presents a summary of the values used to calculate commercial heat pump clothes dryers savings. The detailed methodology follows.

**Table 331: Commercial Heat Pump Clothes Dryer Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                                                                                                                                           | Reference                                                 |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                                                                                                                                                        |                                                           |
| Measure                                            | Commercial heat pump clothes dryer meeting a minimum Combined Energy Factor (CEF) of 4.5, rebated after installation <ul style="list-style-type: none"> <li>ENERGY STAR® rated</li> <li>Used for commercial purpose (units installed in individual apartments are not eligible for rebates)</li> </ul> | -                                                         |
| Baseline                                           | Standard electric commercial clothes dryer                                                                                                                                                                                                                                                             | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                                                                                                                                                        |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                                                                                                                                                   | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 12                                                                                                                                                                                                                                                                                                     | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                                                                                                                                                        |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                          | See details below under Electrical Unitary Energy Savings |
| Peak Coincidence Factor                            | 34%                                                                                                                                                                                                                                                                                                    | See Subsection 5.12.2                                     |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                                                                                                                                          | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                                                                                                                                      | See Subsection 5.12.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                                                                                                                                      | See Subsection 5.12.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for commercial heat pump clothes dryers are calculated using the variables defined and listed in the equation<sup>339</sup> and Table 332 below.

$$\Delta kWh = QTY \times C_{dry} \times Load_{avg} \times \left( \frac{1}{CEF_{base}} - \frac{1}{CEF_{ee}} \right)$$

<sup>339</sup> Efficiency Vermont, *Technical Reference User Manual Measure Savings Algorithms and Cost Assumptions*, March 2015.

**Table 332: Electrical Unitary Energy Savings Values for Commercial Heat Pump Clothes Dryers**

| Parameter                         | Symbol       | BER-AR, SBES                                                                                                                                                                      | Reference                        |
|-----------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Quantity                          | QTY          | Actual                                                                                                                                                                            | Use information in TS            |
| Loads per Year                    | Cdry         | Multi-unit Residential 1,095<br>Laundromats 2,190<br>Weighted Average 1,314                                                                                                       | CEE                              |
| Average Load                      | LoadAvg      | 8.45 lbs/load (standard) and 3.0 lbs/load (compact)                                                                                                                               | Vermont TRM, 2015 <sup>340</sup> |
| CEF for Baseline                  | CEFbase      | Actual or<br>Standard clothes dryer (≥ 125-litre capacity) 2.51<br>120V Compact clothes dryer (<125-litre capacity) 2.61<br>240V Compact clothes dryer (<125-litre capacity) 2.42 | Vermont 2015 TRM                 |
| CEF for Efficient Equipment       | CEFee        | Actual                                                                                                                                                                            | Use information in TS            |
| Unitary Energy Savings [kWh/year] | $\Delta kWh$ | Calculation based on specification data for each rebated unit                                                                                                                     | Calculation                      |

## Unitary Peak Demand Savings

The unitary peak demand savings for commercial heat pump clothes dryers are calculated using the variables defined and listed in the equation and Table 333 below, as well as variables from Table 332 above.

$$\Delta kW = \frac{Load_{avg} \times \left( \frac{1}{CEF_{base}} - \frac{1}{CEF_{ee}} \right)}{time_{cycle}} \times PCF \times QTY$$

**Table 333: Unitary Peak Demand Savings Values for Commercial Heat Pump Clothes Dryers**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference             |
|---------------------------------|-------------|---------------------------------------------------------------|-----------------------|
| Time Cycle                      | timecycle   | 1                                                             | Vermont 2015 TRM      |
| Peak Coincidence Factor         | PCF         | Actual or 0.34                                                | See Subsection 5.12.2 |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation           |

## Installation Rates

Installation rates for commercial heat pump clothes dryers are assumed to be 100%.

<sup>340</sup> Efficiency Vermont, *Technical reference User Manual*, March 16, 2015.

## (11) Demand Controlled Kitchen Exhaust

### Summary

Table 334 presents a summary of the values used to calculate electrical demand-controlled kitchen exhaust savings. The detailed methodology follows.

**Table 334: Demand Controlled Kitchen Exhaust Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                         | Reference                                                 |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                      |                                                           |
| Measure                                            | Controlled by temperature and/or optical sensors located in exhaust hood, rebated after installation | -                                                         |
| Baseline                                           | No DCV                                                                                               | -                                                         |
| <b>General Parameters</b>                          |                                                                                                      |                                                           |
| Installation Rate                                  | 100%                                                                                                 | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 15                                                                                                   | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                      |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                        | See details below under Electrical Unitary Energy Savings |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                        | See details below under Electrical Unitary Energy Savings |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                    | See Subsection 5.11.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                    | See Subsection 5.11.1                                     |

### Electrical Unitary Energy Savings

The electrical unitary energy savings for demand-controlled kitchen exhaust are calculated using the variables defined and listed in the equation and Table 335 below.

$$\text{Energy Savings}_{kWh} = \text{ESVG} \times \text{HP}$$

**Table 335: Electrical Unitary Energy Savings Values for Demand Controlled Kitchen Exhaust**

| Parameter                                           | Symbol                        | BER-AR R, SBES                                                   | Reference                            |
|-----------------------------------------------------|-------------------------------|------------------------------------------------------------------|--------------------------------------|
| Energy Savings Factor [kWh/hp]                      | ESVG                          | 4,486                                                            | Pennsylvania TRM 2016 <sup>341</sup> |
| Total Horsepower of Motor Controlled (exhaust only) | HP                            | Actual                                                           | Pennsylvania TRM 2016                |
| Unitary Energy Savings [kWh/year]                   | $\text{Energy Savings}_{kWh}$ | Calculated based on specification data for each installed system | Calculation                          |

<sup>341</sup> Pennsylvania Public Utility Commission, *Technical Reference Manual – State of Pennsylvania*, 2016.

## Unitary Peak Demand Savings

The unitary peak demand savings for demand controlled kitchen exhaust are calculated using the variables defined and listed in the equation and Table 336 below, as well as variables from Table 335 above.

$$\text{Peak Demand Savings}_{kW} = \text{DSVG} \times \text{PCF} \times \text{HP}$$

**Table 336: Unitary Peak Demand Savings Values for Demand Controlled Kitchen Exhaust**

| Parameter                       | Symbol                     | BER-AR, SBES                                                  | Reference                |
|---------------------------------|----------------------------|---------------------------------------------------------------|--------------------------|
| Demand Savings Factor (kW/hp)   | DSVG                       | 0.76                                                          | Pennsylvania TRM 2016    |
| Peak Coincidence Factor         | PCF                        | 0.68                                                          | As per Subsection 5.11.2 |
| Unitary Peak Demand Savings [W] | <i>Peak Demand Savings</i> | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for demand-controlled kitchen exhaust are assumed to be 100%.

## 5.13 Commercial IT and Datacentres

### 5.13.1 Interactive Effects

Interactive effects factors are not included in commercial IT and datacentre measures.

### 5.13.2 Peak Demand Savings Factor

No standard PCF values have been determined for commercial IT and datacentre measures.

### 5.13.3 Adjustment Ratios

For IT and datacentres measures, no adjustment ratios were calculated.

## 5.13.4 Commercial IT and Datacentres

### (1) Server-based Power Management Software

#### Summary

Table 337 presents a summary of the values used to calculate server-based power management software savings. The detailed methodology follows.

**Table 337: Server-based Power Management Software Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                                                                                                      | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                                                                                                   |                                                           |
| Measure                                            | Power management utility must be network-based, rebated after installation<br>• Must enable both monitor shut-down as well as computer sleep mode within 30 minutes of inactivity | -                                                         |
| Baseline                                           | No network-based management system                                                                                                                                                | -                                                         |
| <b>General Parameters</b>                          |                                                                                                                                                                                   |                                                           |
| Installation Rate                                  | 100%                                                                                                                                                                              | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 5                                                                                                                                                                                 | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                                                                                                   |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                                                                                                     | See details below under Electrical Unitary Energy Savings |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                                                                                                     | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                                                                                                 | See Subsection 5.13.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                                                                                                 | See Subsection 5.13.1                                     |

#### Electrical Unitary Energy Savings

The electrical unitary energy savings for server-based power management software are calculated using the variables defined and listed in the equation<sup>342</sup> and Table 338 below.

$$\Delta kWh = ESF_D * Q_D + ESF_L * Q_L$$

<sup>342</sup> Pennsylvania PUC, *Technical Reference Manual (TRM) Volume 1*, August 2019.

**Table 338: Electrical Unitary Energy Savings Values for Server-based Power Management Software**

| Parameter                                    | Symbol       | BER-AR, SBES                                                  | Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------|--------------|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Energy Savings Factor for a Desktop Computer | ESFD         | 356                                                           | Based on ENERGY STAR Computer Power Management Savings Calculator <sup>343</sup> using the following assumptions: Typical forty-hour work week; Monitor off setting of 5 minutes of inactivity; Computer sleep setting of 15 minutes of inactivity; Computer on wattage of 46 Watts; Computer sleep wattage of 2 Watts; LCD monitor wattage of 25 Watts; LCD monitor sleep wattage of 1 Watt; Default of 36% is the percentage of computers turned off each night is based upon 2004 Lawrence Berkeley National Lab Report entitled "After-hours Power Status of Office Equipment and Inventory of Miscellaneous Plug-Load Equipment" |
| Quantity of Power Managed Desktop Computers  | Qd           | Actual                                                        | Use information in TS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Energy Savings Factor for a Laptop Computer  | ESFL         | 69                                                            | Based on ENERGY STAR Computer Power Management Savings Calculator using the following assumptions: Typical forty-hour work week; Monitor off setting of 5 minutes of inactivity; Computer sleep setting of 15 minutes of inactivity; Laptop on wattage of 14 Watts; Laptop sleep wattage of 1 Watt; Assumes 50% of laptop power is for computer, while 50% is for monitor; Default of 36% is the percentage of computers turned off each night is based upon 2004 Lawrence Berkeley National Lab Report entitled "After-hours Power Status of Office Equipment and Inventory of Miscellaneous Plug-Load Equipment"                    |
| Quantity of Power Managed Laptop Computers   | Ql           | Actual                                                        | Use information in TS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Unitary Energy Savings [kWh/year]            | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

## Unitary Peak Demand Savings

The unitary peak demand savings for server-based power management software are calculated using the variables defined and listed in the equation and Table 339 below, as well as variables from Table 338 above.

$$\Delta kW = DSF_D * Q_D + DSF_L * Q_L$$

<sup>343</sup> Retrieved from <https://www.energystar.gov/sites/default/files/asset/document/LowCarbonITSavingsCalc.xlsx>.

**Table 339: Unitary Peak Demand Savings Values for Server-based Power Management Software**

| Parameter                                    | Symbol      | BER-AR, SBES                                                  | Reference                                                                                                                                                                                                                                                                            |
|----------------------------------------------|-------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Demand Savings Factor for a Desktop Computer | DSFD        | 68                                                            | Based on ENERGY STAR Computer Power Management Savings Calculator using the following assumptions: Computer on wattage of 46 Watts; Computer sleep wattage of 2 Watts; LCD monitor wattage of 25 Watts; LCD monitor sleep wattage of 1 Watt                                          |
| Demand Savings Factor for a Laptop Computer  | DSFL        | 13                                                            | Demand Savings Factor for a Laptop Computer. Based on ENERGY STAR Computer Power Management Savings Calculator using the following assumptions: Laptop on wattage of 14 Watts; Laptop sleep wattage of 1 Watt; Assumes 50% of laptop power is for computer, while 50% is for monitor |
| Unitary Peak Demand Savings [W]              | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation                                                                                                                                                                                                                                                                          |

## Installation Rates

Installation rates for server-based power management software are estimated at 100%.

## (2) Server Virtualization and Decommissioning

### Summary

Table 340 presents a summary of the values used to calculate server virtualization and decommissioning savings. The detailed methodology follows.

**Table 340: Server-based Server Virtualization and Decommissioning Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                                              | Reference                                                 |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>Measure Description and Identification</b>      |                                                                                                           |                                                           |
| Measure                                            | Removed servers must be properly disposed of and not be reused in any form, rebated after decommissioning | -                                                         |
| Baseline                                           | Removed servers which were functional and in use prior to virtualization                                  | -                                                         |
| <b>General Parameters</b>                          |                                                                                                           |                                                           |
| Installation Rate                                  | 100%                                                                                                      | See details below under Installation Rates                |
| Effective Useful Life [years]                      | 4                                                                                                         | See Subsection 6.2                                        |
| <b>Electrical Savings Parameters</b>               |                                                                                                           |                                                           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                                             | See details below under Electrical Unitary Energy Savings |
| Unitary Peak Demand Savings [W]                    | Calculation based on specification data for each rebated unit                                             | See details below under Unitary Peak Demand Savings       |
| Interactive Effects Factor for Energy Savings      | 0                                                                                                         | See Subsection 5.13.1                                     |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                                                         | See Subsection 5.13.1                                     |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for server virtualization and decommissioning are calculated using the variables defined and listed in the equation<sup>344</sup> and Table 341 below.

$$\Delta kWh = (kWh_{BV} - kWh_{AV}) / VH$$

$$kWh_{BV} = \frac{8,760}{1,000} \times RS \times (W_{rs, idle} + U_{rs} * (W_{rs, full load} - W_{rs, idle}))$$

$$kWh_{AV} = \frac{8,760}{1,000} \times VH \times (W_{vh, idle} + U_{vh} * (W_{vh, full load} - W_{vh, idle}))$$

**Table 341: Electrical Unitary Energy Savings Values for Server Virtualization and Decommissioning**

| Parameter                                            | Symbol        | BER-AR, SBES                                                  | Reference             |
|------------------------------------------------------|---------------|---------------------------------------------------------------|-----------------------|
| Servers to Be Retired                                | RS            | Actual (minimum of 8)                                         | Use information in TS |
| Power Use in Idle [W] of a Server to Be Retired      | Wrs_idle      | Actual                                                        | Use information in TS |
| Utilization of Server to Be Retired                  | Urs           | 0.09                                                          | Assumption            |
| Power Use at Full Load [W] of a Server to Be Retired | Wrs_full load | Actual                                                        | Use information in TS |
| Virtual Host Servers                                 | VH            | Actual                                                        | Use information in TS |
| Power Use of a Virtual Host Server in Idle [W]       | Wvh_idle      | Actual                                                        | Use information in TS |
| Virtual Host Server Utilization                      | Uvh           | 0.5                                                           | Assumption            |
| Power Use of Virtual Host Server at Full Load [W]    | Wvh_full load | Actual                                                        | Use information in TS |
| Energy Use Before Virtualization                     | kWhBV         | Calculation based on specification data for each rebated unit | Calculation           |
| Energy Use After Virtualization                      | kWhAV         | Calculation based on specification data for each rebated unit | Calculation           |
| Unitary Energy Savings [kWh/year]                    | $\Delta kWh$  | Calculation based on specification data for each rebated unit | Calculation           |

## Unitary Peak Demand Savings

The unitary peak demand savings for server virtualization and decommissioning are calculated using the variables defined and listed in the equation and Table 342 below, as well as variables from Table 341 above.

$$\Delta kW = \Delta kWh /_{HOU}$$

<sup>344</sup> Pennsylvania PUC, *Technical Reference Manual (TRM) Volume 1*, August 2019.



**Table 342: Unitary Peak Demand Savings Values for Server Virtualization and Decommissioning**

| Parameter                       | Symbol      | BER-AR, SBES                                                  | Reference   |
|---------------------------------|-------------|---------------------------------------------------------------|-------------|
| Hours of Use [h/year]           | HOU         | 8760                                                          | Assumption  |
| Unitary Peak Demand Savings [W] | $\Delta kW$ | Calculation based on specification data for each rebated unit | Calculation |

## Installation Rates

Installation rates for server virtualization and decommissioning are estimated at 100%.

## (3) Uninterruptible Power Supply (UPS)

### Summary

Table 343 presents a summary of the values used to calculate uninterruptible power supply (UPS) savings. The detailed methodology follows.

**Table 343: Uninterruptible Power Supply (UPS) Measure Summary**

| Parameter                                          | BER-AR, SBES                                                                   |                                                           | Reference |
|----------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------|-----------|
| Measure Description and Identification             |                                                                                |                                                           |           |
| Measure                                            | ENERGY STAR® certified UPS to reduce energy losses, rebated after installation | -                                                         |           |
| Baseline                                           | No UPS                                                                         | -                                                         |           |
| General Parameters                                 |                                                                                |                                                           |           |
| Installation Rate                                  | 100%                                                                           | See details below under Installation Rates                |           |
| Effective Useful Life [years]                      | 10                                                                             | See Subsection 6.2                                        |           |
| Electrical Savings Parameters                      |                                                                                |                                                           |           |
| Unitary Energy Savings [kWh/year]                  | Calculation based on specification data for each rebated unit                  | See details below under Electrical Unitary Energy Savings |           |
| Unitary Peak Demand Savings [W]                    | 0                                                                              | No peak demand reduction                                  |           |
| Interactive Effects Factor for Energy Savings      | 0                                                                              | See Subsection 5.13.1                                     |           |
| Interactive Effects Factor for Peak Demand Savings | 0                                                                              | See Subsection 5.13.1                                     |           |

## Electrical Unitary Energy Savings

The electrical unitary energy savings for uninterruptible power supply (UPS) are calculated using the variables defined and listed in the equation<sup>345</sup> and Table 344 below.

$$\Delta kWh = 204 \times kVA$$

<sup>345</sup> California Municipal Utilities Association, *Savings Estimation Technical Reference Manual*, 2017, p.8-15.

**Table 344: Electrical Unitary Energy Savings Values for Uninterruptible Power Supply (UPS)**

| Parameter                         | Symbol       | BER-AR, SBES                                                  | Reference                |
|-----------------------------------|--------------|---------------------------------------------------------------|--------------------------|
| Energy Use per Rated kVA          | -            | 204                                                           | CMUA California 2017 TRM |
| UPS Power [kVA]                   | $kVA$        | Actual                                                        | Use information in TS    |
| Unitary Energy Savings [kWh/year] | $\Delta kWh$ | Calculation based on specification data for each rebated unit | Calculation              |

## Installation Rates

Installation rates for uninterruptible power supply (UPS) are estimated at 100%.

## 6 Effective Useful Life

This section outlines the EUL values used to calculate lifetime energy savings. This section also presents EUL values for demand reduction measures; these values are not used to calculate lifetime energy savings since those measures do not save energy. For demand response measures, the EUL represents the number of years for which the demand reduction is expected to persist. The EUL values should be used when calculating cost-effectiveness ratios for measures, in order to account for lifetime benefits.

### 6.1 LED Lamps and Fixtures

To establish lifetime energy savings for LED lamps and fixtures, the equipment life is determined using rated lifetimes identified in product specification sheets and annual HOU, as described in the equation below.

$$\text{Equipment Life [Years]} = \frac{\text{Rated Lifetime [Hours]}}{\text{Annual HOU [Hours]}}$$

Since regulatory changes will cause the baseline to increase over the lifetime of LEDs and thus decrease annual savings over the lifetime of the product, an equivalent EUL is necessary to determine lifetime savings. The equivalent EUL is multiplied by first-year savings to obtain lifetime energy savings. Since the equivalent EUL is based on upcoming regulatory changes, it must be updated annually to take into account the changing duration of each baseline. The detailed assumptions and calculations to obtain equivalent EUL values are presented in Appendix III.

Table 345 summarizes the equivalent EUL values for BNI LED lamps and fixtures.

**Table 345: EUL Values for BNI LED Lamps and Fixtures**

| Measure                               | Program Component    | Average Rated Lifetime (hours) | Annual HOU (hours/year) | Equipment Life | 2024 Equivalent EUL |
|---------------------------------------|----------------------|--------------------------------|-------------------------|----------------|---------------------|
| <b>LED Linear Fixtures</b>            |                      |                                |                         |                |                     |
| 1 x 4 Luminaires                      | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| 2 x 2 Luminaires and Retrofit Kits    | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| 2 x 4 Luminaires and Retrofit Kits    | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| Linear Ambient and Low-bay Luminaires | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| High-bay Luminaires                   | BER-AR, SBES         | 100,000                        | 4,209                   | 23.8           | 23.8                |
| Troffers                              | BER-IR, BER-AR, SBES | 90,000                         | 4,209                   | 21.4           | 21.4                |
| Stairwell and Passageway Luminaire    | BER-AR, SBES         | 100,000                        | 7,000                   | 14.3           | 14.3                |
| <b>LED Linear Lamps</b>               |                      |                                |                         |                |                     |
| 2-foot Replacement Lamps              | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| 3-foot Replacement Lamps              | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| 4-foot Replacement Lamps              | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| 8-foot Replacement Lamps              | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| U-bend                                | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |

| Measure                                                                                                                                            | Program Component | Average Rated Lifetime (hours) | Annual HOU (hours/year) | Equipment Life | 2024 Equivalent EUL |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--------------------------------|-------------------------|----------------|---------------------|
| LED General-use and Decorative Lamps                                                                                                               |                   |                                |                         |                |                     |
| LED Decorative (Chandelier)                                                                                                                        | SBES              | 25,000                         | 3,600                   | 6.9            | 1.0                 |
| LED Omnidirectional (A-lamp and Globe)                                                                                                             | SBES              | 25,000                         | 3,600                   | 6.9            | 1.0                 |
| Four Pin-base Replacement Lamps for Compact fluorescent lamp (CFLs)                                                                                | BER-AR, SBES      | 50,000                         | 4,209                   | 11.9           | 11.9                |
| 9 W Replacing 25 W                                                                                                                                 | SBES              | 25,000                         | 3,600                   | 6.9            | 1.0                 |
| 9 W Replacing 29 W                                                                                                                                 |                   |                                |                         |                | 1.0                 |
| 9 W Replacing 40 W                                                                                                                                 |                   |                                |                         |                | 1.0                 |
| 9 W Replacing 43 W                                                                                                                                 |                   |                                |                         |                | 1.0                 |
| 9 W Replacing 60 W                                                                                                                                 |                   |                                |                         |                | 1.0                 |
| 9 W Replacing 72 W                                                                                                                                 |                   |                                |                         |                | 1.0                 |
| 9 W Replacing 100 W                                                                                                                                |                   |                                |                         |                | 1.0                 |
| 9 W Replacing 150 W                                                                                                                                |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 25 W                                                                                                                               |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 29 W                                                                                                                               |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 40 W                                                                                                                               |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 43 W                                                                                                                               |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 60 W                                                                                                                               |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 72 W                                                                                                                               |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 100 W                                                                                                                              |                   |                                |                         |                | 1.0                 |
| 9.5 W Replacing 150 W                                                                                                                              |                   |                                |                         |                | 1.0                 |
| 18 W Replacing 75 W                                                                                                                                |                   |                                |                         |                | 1.0                 |
| 18 W Replacing 100 W                                                                                                                               |                   |                                |                         |                | 1.0                 |
| 7 W Blackout Bulbs Replacing 60 W                                                                                                                  |                   |                                |                         |                | 1.0                 |
| LED Reflector Lamps                                                                                                                                |                   |                                |                         |                |                     |
| Small LED Reflector Lamps - PAR, MR, MRX 16                                                                                                        | SBES              | 25,000                         | 3,600                   | 6.9            | 1.0                 |
| Small LED Reflector Lamps - PAR, R 20                                                                                                              | SBES              | 25,000                         | 3,600                   | 6.9            | 1.0                 |
| Large LED Reflector Lamps - PAR, BR, R 30/30L                                                                                                      | SBES              | 25,000                         | 3,600                   | 6.9            | 1.0                 |
| Large LED Reflector Lamps - PAR, BR, R 38/40                                                                                                       | SBES              | 25,000                         | 3,600                   | 6.9            | 1.0                 |
| LED Downlight Fixtures                                                                                                                             |                   |                                |                         |                |                     |
| LED Recessed                                                                                                                                       | SBES              | 50,000                         | 3,600                   | 13.9           | 1.0                 |
| LED Ceiling Mount, LED Surface Mount, LED Solid State Retrofit, LED Inseparable Solid State Luminaire, LED Wall Sconces, LED Wall Sconce Retrofits | SBES              | 50,000                         | 3,600                   | 13.9           | 1.0                 |

| Measure                                                              | Program Component    | Average Rated Lifetime (hours) | Annual HOU (hours/year) | Equipment Life | 2024 Equivalent EUL |
|----------------------------------------------------------------------|----------------------|--------------------------------|-------------------------|----------------|---------------------|
| <b>LED Outdoor Fixtures</b>                                          |                      |                                |                         |                |                     |
| Outdoor Full-cut-off Wall-mounted Area Luminaires                    | BER-IR, BER-AR, SBES | 75,000                         | 4,317                   | 17.4           | 17.4                |
| Flood and Spot Luminaires                                            | BER-IR, BER-AR, SBES | 75,000                         | 4,317                   | 17.4           | 17.4                |
| Fuel Pump Canopy Luminaires                                          | BER-AR, SBES         | 50,000                         | 4,317                   | 11.6           | 11.6                |
| LED Replacements for High-Intensity Discharge Lamps                  | BER-AR, SBES         | 50,000                         | 4,317                   | 11.6           | 11.6                |
| Non-cut-off and Semi-cut-off Wall-mounted Area Luminaires            | BER-IR, BER-AR, SBES | 100,000                        | 4,317                   | 23.2           | 23.2                |
| Pole/Arm-mounted Area Luminaires                                     | BER-AR, SBES         | 60,000                         | 4,317                   | 13.9           | 13.9                |
| Pole/Arm-mounted Decorative Luminaires                               | BER-AR, SBES         | 100,000                        | 4,317                   | 23.2           | 23.2                |
| Parking Garage Luminaires                                            | BER-AR, SBES         | 100,000                        | 4,317                   | 23.2           | 23.2                |
| Case Lighting for Sign Retrofit Applications                         | BER-AR, SBES         | 50,000                         | 4,209                   | 11.9           | 11.9                |
| <b>LED Directional and Architectural Fixtures</b>                    |                      |                                |                         |                |                     |
| Track or Mono-point Directional Luminaires, LED Wall Wash Luminaires | BER-IR, BER-AR, SBES | 50,000                         | 4,209                   | 11.9           | 11.9                |
| <b>Other LED Lighting</b>                                            |                      |                                |                         |                |                     |
| Refrigerated Case Luminaires                                         | BER-AR, SBES         | 70,000                         | 4,209                   | 16.6           | 16.6                |
| LED Nightlights                                                      | SBES                 | 100,000                        | 4,317                   | 23.2           | 1.0                 |
| LED Roadway Lighting                                                 | BER-AR               | 100,000                        | 7,300                   | 13.7           | 13.7                |
| Horticultural Lighting                                               | BER-AR               | 50,000                         | 6,000                   | 8.3            | 8.3                 |
| Lighting                                                             | AMH                  | 50,000                         | 8,760                   | 5.7            | 5.7                 |

## 6.2 Other Measures

The EUL values for non-LED lighting measures were established by conducting a literature review of technical reference manuals (TRMs) and studies from other similar jurisdictions.

Table 346 summarizes the EUL values and their source for Business, non-profit, and institutional (BNI) measures.

**Table 346: EUL Values for Non-LED Lighting BNI Measures**

| Measure Name                                      | Program Component    | EUL Value | Reference                                                                                                                                                |
|---------------------------------------------------|----------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Lighting Controls</b>                          |                      |           |                                                                                                                                                          |
| Occupancy Sensors                                 | BER-IR, BER-AR, SBES | 10        | GDS, 2007 (Table 2 – Commercial & Industrial Measures, value for occupancy sensors in new constructions)                                                 |
| <b>Agriculture</b>                                |                      |           |                                                                                                                                                          |
| Agriculture Heat Pads                             | BER-AR, SBES         | 10        | IESO PMA List, 2019 (Value for single creep heat pads)                                                                                                   |
| Dairy Scroll Compressors                          | BER-AR, SBES         | 15        | IESO PMA List, 2019 (Value for milk scroll compressors)<br>KEMA, 2009 <sup>346</sup> (Value for scroll compressors for dairy refrigeration)              |
| Energy Efficient Ventilation and Circulation Fans | BER-AR, SBES         | 15        | GDS, 2007 (Appendix C)<br>KEMA, 2009 (Value for ventilation fans, high efficiency)                                                                       |
| Heat Reclaimer Units                              | BER-AR, SBES         | 15        | Pennsylvania TRM, 2016<br>KEMA, 2009 (Value for process heat recovery)                                                                                   |
| High-volume Low-speed Fans                        | BER-AR, SBES         | 15        | IESO PMA List, 2019 (Value for high-volume low-speed fans)<br>KEMA, 2009 (Value for high-volume low-speed fans)<br>DEER, 2008 (Value for two-speed fans) |
| Low-energy and Zero-energy Livestock Waterers     | BER-AR, SBES         | 10        | KEMA, 2009 (Value for energy efficient livestock waterers)<br>IESO PMA List, 2019 (Value for low-energy livestock waterers)                              |
| Milk Pre-coolers                                  | BER-AR, SBES         | 15        | KEMA, 2009 (Value for well water pre-coolers)                                                                                                            |
| Natural and Dual Ventilation                      | BER-AR, SBES         | 15        | IESO PMA List, 2019 (Value for dual and natural exhaust ventilation systems)                                                                             |
| Tractor Engine-block Heater Timers                | BER-AR, SBES         | 5         | Minnesota TRM, 2020 (Value for agriculture – engine block heater timers)<br>IESO PMA List, 2019 (Value for engine block heater timers)                   |
| VFD for Milk Vacuum Pumps                         | BER-AR, SBES         | 15        | KEMA, 2009 (Value for VFD on milk vacuum pumps)<br>DEER, 2008 (Value for milking vacuum pump variable speed drives)                                      |
| VFD for Milk Transfer Pumps                       | BER-AR, SBES         | 15        | DEER, 2014 (Value for milking transfer pump variable speed drives)                                                                                       |

<sup>346</sup> KEMA. Focus on Energy Evaluation Business Programs: Measure Life Study. Prepared for PA Consulting Group Inc., August 2009.

| Measure Name                                                           | Program Component | EUL Value | Reference                                                                                                                                                                                                                            |
|------------------------------------------------------------------------|-------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Compressed Air</b>                                                  |                   |           |                                                                                                                                                                                                                                      |
| Air-entraining Air Nozzles                                             | BER-AR, SBES      | 15        | KEMA, 2009 (Value for compressed air nozzles)                                                                                                                                                                                        |
| Cycling Air Dryers                                                     | BER-AR, SBES      | 10        | KEMA, 2009 (Value for cycling air dryers)                                                                                                                                                                                            |
| No-loss Drains                                                         | BER-AR, SBES      | 15        | ERS, 2005 <sup>347</sup> (Table 1-2, value for compressed air)                                                                                                                                                                       |
| Compressed Air Leak Repairs                                            | Custom            | 2         | KEMA, 2009 <sup>348</sup> (Value for compressed air - service)                                                                                                                                                                       |
| Air Compressor Replacement                                             | Custom            | 15        | ERS, 2005 (Table 1-2, value for compressed air – new construction)                                                                                                                                                                   |
| <b>HVAC</b>                                                            |                   |           |                                                                                                                                                                                                                                      |
| Air-source Heat Pumps Greater Than or Equal to 65,000 Btu/hr           | BER-AR, SBES      | 20        | California Public Utilities Commission, 2024 <sup>349</sup> (Value for HVAC heat pump)                                                                                                                                               |
| Air-source Heat Pumps Less Than 65,000 Btu/hr (Excluding Air-to-water) | BER-AR, SBES      | 18        | GDS, 2007 (Table 1 – Residential Measures, value for AC/heat pump, assuming air-source heat pumps of smaller capacities, mostly mini-split systems, have operating conditions closer to residential)                                 |
| Air-to-water Heat Pumps                                                | BER-AR, SBES      | 15        | GDS, 2007 (Table 2 – Commercial & Industrial Measures, value for packaged AC/HP)<br>ERS, 2005 (Table 4-7, value for packaged AC/HP)                                                                                                  |
| Dual-enthalpy Economizer Controls                                      | BER-AR, SBES      | 10        | GDS, 2007 (Table 2 – Commercial & Industrial Measures, value for enthalpy economizers)<br>ERS, 2005 (value for enthalpy economizers)                                                                                                 |
| Ground-source Heat Pumps                                               | BER-AR, SBES      | 25        | Life expectancy estimated by the U.S. Department of Energy <sup>350</sup> (up to 24 years for the inside component and more than 50 years for the ground loop) and by Natural Resources Canada <sup>351</sup> (about 20 to 25 years) |
| HVAC Hotel Occupancy Sensors                                           | BER-AR, SBES      | 8         | DEER, 2014 (Value for occupancy sensors)                                                                                                                                                                                             |
| Packaged Terminal Heat Pumps (PTHPs)                                   | BER-AR, SBES      | 15        | GDS, 2007 (Table 2 – Commercial & Industrial Measures, value for packaged AC/HP)                                                                                                                                                     |
| Water-source Heat Pumps                                                | BER-AR, SBES      | 15        | GDS, 2007 (Table 2 – Commercial & Industrial Measures, value for packaged AC/HP)<br>ERS, 2005 (Value for WSHP)<br>DEER 2014 (Value for high-efficiency water-source heat pumps)                                                      |
| Electric Thermal Storage                                               | BER-AR, SBES      | 18        | The EUL is expected to be comparable to other heating systems. The EUL therefore corresponds to the value used for stoves, furnaces/boilers, and air-source heat pumps                                                               |
| Advanced RTU Controls                                                  | BER-AR            | 10        | Illinois TRM, 2021 (Value for advanced RTU controls)                                                                                                                                                                                 |
| Smart Thermostats for Electric Heating                                 | BER-AR, BER-IR    | 8         | Wisconsin TRM, 2024 (Value for Smart Thermostats for Business)                                                                                                                                                                       |

<sup>347</sup> ERS. Measure Life Study. Prepared for the Massachusetts Joint Utilities. November 2005.

<sup>348</sup> KEMA. Focus on Energy Evaluation Business Programs: Measure Life Study. Prepared for PA Consulting Group Inc., August 2009.

<sup>349</sup> California Public Utilities Commission, *Commercial HVAC and Water Heating Measure Effective Useful Life Study Draft Report*, May 2, 2024, p. 21.

<sup>350</sup> Retrieved from <https://energy.gov/energysaver/heat-and-cool/heat-pump-systems/geothermal-heat-pumps#306534-tab-1>.

<sup>351</sup> Retrieved from <https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about-energy-star-canada/energy-star-announcements/publications/heating-cooling-heat-pump/ground-source-heat-pumps-earth-energy-systems/6833>.

| Measure Name                                        | Program Component | EUL Value                                          | Reference                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------|-------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Commercial Kitchen Equipment</b>                 |                   |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Demand-controlled Kitchen Exhausts                  | BER-AR, SBES      | 15                                                 | Efficiency Maine TRM, 2019 (Value for demand control kitchen ventilation)<br>DEER, 2014 (Value for variable speed drives controlled by CO2 sensors)                                                                                                                                                                                                                                                                                      |
| Dishwashers                                         | BER-AR, SBES      | Under-counter: 10<br>Door-type: 15<br>Conveyor: 20 | William Goetzler et al., Energy Savings Potential and RD&D Opportunities for Commercial Building Appliances, U.S. Department of Energy, June 2016<br>Koeller and Company and H.W. Hoffman & Associates, LLC. 2010. "A Report on Potential Best Management Practices – Commercial Dishwashers," Prepared for the California Urban Water Conservation Council (CUWCC) by Koeller and Company and H.W. Hoffman & Associates, LLC. June 2010 |
| Freezers/Refrigerators                              | BER-AR, SBES      | 12                                                 | DEER 2014 (Value for commercial reach-in refrigerator/freezers)<br>DOE, 2011 Buildings Energy Data Book, Table 5.7.15 (Value for refrigerators)                                                                                                                                                                                                                                                                                          |
| Fryers                                              | BER-AR, SBES      | 12                                                 | DEER 2014 (Value for fryers)                                                                                                                                                                                                                                                                                                                                                                                                             |
| Griddles                                            | BER-AR, SBES      | 12                                                 | DEER 2014 (Value for griddles)                                                                                                                                                                                                                                                                                                                                                                                                           |
| Hot Food Holding Cabinets                           | BER-AR, SBES      | 12                                                 | DEER 2014 (Value for commercial insulated holding cabinets)                                                                                                                                                                                                                                                                                                                                                                              |
| Ice Machines                                        | BER-AR, SBES      | 10                                                 | DEER 2014 (Value for ice machines)<br>KEMA, 2009 (Value for ice machines)                                                                                                                                                                                                                                                                                                                                                                |
| Ovens                                               | BER-AR, SBES      | 12                                                 | DEER 2014 (Value for combination ovens or convection ovens)                                                                                                                                                                                                                                                                                                                                                                              |
| Steam Cookers                                       | BER-AR, SBES      | 12                                                 | DEER 2014 (Value for steam cookers)                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Commercial Laundry Equipment</b>                 |                   |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Commercial Clothes Dryers (NG Conversion)           | BER-AR, SBES      | 12                                                 | Vermont TRM, 2018 (Value for clothes dryers)<br>DOE, 2011 Buildings Energy Data Book, Table 5.7.15 (Value for clothes dryers)                                                                                                                                                                                                                                                                                                            |
| Commercial Heat Pump Clothes Dryers                 | BER-AR, SBES      | 12                                                 | Vermont TRM, 2018 (Value for clothes dryers)<br>DOE, 2011 Buildings Energy Data Book, Table 5.7.15 (Value for clothes dryers)                                                                                                                                                                                                                                                                                                            |
| Commercial Washing Machines                         | BER-AR, SBES      | 11                                                 | DEER 2011 (Value for high efficiency clothes washers)<br>William Goetzler et al., Energy Savings Potential and RD&D Opportunities for Commercial Building Appliances, U.S. Department of Energy, June 2016<br>DOE, 2011 Buildings Energy Data Book, Table 5.7.15 (Value for clothes washers)                                                                                                                                             |
| <b>Motors and VFDs</b>                              |                   |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Variable Frequency Drives for non-HVAC Applications | BER-AR            | 15                                                 | DEER, 2008 (Value for VSD supply fan motors)<br>ERS, 2005 (Value for VFDs on fans)<br>Navigant. Incremental Cost Study Phase Two Final Report Burlington, MA, 2013                                                                                                                                                                                                                                                                       |
| <b>Pumping</b>                                      |                   |                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Circulator Pumps                                    | BER-IR, BER-AR    | 15                                                 | KEMA, 2009 (Value for wells and pumps)                                                                                                                                                                                                                                                                                                                                                                                                   |
| Booster Pumps                                       | BER-AR            | 15                                                 | KEMA, 2009 (Value for wells and pumps)                                                                                                                                                                                                                                                                                                                                                                                                   |



| Measure Name                                            | Program Component       | EUL Value | Reference                                                                                                                                          |
|---------------------------------------------------------|-------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Refrigeration                                           |                         |           |                                                                                                                                                    |
| Brushless DC Motors                                     | BER-AR, SBES            | 15        | KEMA, 2009 (Value for NEMA motors)<br>ERS, 2005 (Table 4-7, value for motors)<br>DEER, 2008 (Value for premium-efficiency motors)                  |
| Cooler Night Covers/Display Case Strip Curtains         | BER-AR, SBES            | 4         | DEER, 2014 (Value for strip curtains for walk-ins)                                                                                                 |
| Door Heater Controls                                    | BER-AR, SBES            | 12        | KEMA, 2009 (Value for anti-sweat heater controls)<br>ERS, 2005 (Table 4-7, value for door heater controls)                                         |
| Efficient Refrigeration Compressors                     | BER-AR, SBES            | 15        | DEER, 2014 (Value for refrigeration upgrades, variable speed compressors)<br>ERS, 2005 (Table 4-7, value for commercial refrigeration compressors) |
| Evaporator Fan Motor Controls                           | BER-AR, SBES            | 10        | ERS, 2005 (Value for motor controls)                                                                                                               |
| Intelligent Freezer Defrost Controls                    | BER-AR, SBES            | 10        | ERS, 2005 (Value for motor controls)                                                                                                               |
| Refrigerated Vending Machine Controllers                | BER-AR, SBES            | 5         | DEER, 2008, 2014 (Value for vending machine controllers)<br>ERS, 2005 (Table 1-1, value for vending machine controllers)                           |
| Refrigeration Economizers                               | BER-AR, SBES            | 15        | Illinois TRM, 2019 (Value for refrigeration economizers)                                                                                           |
| Vertical Refrigeration Open-to-closed Cooler Conversion | BER-AR, SBES            | 12        | DEER, 2008 (Value for reach-in refrigerators/freezers)                                                                                             |
| Zero-energy Doors                                       | BER-AR, SBES            | 12        | DEER 2014 (Value for zero heat reach-in glass doors)<br>KEMA, 2009 (Value for no-energy doors)                                                     |
| Water Heating                                           |                         |           |                                                                                                                                                    |
| Heat Pump Water Heaters                                 | BER-AR, SBES            | 10        | DEER, 2008, 2014 (Value for heat pump water heaters)                                                                                               |
| Low-flow Showerheads                                    | SBES                    | 10        | DEER, 2014 (Value for low-flow showerheads)                                                                                                        |
| Faucet Aerators                                         |                         | 10        | DEER, 2014 (Value for faucet aerators)                                                                                                             |
| Thermostatic Shower Valves                              |                         | 10        | Efficiency Maine TRM, 2019                                                                                                                         |
| Pipe Insulation                                         |                         | 13        | DEER, 2014 (Value for pipe insulation – electric water heaters)                                                                                    |
| Hot Water Tank Wraps                                    |                         | 7         | DEER, 2014 (Value for water heater tank wraps)                                                                                                     |
| Solar                                                   |                         |           |                                                                                                                                                    |
| Solar Water Heaters                                     | BER-AR, SBES            | 20        | ENERGY STAR, Save Money and More with ENERGY STAR Qualified Solar Water Heaters <sup>352</sup>                                                     |
| Solar Space Heating Systems                             | BER-AR, SBES            | 20        | ENERGY STAR, Save Money and More with ENERGY STAR Qualified Solar Water Heaters                                                                    |
| Solar Photovoltaic Panels                               | Custom Retrofit, BER-AR | 30        | NREL, 2020. <sup>353</sup> Nearly 90% of respondents to this study gave an EUL of at least 30 years, making this a conservative estimate)          |
| Pool                                                    |                         |           |                                                                                                                                                    |
| ENERGY STAR Pool Pumps                                  | BER-AR, SBES            | 10        | DEER, 2014 (Value for high-efficiency pool pumps)                                                                                                  |

<sup>352</sup> Retrieved from: [https://www.energystar.gov/products/water\\_heaters/water\\_heater\\_solar/benefits\\_savings](https://www.energystar.gov/products/water_heaters/water_heater_solar/benefits_savings).

<sup>353</sup> National Renewable Energy Laboratory. *Benchmarking Utility-Scale PV Operational Expenses and Project Lifetimes*, June 2020, p.3.

| Measure Name                                                                                                                                                                                                                                                                                                                                                                                                    | Program Component | EUL Value | Reference                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IT &amp; Datacentres</b>                                                                                                                                                                                                                                                                                                                                                                                     |                   |           |                                                                                                                                                                |
| Server-based Power Management Software                                                                                                                                                                                                                                                                                                                                                                          | BER-AR, SBES      | 5         | DEER 2014 (Value for power management software)                                                                                                                |
| Server Virtualization and Decommissioning                                                                                                                                                                                                                                                                                                                                                                       | BER-AR, SBES      | 4         | Pennsylvania TRM, 2019 (Value for server virtualization)                                                                                                       |
| ENERGY STAR Uninterruptible Power Supply                                                                                                                                                                                                                                                                                                                                                                        | BER-AR, SBES      | 10        | California TRM, 2017 (Value for ENERGY STAR uninterrupted power supply)                                                                                        |
| <b>New Construction (NC)</b>                                                                                                                                                                                                                                                                                                                                                                                    |                   |           |                                                                                                                                                                |
| <p><i>For NC projects, since the savings calculation is based on a modelling approach, the EUL values are established by end-use categories found in the simulation software. The EUL values are determined by considering the most reasonable and common measures for each end-use category and, in most cases, correspond to the values used for the other BNI program components (referenced above).</i></p> |                   |           |                                                                                                                                                                |
| DHW Measures                                                                                                                                                                                                                                                                                                                                                                                                    | Custom NC         | 10        | Based on the EUL value of heat pump water heaters and several other DHW measures such as faucet aerators, low-flow showerheads, and thermostatic shower valves |
| Solar Thermal DHW                                                                                                                                                                                                                                                                                                                                                                                               | Custom NC         | 20        | Based on the EUL value of solar water heaters                                                                                                                  |
| Cooling Measures                                                                                                                                                                                                                                                                                                                                                                                                | Custom NC         | 18        | Based on the EUL value of air-source heat pumps less than 65,000 Btu/hr                                                                                        |
| Heating Measures                                                                                                                                                                                                                                                                                                                                                                                                | Custom NC         |           |                                                                                                                                                                |
| Ventilation Measures                                                                                                                                                                                                                                                                                                                                                                                            | Custom NC         | 20        | Based on the EUL value of heat recovery ventilators                                                                                                            |
| Motor Equipment                                                                                                                                                                                                                                                                                                                                                                                                 | Custom NC         | 15        | Based on the EUL value of energy efficient motors                                                                                                              |
| Other                                                                                                                                                                                                                                                                                                                                                                                                           | Custom NC         | 15        | Reasonable average EUL values for any measures outside of the defined categories                                                                               |
| Refrigeration                                                                                                                                                                                                                                                                                                                                                                                                   | Custom NC         | 15        | Based on the EUL value of efficient refrigeration compressors                                                                                                  |
| Renewable Power Generation (Solar)                                                                                                                                                                                                                                                                                                                                                                              | Custom NC         | 25        | NREL, Useful Life <sup>354</sup> (Most conservative value for photovoltaics)                                                                                   |
| Renewable Power Generation (Wind)                                                                                                                                                                                                                                                                                                                                                                               | Custom NC         | 20        | NREL, Useful Life <sup>355</sup> (Value for wind)                                                                                                              |
| <b>Building Optimization (BOpt)</b>                                                                                                                                                                                                                                                                                                                                                                             |                   |           |                                                                                                                                                                |
| Changes to Control Parameters                                                                                                                                                                                                                                                                                                                                                                                   | Custom BOpt       | 3         | SBW Consulting, 2010 <sup>356</sup>                                                                                                                            |
| Equipment Repairs                                                                                                                                                                                                                                                                                                                                                                                               | Custom BOpt       | 8         | SBW Consulting, 2010 <sup>357</sup>                                                                                                                            |
| New Equipment Installations                                                                                                                                                                                                                                                                                                                                                                                     | Custom BOpt       | 12        | SBW Consulting, 2010 <sup>358</sup>                                                                                                                            |
| <b>Energy Management</b>                                                                                                                                                                                                                                                                                                                                                                                        |                   |           |                                                                                                                                                                |
| Strategic Energy Management                                                                                                                                                                                                                                                                                                                                                                                     | SEM               | N/A       | Calculated by project based on implemented measures                                                                                                            |

<sup>354</sup> NREL. *Useful Life*. Retrieved from <https://www.nrel.gov/analysis/tech-footprint.html>.

<sup>355</sup> NREL. *Useful Life*. Retrieved from <https://www.nrel.gov/analysis/tech-footprint.html>.

<sup>356</sup> Roberts J. and Tso B. (SBW Consulting), *Do Savings from Retrocommissioning Last? Results from an Effective Useful Life Study*, ACEEE Summer Study on Energy Efficiency in Buildings, 2010.

<sup>357</sup> Ibid.

<sup>358</sup> Ibid.

## APPENDIX I

# Verification of Climate Validity for Interactive Effects Calculations

The climate data of Nova Scotia and Quebec for the duration of the heating and cooling seasons were analyzed as part of the 2015 evaluation and found to be comparable, and thus the 1992 ADS study results are applicable for EfficiencyOne (E1) lighting measures. This appendix presents the analysis conducted in 2015.

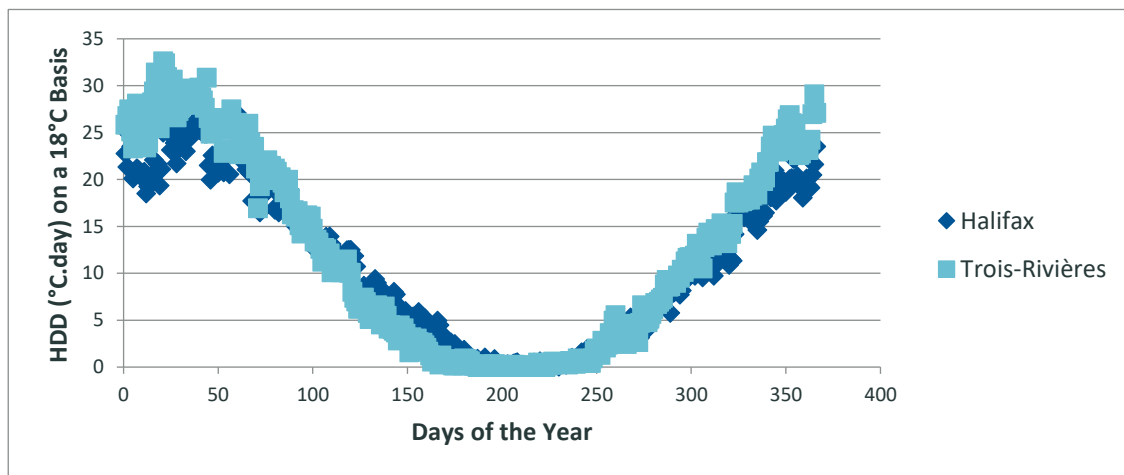
### Verification of Climate Data Validity

Considering that the 1992 ADS study remains the only well-documented study for cold climates, it is still used to establish interactive effects. To ensure that the findings of the ADS study are valid and applicable to Nova Scotia, Nova Scotia's climate characteristics were compared with those of Quebec to determine whether it is appropriate to use the weather data used in the ADS study in the impact evaluation of Nova Scotia's programs.

This analysis was conducted based on the assumption that internal gains (from lighting, DHW or any other appliances) reduce the heating load as long as the outdoor temperature is below the balance temperature of the building (and the opposite during the cooling season). This would mean that the most significant variable involved in calculating the interactive effect factors is the duration of the heating and cooling seasons, rather than the total heating and cooling degree days in a given climate.

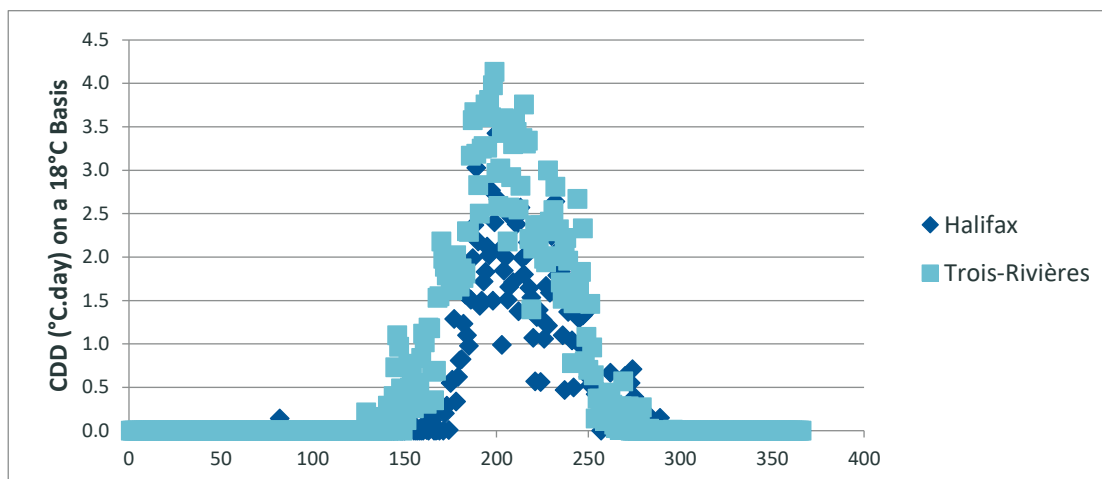
The following two figures show the average heating degree days (HDD) and cooling degree days (CDD) per day over a full year in Trois-Rivières<sup>359</sup> and Halifax, respectively.

**Figure 1: HDD per Day for Trois-Rivières and Halifax**



<sup>359</sup> Since this city is located about halfway between Montreal and Quebec City, it is representative of the climate used in the ADS study.

Figure 2: CDD per Day for Trois-Rivières and Halifax



In the case of HDD, Figure 1 shows that Trois-Rivières' heating season ends about 15 days earlier than Halifax (based on the assumption that heating is turned on when there are around 5 HDD per day). Indeed, the heating season ends around May 20 in Trois-Rivières and around June 4 in Halifax. In both cities, the heating season starts around the 270<sup>th</sup> day of the year, which roughly falls on September 28. As for the cooling season, Figure 2 indicates that it starts around the 160<sup>th</sup> day and the 180<sup>th</sup> day in Trois-Rivières and Halifax, respectively, and ends around the 250<sup>th</sup> day in both cities.

In conclusion, the heating season is about 6% shorter in Trois-Rivières than in Halifax, while the former cooling season is about 22% longer than the latter. This means that the interactive effect factors based on the ADS study slightly underestimate the negative interactive effects occurring during the heating season in Nova Scotia; however, the Evaluator considers this 6% difference not significant. The overestimation of the cooling season also results in a positive impact on the interactive effects; nevertheless, because of the very small impact of cooling on the interactive effects (3.6% according to the ADS study), the overestimation is considered negligible. Therefore, the Evaluator concludes that the findings of the ADS study are still applicable to Nova Scotia.

## APPENDIX II

### Detailed Calculations of 2024 Equivalent EUL Values for LED Lamps and Fixtures

This appendix presents how the equivalent effective useful life (EUL) of LED lamps and fixtures were calculated for applicable measures in the EPI and Instant Savings program components. An equivalent EUL corresponds to the number of years by which the first-year savings need to be multiplied to obtain the lifetime savings.

The Evaluator first calculated the equipment life of each type of lamp and fixture, as presented in Table 347. The equipment life was calculated as the ratio between the manufacturer rated lifetime for the lamps and fixtures installed under the program components and the annual HOU values used to calculate unitary savings values.

**Table 347: Equipment Life Value per LED Lamp and Fixture Types**

| LED Lamp and Fixture Type                              | Program Component | Average Rated Lifetime Hours (hours) <sup>360</sup> | Annual HOU (hours/year) <sup>361</sup> | Equipment Life (years) |
|--------------------------------------------------------|-------------------|-----------------------------------------------------|----------------------------------------|------------------------|
| LED A19 Lamps                                          | EPI               | 25,000                                              | 949                                    | 26                     |
| LED Reflector Lamps                                    |                   | 25,000                                              | 949                                    | 26                     |
| LED Decorative Lamps                                   |                   | 15,000                                              | 949                                    | 16                     |
| LED Non-A-type Lamps (R, BR, and Decorative)           | Instant Savings   | 15,952                                              | 1,022                                  | 16                     |
| LED Non-A-type Lamps (Excluding R, BR, and Decorative) |                   | 25,000                                              | 1,022                                  | 24                     |
| LED Recessed Downlight Fixtures                        |                   | 37,400                                              | 1,022                                  | 37                     |
| LED Fixtures Without Motion Sensors                    |                   | 50,000                                              | 1,022                                  | 49                     |
| LED Fixtures with Motion Sensors                       |                   | 49,044                                              | 1,059                                  | 46                     |

<sup>360</sup> Based on manufacturer specification sheets for the most popular models installed through EPI in 2017.

<sup>361</sup> Based on the unitary savings review.



## Rationale for Using an Equivalent EUL

The LED market is evolving rapidly, driven in part by government regulations. LED products installed today are likely to become the baseline before the end of their rated lifetime since LED technologies are developing quickly and prices are falling. Some jurisdictions have already applied a reduced equivalent EUL to their lighting savings by adopting a higher baseline to represent savings in future years. In other words, their baseline increases over the lifetime of the product, which in turns reduces the equivalent EUL applied to first-year savings to obtain lifetime energy savings. The baseline is informed by government regulations as well as LED market information.

In terms of government regulations, the U.S. Energy Independence, and Security Act (EISA) 2020 requiring a minimum efficiency level for CFLs, also known as the EISA backstop, continues to be a key consideration.<sup>362</sup> The previous administration decided to eliminate the EISA backstop on inefficient lighting products. However, six states passed their own state legislation to implement the efficient lighting standards on January 1, 2020, regardless of what happened nationally. As of April 2022, the Biden administration restored the lighting standards for the extended definition of general service lamps (including decorative and reflector lamps) to the 45 lm/W efficiency standard. The standard will apply as of July 2023. In Canada, lighting has been added to the list of considered products for Amendments 18 and 19, which are planned to be at the pre-publication stage in early 2024. This would be consistent with the usual delay of approximately two years between Canadian and U.S. regulations as a new standard could be expected to be enforced in 2025.

While the latest U.S. regulation is set to establish a minimum efficiency level corresponding to a high-efficiency CFL, recent studies<sup>363</sup> indicate that the U.S. market is rapidly moving away from CFL lamps toward LED lamps. Steady shipment volumes, high LED shipment shares, elevated free-ridership levels, retailers' impressions on market saturation, and the greater availability of LED technologies compared to non-LEDs are all factors leading the Evaluator to believe that the markets for both LED A-type as well as LED non-A-type lamps are close to maturity. Although the Canadian general service lamp minimum energy performance has not yet been updated, it is expected that it will result in a ban on halogen incandescent lamps once it is applied. The Evaluator then expects LED technology to become the standard, a standard that most of the market has already attained. For these reasons, the Evaluator expects the baseline for LED lamps rebated on purchase to change in 2025; hence, 2024 is the last year with savings before the LED baseline is applied. The assumed baseline changes for A-type and non-A-type lamps are outlined in Table 348 below.

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<sup>362</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 8.0, Volume 3*, October 17, 2019, p. 258.

<sup>363</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 8.0, Volume 3*, October 17, 2019, p. 258.

**Table 348: LED Baseline Evolution for Rebate on Purchase (Instant Savings)**

| Baseline                                                      | Minimum Wattage Requirement | Years                      | Rationale                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------|-----------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A-type</b>                                                 |                             |                            |                                                                                                                                                                                                                                                                                                                                                                   |
| Incandescent Baseline                                         | N/A                         | 2024<br>(1,000 hours)      | Since incandescent lamps may no longer be replaced by incandescent lamps, there is a first increase in the baseline upon burnout. Incandescent light lamps have a typical rated life expectancy of 1,000 to 2,000 hours. <sup>364</sup> The remaining useful life of replaced functional incandescent light lamps is assumed to be half the rated life expectancy |
| LED Equivalent Baseline – American Legislation <sup>365</sup> | 45 lumens/W                 | 2025 - end of product life | See rationale above                                                                                                                                                                                                                                                                                                                                               |
| <b>Reflector (R, BR) and Decorative Lamps</b>                 |                             |                            |                                                                                                                                                                                                                                                                                                                                                                   |
| Halogen Incandescent Baseline                                 | N/A                         | 2024                       | The current Canadian regulations allow halogen incandescent lamps for reflector lamps (R, BR) and decorative. Therefore, the first baseline corresponds to the baseline product, namely halogen incandescent lamps                                                                                                                                                |
| LED Equivalent Baseline – American Legislation <sup>366</sup> | 45 lumens/W                 | 2025 - end of product life | See rationale above                                                                                                                                                                                                                                                                                                                                               |
| <b>Reflector (GU, PAR, MR) Lamps</b>                          |                             |                            |                                                                                                                                                                                                                                                                                                                                                                   |
| Halogen Baseline                                              | N/A                         | 2024                       | The current Canadian regulations allow halogen incandescent lamps for reflector lamps (GU, PAR, MR). Therefore, the first baseline corresponds to the baseline product, namely halogen lamps                                                                                                                                                                      |
| LED Equivalent Baseline – American Legislation <sup>367</sup> | 45 lumens/W                 | 2025 - end of product life | See rationale above                                                                                                                                                                                                                                                                                                                                               |

Using the baseline evolution presented above, the following sections present the detailed calculations and resulting values for all LED lighting products.

For direct-install programs (EPI) from an impact perspective, if an incandescent is replaced, E1 would be able to claim one year of savings. Indeed, if through these programs a functional non-LED bulb is replaced, savings are achieved and persist until that bulb burns out – the standard assumption is that savings are achieved for one year. After that one-year period, the bulb would have to be replaced with bulbs available in store, which are assumed to be LED starting in 2025.

<sup>364</sup> Lighting Research Center - Rensselaer Polytechnic Institute, *Lighting Patterns for Homes. Light Bulb Features*, [www.lrc.rpi.edu/patternbook/resources/lamp\\_features.asp](http://www.lrc.rpi.edu/patternbook/resources/lamp_features.asp) (last accessed October 1, 2020).

<sup>365</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

<sup>366</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

<sup>367</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

## EPI

### LED A-type Lamps

LED A-type lamps installed under EPI replace incandescent lamps. The calculation is based on 9 W lamps because they are the most common A-type lamps installed through EPI. The first baseline increase occurs one year following the anticipated burnout of incandescent lamps.<sup>368</sup> Importantly, given their rated life of 25,000 hours and corresponding equipment life of 26 years, the baseline is affected by the change in regulation occurring in 2025. Starting in 2025 and for the remaining lifetime of those lamps (25 years), the baseline will be LED equivalent lamps as discussed above. The following equation is used to establish the equivalent EUL presented in Table 349.

$$\text{Equivalent EUL} = \frac{\Delta W_{\text{Incandescent}} \times 1 \text{ Year} + \Delta W_{\text{LED}} \times 25 \text{ Years}}{\Delta W_{\text{Incandescent}}}$$

**Table 349: Equivalent EUL Calculation Summary for LED A19 Lamps**

| Replaced Lamp (W) | Typical Efficient Lamp (W) | Incandescent Baseline 1 Year (2024) |                   | LED Equivalent Baseline – American Legislation 25 Years (2025-2049) |                   | Equivalent EUL (years) |
|-------------------|----------------------------|-------------------------------------|-------------------|---------------------------------------------------------------------|-------------------|------------------------|
|                   |                            | Baseline Wattage                    | Displaced Wattage | Baseline Wattage                                                    | Displaced Wattage |                        |
| 40                | 9                          | 40                                  | 31                | 9                                                                   | 0                 | 1.0                    |
| 60                | 9                          | 60                                  | 51                | 9                                                                   | 0                 | 1.0                    |
| 100               | 9                          | 100                                 | 91                | 9                                                                   | 0                 | 1.0                    |

### Reflector Lamps

For reflector lamps, only the second and third baselines apply. While reflector lamps are not impacted by current Canadian regulations, they will be affected by the requirements of upcoming regulations (Amendments 18 & 19). Starting in 2025, the baseline wattage is therefore increased to a LED since the minimum efficiency level of 45 lumens/watt bans halogen lamps and the market moves away from CFL lamps. Therefore, these lamps will no longer generate savings starting in 2025 and only generate savings for the year prior to the baseline increase, which results in an equivalent EUL of one year.

### Decorative Lamps

As for decorative lamps (G25 and chandelier lamps), the same approach as for reflector lamps is applied. While both types of lamps are not impacted by current Canadian regulations, they will be affected by the requirements of upcoming regulations (Amendments 18 & 19). Starting in 2025, the baseline wattage is therefore increased to a LED and will no longer generate savings. They only generate savings for the year prior to the baseline increase, which results in an equivalent EUL of one year.

For solar fixtures, a measure life of 10 years was assumed based on the EUL values for motion sensors. While solar lamps initially remove the full wattage of the baseline lamps from the grid, the baseline wattage is assumed to become LED lamps starting in 2025. Therefore, the wattage of outdoor fixtures with motion sensors was assumed starting in 2025 until the end of the measure life. An equivalent EUL was obtained using the equation and the value presented in Table 350 below, which corresponds to 2.5 years.

<sup>368</sup> Assuming the remaining lifetime is 1,000 hours for incandescent lamps and that they are used 2.6 hours per day, they will burnout in approximately one year.



$$\text{Equivalent EUL} = (\Delta W_{\text{Initial}} \times 1 \text{ Year} + \Delta W_{\text{LED}} \times 9 \text{ Years}) / \Delta W_{\text{Initial}}$$

**Table 350: Equivalent EUL Calculation for Solar Fixtures**

| Average Replaced Lamp (W) | Average Wattage of Efficient Lamp (W) | Halogen Incandescent Baseline – Canadian Legislation<br>1 Year (2024) |                   | LED Equivalent Baseline – American Legislation <sup>369</sup><br>9 Years (2025-2033) |                   |
|---------------------------|---------------------------------------|-----------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------|-------------------|
|                           |                                       | Baseline Wattage                                                      | Displaced Wattage | Baseline Wattage                                                                     | Displaced Wattage |
| 92.6                      | 0 (not connected to grid)             | 92.6                                                                  | 92.6              | 15.0                                                                                 | 15.0              |

## Instant Savings

### LED Non-A-type Lamps

For LED non-A-type lamps sold through Instant Savings, lifetime energy savings values were established for the different types of lamps replaced, which mostly included reflector (R, BR, GU, PAR, MR) and decorative lamps. Reflector and decorative lamps are not impacted by the current Canadian regulation, although they are impacted by EISA 2020. Therefore, starting in 2025, the baseline wattage is increased to match that of LED technology since the minimum efficiency level of 45 lumens/watt bans halogen lamps and the market moves away from CFL lamps. Therefore, these lamps will no longer generate savings starting in 2025 and only generate savings for the year prior to the baseline increase, which results in an equivalent EUL of one year.

### LED Fixtures

As for LED fixtures without motion sensors (including recessed downlight fixtures), the equivalent EUL is analyzed in the same manner as for replace-on-burn-out lamps since the energy consumption of these fixtures is the consumption of the lamps provided with them. Therefore, the baseline is a fixture with lamps meeting current energy efficiency standards. Moreover, those lamps will be affected by the requirements of upcoming regulations (Amendments 18 & 19). Hence, starting in 2025, the baseline wattage is increased to a LED since the minimum efficiency level of 45 lumens/watt bans halogen lamps and the market moves away from CFL lamps. Therefore, like non-A-type lamps, LED fixtures will no longer generate savings starting in 2025 and only generate savings for the year prior to the baseline increase, which results in an equivalent EUL of one year.

For LED fixtures with motion sensors, the lifetime energy savings are calculated by first considering the reduced wattage and then the reduction in hours of use due to the motion sensor. The baseline for LED fixtures with motion sensors is reflector lamps for the majority (89%) of units sold. Therefore, based on the average daily HOU of 4.69, the same methodology as for LED non-A-type lamps is applied, as presented in Table 351.

<sup>369</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2nd Tier EISA 2007.

**Table 351: Lifetime Energy Savings for LED Fixtures with Motion Sensors – Reduced wattage**

| Average Replaced Lamp (W) | Average Wattage of Efficient Lamp (W) | Halogen Incandescent Baseline – Canadian Legislation 1 Year (2024) |                   | LED Equivalent Baseline – American Legislation <sup>370</sup> 23 Years (2025-2047) |                   | Lifetime Energy Savings (kWh) |
|---------------------------|---------------------------------------|--------------------------------------------------------------------|-------------------|------------------------------------------------------------------------------------|-------------------|-------------------------------|
|                           |                                       | Baseline Wattage                                                   | Displaced Wattage | Baseline Wattage                                                                   | Displaced Wattage |                               |
| 131                       | 22.4                                  | 131                                                                | 109               | 22.4                                                                               | 0                 | 187                           |

Then, the difference in hours of operation generated by the motion sensors was considered, as presented in Table 352.

**Table 352: Lifetime Energy Savings for LED Fixtures with Motion Sensors – Reduced Hours of Use**

| Old Average Hours of Use (hours per day) | New Average Hours of Use (hours per day) | Average Wattage of Efficient Lamp | Measure Life (years) | Lifetime Energy Savings (kWh) |
|------------------------------------------|------------------------------------------|-----------------------------------|----------------------|-------------------------------|
| 4.69                                     | 2.90                                     | 22.4                              | 10.0                 | 146                           |

The total lifetime energy savings of 333 kWh were divided by the first-year savings of 202 kWh to obtain an equivalent EUL of 1.6 years.

For solar fixtures, a measure life of 10 years was assumed based on the EUL values for motion sensors. While solar lamps initially remove the full wattage of the baseline lamps from the grid, the baseline wattage is assumed to become LED lamps starting in 2025. Therefore, the wattage of the outdoor fixtures with motion sensors was assumed starting in 2025 until the end of the measure life. An equivalent EUL was obtained using the equation and Table 353 below, which corresponds to 1.9 years.

$$\text{Equivalent EUL} = (\Delta W_{\text{Initial}} \times 1 \text{ Year} + \Delta W_{\text{LED}} \times 9 \text{ Years}) / \Delta W_{\text{Initial}}$$

**Table 353: Equivalent EUL Calculation for Solar Fixtures**

| Average Replaced Lamp (W) | Average Wattage of Efficient Lamp (W) | Halogen Incandescent Baseline – Canadian Legislation 1 Year (2024) |                   | LED Equivalent Baseline – American Legislation <sup>371</sup> 9 Years (2025-2033) |                   |
|---------------------------|---------------------------------------|--------------------------------------------------------------------|-------------------|-----------------------------------------------------------------------------------|-------------------|
|                           |                                       | Baseline Wattage                                                   | Displaced Wattage | Baseline Wattage                                                                  | Displaced Wattage |
| 46.7                      | 0 (Not connected to grid)             | 46.7                                                               | 46.7              | 4.68                                                                              | 4.68              |

<sup>370</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2nd Tier EISA 2007.

<sup>371</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2nd Tier EISA 2007.

## APPENDIX III

### Detailed Calculations of 2024 Equivalent EUL Values for LED Lamps and Fixtures

This appendix presents how the equivalent effective useful life (EUL) of LED lamps and fixtures were calculated for applicable measures in the SBES program component. An equivalent EUL corresponds to the number of years by which the first-year savings need to be multiplied to obtain the lifetime savings.

The Evaluator first calculated the equipment life of each type of lamp and fixture, as presented in Table 354. The equipment life was calculated as the ratio between the manufacturer rated lifetime for the lamps and fixtures installed under the program components and the annual HOU values used to calculate unitary savings values.

**Table 354: Equipment Life Value per LED Lamp and Fixture Types**

| LED Lamp and Fixture Type            | Program Component | Average Rated Lifetime Hours (hours) <sup>372</sup> | Annual HOU (hours/year) <sup>373</sup> | Equipment Life (years) |
|--------------------------------------|-------------------|-----------------------------------------------------|----------------------------------------|------------------------|
| LED General-use and Decorative Lamps | SBES              | 25,000                                              | 3,600                                  | 6.9                    |
| Reflector Lamps                      |                   | 25,000                                              | 3,600                                  | 6.9                    |
| Non-recessed Downlight Fixtures      |                   | 50,000                                              | 3,600                                  | 13.9                   |
| Recessed Downlight Fixtures          |                   | 50,000                                              | 3,600                                  | 13.9                   |

<sup>372</sup> Based on manufacturer specification sheets for the most popular models installed through EPI in 2017.

<sup>373</sup> Based on the unitary savings review.



## Rationale for Using an Equivalent EUL

The LED market is evolving rapidly, driven in part by government regulations. LED products installed today are likely to become the baseline before the end of their rated lifetime since LED technologies are developing quickly and prices are falling. Some jurisdictions have already applied a reduced equivalent EUL to their lighting savings by adopting a higher baseline to represent savings in future years. In other words, their baseline increases over the lifetime of the product, which in turns reduces the equivalent EUL applied to first-year savings to obtain lifetime energy savings. The baseline is informed by government regulations as well as LED market information.

In terms of government regulations, the U.S. Energy Independence and Security Act (EISA) 2020 requiring a minimum efficiency level for CFLs, also known as the EISA backstop, continues to be a key consideration.<sup>374</sup> The previous administration decided to eliminate the EISA backstop on inefficient lighting products. However, six states passed their own state legislation to implement the efficient lighting standards on January 1, 2020, regardless of what happened nationally. As of April 2022, the Biden administration restored the lighting standards for the extended definition of general service lamps (including decorative and reflector lamps) to the 45 lm/W efficiency standard. The standard will apply as of July 2023. In Canada, lighting has been added to the list of considered products for Amendments 18 and 19, which are planned to be at the pre-publication stage in early 2024. This would be consistent with the usual delay of approximately two years between Canadian and U.S. regulations as a new standard could be expected to be enforced in 2025.

While the latest U.S. regulation is set to establish a minimum efficiency level corresponding to a high-efficiency CFL, recent studies<sup>375</sup> indicate that the U.S. market is rapidly moving away from CFL lamps toward LED lamps. Steady shipment volumes, high LED shipment shares, elevated free-ridership levels, retailers' impressions on market saturation, and the greater availability of LED technologies compared to non-LEDs are all factors leading the Evaluator to believe that the markets for both LED A-type as well as LED non-A-type lamps are close to maturity. Although the Canadian general service lamp minimum energy performance has not yet been updated, it is expected that it will result in a ban on halogen incandescent lamps once it is applied. The Evaluator then expects LED technology to become the standard, a standard that most of the market has already attained. For these reasons, the Evaluator expects the baseline for LED lamps to change in 2025; hence, 2024 is the last year with savings before the LED baseline is applied. The assumed baseline changes for A-type and non-A-type lamps are outlined in Table 355 below.

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<sup>374</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 8.0, Volume 3*, October 17, 2019, p. 258.

<sup>375</sup> Illinois Commerce Commission, *Illinois Statewide Technical Reference Manual for Energy Efficiency Version 8.0, Volume 3*, October 17, 2019, p. 258.

**Table 355: LED Baseline Evolution**

| Baseline                                                      | Minimum Wattage Requirement | Years                      | Rationale                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------|-----------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A-type</b>                                                 |                             |                            |                                                                                                                                                                                                                                                                                                                                                                   |
| Incandescent Baseline                                         | N/A                         | 2024 (1,000 hours)         | Since incandescent lamps may no longer be replaced by incandescent lamps, there is a first increase in the baseline upon burnout. Incandescent light lamps have a typical rated life expectancy of 1,000 to 2,000 hours. <sup>376</sup> The remaining useful life of replaced functional incandescent light lamps is assumed to be half the rated life expectancy |
| LED Equivalent Baseline – American Legislation <sup>377</sup> | 45 lumens/W                 | 2025 - end of product life | See rationale above.                                                                                                                                                                                                                                                                                                                                              |
| <b>Reflector (R, BR) and Decorative Lamps</b>                 |                             |                            |                                                                                                                                                                                                                                                                                                                                                                   |
| Halogen Incandescent Baseline                                 | N/A                         | 2024                       | The current Canadian regulations allow halogen incandescent lamps for reflector lamps (R, BR) and decorative. Therefore, the first baseline corresponds to the baseline product, namely halogen incandescent lamps                                                                                                                                                |
| LED Equivalent Baseline – American Legislation <sup>378</sup> | 45 lumens/W                 | 2025 - end of product life | See rationale above                                                                                                                                                                                                                                                                                                                                               |
| <b>Reflector (GU, PAR, MR) Lamps</b>                          |                             |                            |                                                                                                                                                                                                                                                                                                                                                                   |
| Halogen Baseline                                              | N/A                         | 2024                       | The current Canadian regulations allow halogen incandescent lamps for reflector lamps (GU, PAR, MR). Therefore, the first baseline corresponds to the baseline product, namely halogen lamps                                                                                                                                                                      |
| LED Equivalent Baseline – American Legislation <sup>379</sup> | 45 lumens/W                 | 2025 - end of product life | See rationale above                                                                                                                                                                                                                                                                                                                                               |

Using the baseline evolution presented above, the following sections present the detailed calculations and resulting values for all LED lighting products.

<sup>376</sup> Lighting Research Center - Rensselaer Polytechnic Institute, *Lighting Patterns for Homes. Light Bulb Features*, [www.lrc.rpi.edu/patternbook/resources/lamp\\_features.asp](http://www.lrc.rpi.edu/patternbook/resources/lamp_features.asp) (last accessed October 1, 2020).

<sup>377</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

<sup>378</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

<sup>379</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

## SBES

### LED General-use and Decorative Lamps

The methodology used to establish the equivalent EUL of general-use and decorative lamps is based on the information presented in Table 356 and the equation below. The equivalent EUL calculation is based on 9 W LED lamps. The baseline technology is assumed to be a mix of 60 W incandescent lamps and 43 W halogen incandescent lamps, which yields an average baseline of 52 W.

Since incandescent lamps can no longer be replaced by incandescent lamps, there is a baseline increase upon burnout. These lamps are assumed to have a remaining lifetime of 1,000 hours, which translates to 0.28 years with an annual HOU of 3,600 hours. Since SBES targets commercial participants, it is assumed that some participants might have incandescent lamps stocked and, therefore, the Evaluator increased the duration of this baseline to a full year.

As outlined in Table 355 above, the equipment life of this product is 6.9 years, meaning the corresponding baseline will be affected by the change in legislation occurring in 2025. Starting in 2025 and for the remaining lifetime of the fixture (5.9 years), the baseline will be a LED, which results in no additional savings. With the information presented in Table 356, the following equation served to set the equivalent EUL of general-use and decorative lamps at 1.0 year.

$$\text{Equivalent EUL} = \frac{\Delta W_{\text{Halogen Incandescent and Incandescent}} \times 1 \text{ Year} + \Delta W_{\text{LED}} \times 5.9 \text{ Years}}{\Delta W_{\text{Halogen Incandescent and Incandescent}}}$$

**Table 356: Baseline Evolution During the Effective Useful Life of LED General-use and Decorative Lamps**

| Typical Replaced Lamp (W) | Typical Efficient Lamp (W) | Incandescent and Incandescent Baseline 1 Year (2024) |                   | LED Equivalent Baseline – American Legislation <sup>380</sup> 5.9 Years (2025-2030) |                   | Equivalent EUL (years) |
|---------------------------|----------------------------|------------------------------------------------------|-------------------|-------------------------------------------------------------------------------------|-------------------|------------------------|
|                           |                            | Baseline Wattage                                     | Displaced Wattage | Baseline Wattage                                                                    | Displaced Wattage |                        |
| 52                        | 9                          | 52                                                   | 43                | 9                                                                                   | 0                 | 1.0                    |

### Reflector Lamps

LED reflector lamps typically replace halogen lamps. As outlined in Table 347 further above, their average rated life is estimated at 25,000 hours, which translates into an equipment life of 6.9 years. With the regulation planned to impact reflector lamps in 2025, the baseline wattage will be reduced to a LED starting in 2025 and for the remaining lifetime of the fixture (4.9 years). The equivalent EUL was calculated at 1.0 year based on the following equation and the information presented in Table 357.

$$\text{Equivalent EUL} = \frac{\Delta W_{\text{Halogen}} \times 1 \text{ Year} + \Delta W_{\text{LED}} \times 5.9 \text{ Years}}{\Delta W_{\text{Halogen}}}$$

<sup>380</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

**Table 357: Baseline Evolution During the Effective Useful Life of LED Reflector Lamps**

| Typical Replaced Lamp (W) | Typical Efficient Lamp (W) | Halogen Baseline<br>1 Year (2024) |                   | LED Equivalent Baseline -<br>American Legislation <sup>381</sup><br>5.9 Years (2025-2030) |                   | Equivalent EUL<br>(years) |
|---------------------------|----------------------------|-----------------------------------|-------------------|-------------------------------------------------------------------------------------------|-------------------|---------------------------|
|                           |                            | Baseline Wattage                  | Displaced Wattage | Baseline Wattage                                                                          | Displaced Wattage |                           |
| 43                        | 12                         | 43                                | 31                | 12                                                                                        | 0                 | 1.0                       |

### Non-recessed LED Downlight Fixtures

Since non-recessed LED downlight fixtures replace fixtures using A-type lamps, the methodology for establishing their equivalent EUL is similar to that of A-type lamps in Efficient Product Installation (EPI). The equivalent EUL calculation is based on the typical case of 9 W LED lamps and the first baseline increase occurs one year following the anticipated burnout of incandescent lamps. Importantly, given their rated life of 50,000 hours and corresponding equipment life of 13.9 years, the baseline is affected by the change in regulation occurring in 2025. Starting in 2025 and for the remaining lifetime of the fixture (12.9 years), the baseline will be a LED, which results in no additional savings. The equation and Table 358 below present the information used to calculate the equivalent EUL of 1.0 years.

$$Equivalent\ EUL = \frac{\Delta W_{Halogen\ Incandescent\ and\ Incandescent} \times 1\ Year + \Delta W_{LED} \times 12.9\ Years}{\Delta W_{Halogen\ Incandescent\ and\ Incandescent}}$$

**Table 358: Baseline Evolution During the Effective Useful Life of Downlight Fixtures**

| Typical Replaced Lamp (W) | Typical Efficient Lamp (W) | Halogen Incandescent and Incandescent Baseline<br>1 Year (2024) |                   | LED Equivalent Baseline -<br>American Legislation <sup>382</sup><br>12.9 Years (2025-2037) |                   | Equivalent EUL<br>(years) |
|---------------------------|----------------------------|-----------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------|-------------------|---------------------------|
|                           |                            | Baseline Wattage                                                | Displaced Wattage | Baseline Wattage                                                                           | Displaced Wattage |                           |
| 52                        | 9                          | 52                                                              | 43                | 9                                                                                          | 0                 | 1.0                       |

### Recessed Downlight Fixtures

Since LED recessed downlight fixtures replace fixtures typically housing reflector lamps for which the baseline technology is halogen lamps, the methodology for establishing their equivalent EUL is similar to that of reflector lamps. The EUL of LED recessed downlight fixtures is established at 13.9 years based on a rated life of 50,000 hours. The equivalent EUL calculation is based on the typical case of a 12 W LED reflector lamp replacing a 43 W halogen lamp. With the regulation planned to impact reflector lamps in 2025, LED lamps will become the baseline for the remaining lifetime of LED recessed downlight fixtures (12.9 years). The equivalent EUL was calculated at 1.0 year based on the information presented in Table 359.

$$Equivalent\ EUL = \frac{\Delta W_{Halogen} \times 1\ Year + \Delta W_{LED} \times 12.9\ Years}{\Delta W_{Halogen}}$$

<sup>381</sup> Ibid.

<sup>382</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.

**Table 359: Baseline Evolution During the Effective Useful Life of LED Reflector Lamps  
in Downlight Fixtures**

| Typical<br>Replaced<br>Lamp (W) | Typical<br>Efficient<br>Lamp (W) | Halogen Baseline<br>1 Year (2024) |                      | LED Equivalent Baseline -<br>American Legislation <sup>383</sup><br>12.9 Years (2025-2037) |                      | Equivalent<br>EUL<br>(years) |
|---------------------------------|----------------------------------|-----------------------------------|----------------------|--------------------------------------------------------------------------------------------|----------------------|------------------------------|
|                                 |                                  | Baseline<br>Wattage               | Displaced<br>Wattage | Baseline<br>Wattage                                                                        | Displaced<br>Wattage |                              |
| 43                              | 12                               | 43                                | 31                   | 12                                                                                         | 0                    | 1.0                          |

<sup>383</sup> As imposed by U.S. federal legislation. Incandescent Equivalent 2<sup>nd</sup> Tier EISA 2007.



## APPENDIX IV

### Interactive Effects Methodology for Commercial Lighting

The interactive effects calculation methodology for commercial lighting was revised as part of the 2024-2025 DSM Measure Assessment update. This appendix details how the calculations were performed to obtain revised interactive effect factors, which will be applied to the 2025 savings only, since the new approach requires certain changes in the tracking data and to adjustment ratios.

### Calculation Approach

Pursuant to a literature review of methodologies used by other jurisdictions and of the Uniform Methods Project recommendations, the Evaluator decided to continue applying an engineering calculation approach to estimate interactive effects factors while making some updates to reflect the latest knowledge and available data. The engineering calculations are based on the following general equations for energy interactive effects and for peak demand savings interactive effects.

$$IE_E\% = \%LightingIndoor \times \%LightingHeatConditioned \times (BuildingHeatE + BuildingCoolE)$$

$$BuildingHeatE = f_{heat} \div HeatCOP = \frac{-HoursLightingHeat}{HoursLighting} \div HeatCOP$$

$$BuildingCoolE = f_{cool} \div CoolCOP = \frac{HoursLightingCool}{HoursLighting} \div CoolCOP$$

Where:

- › *%LightingIndoor*: The percentage of fixtures and lamps that are installed in indoor conditioned spaces as only those result in interactive effects.
- › *%LightingHeatConditioned*: The percentage of heat generated by lighting and that is produced inside the conditioned space for indoor lighting. This considers the fact that some fixtures generate a portion of their heat in ceiling plenums or in high ceilings where that heat does not impact the space heating or cooling load.
- › *BuildingHeatE*: The energy interactive effects factor associated with the facility and heating system type.
- › *BuildingCoolE*: The energy interactive effects factor associated with the facility and cooling system type.
- › *f<sub>heat</sub>*: The fraction of lighting hours during which the heat generated impacts on the heating load.
- › *f<sub>cool</sub>*: The fraction of lighting hours during which the heat generated impacts on the cooling load.
- › *HoursLightingHeat*: The number of annual hours when both lights and the heating system are on.
- › *HoursLighting*: The number of annual hours when the lights are on.
- › *HeatCOP*: The efficiency of the heating system.
- › *HoursLightingCool*: The number of annual hours when both lights and the cooling system are on.
- › *CoolCOP*: The efficiency of the cooling system.

The equation for peak demand savings interactive effects follows the same general principles with the difference that the *HoursHeatingPeak* and *HoursPeak* only consider hours that coincide with the peak demand period defined as non-holiday weekdays between 5 p.m. and 7 p.m. in December, January, and February. These variables do not include whether lights are on or not because, if lights are off during these peak hours, the peak demand savings are nil (i.e. the value of the interactive effects factors do not matter). Cooling system operation is not considered for peak demand savings as cooling systems are assumed to not operate during winter peak conditions. The peak demand savings interactive effects factors are therefore calculated as:

$$IE_{PD}\% = \%LightingIndoor \times \%LightingHeatConditioned \times BuildingHeatPD \\ = \%LightingIndoor \times \%LightingHeatConditioned \times \left( \frac{-HoursHeatPeak}{HoursPeak} \div HeatCOP \right)$$

Where:

- › *HoursHeatPeak*: The number of annual hours of the peak demand period when the heating system is on.
- › *HoursPeak*: The number of annual hours of the peak demand period.
- › *BuildingHeatPD*: The peak demand interactive effects factor associated with the facility and heating system type.

The savings with interactive effects (either electrical energy or peak demand) should then be calculated as follows.

$$Savings\ with\ IE = Savings \times (1 + IE_E\%)$$

The following subsections first describe how the building-specific and system-specific intermediate values are obtained (*BuildingHeatE*, *BuildingCoolE*, and *BuildingHeatPD*) and then detail the estimates of *%LightingIndoor* and *%LightingHeatConditioned* variables. The last subsection explains how the values are applied to commercial lighting measures in various program components.

## Calculation of Building and System-Specific Intermediate Values

This first subsection details how the *BuildingHeatE*, *BuildingCoolE*, and *BuildingHeatPD* variables are calculated.

### Lighting Operation Schedule

Each building archetype (as tracked in the BER-AR and SBES tracking sheets) is assigned a typical lighting operation schedule as per Table 360.

**Table 360: Lighting Operation Schedule per Building Archetype**

| Building Archetype              | 8 A.M to 4 P.M. | 8 A.M. to 6 P.M. | 24 hours |
|---------------------------------|-----------------|------------------|----------|
| Agriculture                     | X               |                  |          |
| Banking / Financial             | X               |                  |          |
| Education                       | X               |                  |          |
| Entertainment / Public Assembly | X               |                  |          |
| Healthcare                      |                 |                  | X        |
| Hospitality                     |                 |                  | X        |
| Manufacturing / Industrial      |                 | X                |          |
| Office / Commercial             | X               |                  |          |
| Public Service                  | X               |                  |          |
| Residential                     |                 |                  | X        |
| Restaurant / Bar                |                 | X                |          |
| Retail                          |                 | X                |          |
| Technology / Science            | X               |                  |          |
| Warehouse / Storage             |                 |                  | X        |

It is approximated that lighting is on during these hours for all seven days of the week. Interactive effects factors are calculated for these hours specifically.

## Operation of Building Heating and Cooling Systems

To identify hours during which heating and cooling systems are on, outdoor temperatures as well as the building balance temperatures are considered.

### Balance Temperature

The heating balance temperature is the outdoor temperature below which a heating system will operate to meet thermal comfort requirements in a building. The cooling balance temperature is the outdoor temperature above which a cooling system will operate to meet thermal comfort requirements in a building. While it is difficult to obtain a reference balance temperature for commercial buildings in the literature (since the balance temperature is specific to each building), values in the range of 55°F (or 13°C) to 65°F (18°C) are often mentioned in resources for modellers and, in the Evaluator's experience, are common in hourly measurement and verification energy regressions for commercial buildings. The Uniform Methods Project does not make specific recommendations for the balance temperature of commercial buildings, but it notes that, for residential buildings, 60°F (15.5°C) and 70°F (21°C) are typical balance temperatures for heating and cooling respectively.<sup>384</sup> These values are expected to be higher than those for commercial buildings. The New York interactive effects calculation file<sup>385</sup> assumes a heating balance temperature of 50°F (10°C) and a cooling balance temperature of 60°F (15.5°C). In light of this information, the Evaluator used a balance temperature of 13°C for heating and 18°C for cooling.

<sup>384</sup> Agnew, K.; Goldberg, M., 2017. Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68564. <http://www.nrel.gov/docs/fy17osti/68564.pdf>.

<sup>385</sup> New York State Joint Utilities, New York State TRM V11 - HVAC Interactive Factors (Appendix D) \_7\_20\_2023.xlsx Available at: <https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=14-M0101&CaseSearch=Search>.

## Weather Data

To determine whether each hour of the year is below the heating balance temperature or above the cooling balance temperature, a typical meteorological year based on a 15-year average (2008 to 2023) was built.

## Heating and Cooling Season

Temperatures below 13°C might occur during parts of the year when heating systems are not active, in which case efficient lighting would have no impact on the heating load. The same concept is true of temperatures above 15°C for cooling systems. Therefore, the Evaluator established a heating season and a cooling season to delimitate the periods during which lighting might impact heating and cooling loads. The heating season was estimated to be between October 1 and April 30 as there are fewer than five degree-days per day outside of these dates.<sup>386</sup> The remainder of the year was considered to be the cooling season.

## Heating and Cooling System Efficiency

For each measure installed in BER-AR or SBES, the space heating and cooling systems are known and the efficiency of each is applied as per the following table.

| Table 361: Coefficient of Performance (COP) by Space Heating and Cooling Systems Heating and Cooling System | COP | Reference                                                                               |
|-------------------------------------------------------------------------------------------------------------|-----|-----------------------------------------------------------------------------------------|
| Electric resistance heating                                                                                 | 1.0 | Convention                                                                              |
| Heat pump heating                                                                                           | 1.8 | COP of a standard mini-split heat pump based on an HSPF2 Region V of 6.0 <sup>387</sup> |
| Air conditioning                                                                                            | 2.5 | Assumption <sup>388</sup>                                                               |

## Building and System-specific Intermediate Value Results

Using the equations and the parameters described above, the Evaluator developed the *BuildingHeatE* and *BuildingCoolE* tables below for electrical energy consumption and peak demand. The information in the tables is applicable to both SBES and BER-AR. For lighting measures installed under these program components, interactive effects factors should be selected based on the facility type in which measures are installed as well as the type of electrical heating and cooling systems serving the space.

<sup>386</sup> This assumption was also used in the analysis of the residential interactive effects as presented in appendix of the 20224-2025 DSM Residential Measure Assessment.

<sup>387</sup> Assuming an average HSPF2 of 6.0 for Region V, which corresponds to the minimum for “split system central heat pumps, other than those that are small-duct and high-velocity or space-constrained” as per the NRCan regulation available at <https://natural-resources.canada.ca/energy-efficiency/energy-efficiency-regulations/guide-canadas-energy-efficiency-regulations/split-system-central-air-conditioners-and-heat-pumps/6895>.

<sup>388</sup> This assumption was not documented in the initial methodology. It is consistent with the assumption made in the reference study used for residential interactive effects ADS ASSOCIÉS, Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale, report presented to Hydro-Québec, 1992.

**Table 362: *BuildingHeatE* and *BuildingCoolE* by Facility Type and Heating and Cooling System Type**

| Facility Type                   | BuildingHeatE                         |                                          |                      | BuildingCoolE       |
|---------------------------------|---------------------------------------|------------------------------------------|----------------------|---------------------|
|                                 | Electric Resistance Heating (COP = 1) | Air-source Heat Pump Heating (COP = 1.8) | Non-electric Heating | Cooling (COP = 2.5) |
| Agriculture                     | -52.6%                                | -29.2%                                   | 0.0%                 | 9.1%                |
| Banking / Financial             | -52.6%                                | -29.2%                                   | 0.0%                 | 9.1%                |
| Education                       | -52.6%                                | -29.2%                                   | 0.0%                 | 9.1%                |
| Entertainment / Public Assembly | -52.6%                                | -29.2%                                   | 0.0%                 | 9.1%                |
| Healthcare                      | -54.4%                                | -30.2%                                   | 0.0%                 | 5.7%                |
| Hospitality                     | -54.4%                                | -30.2%                                   | 0.0%                 | 5.7%                |
| Manufacturing / Industrial      | -52.5%                                | -29.2%                                   | 0.0%                 | 9.2%                |
| Office / Commercial             | -52.6%                                | -29.2%                                   | 0.0%                 | 9.1%                |
| Public Service                  | -52.6%                                | -29.2%                                   | 0.0%                 | 9.1%                |
| Residential                     | -54.4%                                | -30.2%                                   | 0.0%                 | 5.7%                |
| Restaurant / Bar                | -52.5%                                | -29.2%                                   | 0.0%                 | 9.2%                |
| Retail                          | -52.5%                                | -29.2%                                   | 0.0%                 | 9.2%                |
| Technology / Science            | -52.6%                                | -29.2%                                   | 0.0%                 | 9.1%                |
| Warehouse / Storage             | -54.4%                                | -30.2%                                   | 0.0%                 | 5.7%                |

**Table 363: *BuildingHeatPD* by Facility Type and Heating System Type**

| Facility Type                   | Electric Resistance Heating (COP = 1) | Air-source Heat Pump Heating (COP = 1.8) | Non-electric Heating |
|---------------------------------|---------------------------------------|------------------------------------------|----------------------|
| Agriculture                     | -100.0%                               | -55.6%                                   | 0.0%                 |
| Banking / Financial             | -100.0%                               | -55.6%                                   | 0.0%                 |
| Education                       | -100.0%                               | -55.6%                                   | 0.0%                 |
| Entertainment / Public Assembly | -100.0%                               | -55.6%                                   | 0.0%                 |
| Healthcare                      | -100.0%                               | -55.6%                                   | 0.0%                 |
| Hospitality                     | -100.0%                               | -55.6%                                   | 0.0%                 |
| Manufacturing / Industrial      | -100.0%                               | -55.6%                                   | 0.0%                 |
| Office / Commercial             | -100.0%                               | -55.6%                                   | 0.0%                 |
| Public Service                  | -100.0%                               | -55.6%                                   | 0.0%                 |
| Residential                     | -100.0%                               | -55.6%                                   | 0.0%                 |
| Restaurant / Bar                | -100.0%                               | -55.6%                                   | 0.0%                 |
| Retail                          | -100.0%                               | -55.6%                                   | 0.0%                 |
| Technology / Science            | -100.0%                               | -55.6%                                   | 0.0%                 |
| Warehouse / Storage             | -100.0%                               | -55.6%                                   | 0.0%                 |

## Estimate of Percentage of Heat Generated in Indoor Conditioned Spaces

This subsection presents the estimates of the *%LightingIndoor* and *%LightingHeatConditioned* variables.

The *%LightingIndoor* variable indicates whether a specific measure is installed indoor (100%) or outdoor (0% as measures installed outdoor do not generate interactive effects). This information comes from each specific measure in the tracking sheet.

The *%LightingHeatConditioned* variable represents the percentage of heat generated by lighting and that is produced inside the conditioned space for indoor lighting. This considers the fact that some fixtures generate a portion of their heat in ceiling plenums or in high ceilings where that heat does not impact the space heating or cooling load. This variable is specific to the measure types installed as outlined in Table 364.

**Table 364: Values for %LightingHeatConditioned per Measure Type**

| Measure Type                               |              | % Heat in Conditioned Space |
|--------------------------------------------|--------------|-----------------------------|
| Linear LED Fixtures                        | Recessed     | 57% <sup>389</sup>          |
|                                            | Non-recessed | 100%                        |
| Linear LED Lamps                           | Recessed     | 57%                         |
|                                            | Non-recessed | 100%                        |
| High Bay Fixtures                          |              | 0% <sup>390</sup>           |
| Outdoor LED Fixtures                       |              | 0%                          |
| Directional and Architectural LED Fixtures |              | 100%                        |
| Indoor Occupancy/Motion Sensors            |              | 100%                        |
| Outdoor Motion Sensors                     |              | 0%                          |
| LED Lamps (SBES – CDI only)                |              | 100%                        |
| LED Nightlights (SBES – CDI only)          |              | 100%                        |

## Application of IE Tables

For BER-AR and SBES, the calculation methodology should be applied for each measure using project-specific information tracked in the CIS starting in early 2025. The table below lists the fields required.

**Table 365: Tracking Sheet Fields Required for Interactive Effect Calculations**

| Field               | Used for Variables                                 | Available in SBES?                                                                                                                                                                                                                        | Available in BER-AR?                                                                                                           |
|---------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Indoor/Outdoor      | %LightingIndoor                                    | Not specifically. Indicated in Measure Location, but not in a standardized field. In the absence of this information, assumptions can be made by measure category since measures tend to be installed almost all indoors or all outdoors. |                                                                                                                                |
| Facility Type       | BuildingHeatE,<br>BuildingCoolE,<br>BuildingHeatPD | Yes                                                                                                                                                                                                                                       | Yes, but is indicated as “IE/IEpd Override” in a large proportion of cases – the facility type should be recorded in all cases |
| Heating System Type | BuildingHeatE,<br>BuildingHeatPD                   | Yes                                                                                                                                                                                                                                       | Yes, but does not differentiate between electric resistance and heat pump                                                      |
| Cooling System Type | BuildingCoolE                                      | Yes                                                                                                                                                                                                                                       | Yes                                                                                                                            |
| Measure Type        | %LightingHeatConditioned                           | Yes                                                                                                                                                                                                                                       | Yes                                                                                                                            |

E1 will be adding tracking fields in BER-AR over the course of 2025 to ensure that all required information (as noted in Table 365) is available to implement the new interactive effect calculations. The Evaluator will also work with E1 to classify a comprehensive list of measure types as recessed or non-recessed. This information will be collected in 2025 through a review of new data that are expected to become available in the DLC Qualified Products List<sup>391</sup> and possibly through the site visits that will be conducted as part of the 2025 DSM evaluation for BER-AR. The 2025 interactive effects factors for SBES and BER-AR, based on this new methodology, will then be used to estimate the average interactive effects for BER-IR.

<sup>389</sup> The estimation of the percentage of heat generated in the conditioned space is derived from Chantrasrisalai, C., and D.E. Fisher, “Lighting heat gain parameters: Experimental results.” in *HVAC&R Research* 13(2):305-324, 2007.

<sup>390</sup> The Evaluator assumes that the heat generated by high bay fixtures (that are installed in areas with high ceilings) remains largely at heights where the temperature is not controlled and therefore generates no significant interactive effects.

<sup>391</sup> If this is not available as expected, the Evaluator will conduct research on a sample of popular products.



## APPENDIX V

### Net-to-Gross Ratio Review

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#### EXECUTIVE SUMMARY

EfficiencyOne (E1) commissioned Econoler to evaluate E1's 2023-2025 DSM program portfolio. As part of the evaluation scope, E1 asked Econoler to present a review of net-to-gross ratio (NTGR) best practices and update the free-ridership and participant spillover questionnaires and algorithms used in E1's DSM programs. The aim of this update is to ensure that the questionnaires and algorithms used are consistent across programs and in line with the latest best practices.

The findings presented herein are drawn from a combination of several references and Econoler's expertise and knowledge. The majority of the findings are based on the Uniform Methods Project (UMP) and the results of a review of publicly available questionnaires and algorithms contained in evaluation protocols, technical reference manuals (TRMs), and results reporting. Information was reviewed from Massachusetts, the IESO and Enbridge in Ontario, Rhode Island, Maine, and New Jersey.

The review focused solely on the self-report method, the most commonly used approach to estimate net savings and the current method employed in the E1 DSM evaluation. An approach to non-participant spillover or market effects was not included.

Based on Econoler's review of NTGR best practices using the self-report approach, Econoler has identified several aspects of the current approach that should be maintained and other areas that should be consistently updated across the portfolio moving forward.

#### Aspects Maintained

- › The overall adjustment approach to **cross-influence** currently used in E1 algorithms. This approach captures influences outside the program (e.g. past participation, educational initiatives, etc.), the results of which are then applied to total free-ridership score results.
- › The current method of capturing **spillover** with a focus on like spillover. Unlike spillover should be considered when a program is designed to influence participants to take further actions beyond what is included in the program (e.g. the educational aspect of the Efficient Product Installation program).
- › **Consistency checks.** Questions that serve to check for contradictions, compare responses to similar questions, and remove inconsistencies from the NTGR calculation continue to be important. Open-ended questions can be included for programs involving larger projects to provide context and a further consistency check.
- › **Number of questions.** The current questionnaire design (number of questions and framing) can be maintained, although language efficiencies may be employed where appropriate (see Key Changes below).



## Key Changes

- › **Averaging the intention and influence scores** to calculate free-ridership. This updated approach adopted by several jurisdictions ensures that both variables carry an equal weighting as decision-making factors. Econoler recommends that E1 move to this new approach.
- › Using a **four-point unbalanced scale for free-ridership and spillover**. Answer scales in E1 algorithms primarily use a 10-point numbered scale approach whereby only the first and last points of the scale are labelled. Econoler recommends moving to a four-point ordinal scale whereby all points are distinctly labelled for improved survey participant comprehension. The proposed scale is unbalanced since each scale point must be scored incrementally for the free-ridership algorithm.
- › **Simplifying question wording where possible**. Simple questions where possible help ensure clarity and comprehension for survey respondents. Econoler will continue to pre-test questionnaire changes among small respondent samples to ensure that questions are correctly understood before fully launching any survey.
- › Ensuring that the NTGR is considered for all measures, either utilizing a **deemed ratio or program-level ratio when not measured**. This would be the case for multi-measure programs (e.g. Efficient Product Installation) where it is not possible to collect data on all measures.



## INTRODUCTION

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EfficiencyOne (E1), an independent, non-profit organization, is responsible for helping Nova Scotians improve the energy efficiency of their homes and workplaces by designing, marketing, and delivering demand-side management (DSM) for Nova Scotians. E1 provides energy efficiency, demand response, and carbon mitigation services through the Efficiency Nova Scotia (ENS) franchise. Regulatory oversight is provided by the Nova Scotia Utility and Review Board (NSUARB). E1 receives funding for its electrical DSM activities from Nova Scotia Power (NS Power) ratepayers.

E1 has a DSM portfolio of three residential programs and three business, non-profit, and institutional (BNI) programs that are marketed to Nova Scotians through the ENS franchise. Each program has one or more program components. Econoler was commissioned by E1 to evaluate E1's 2023-2025 DSM program portfolio.

This report presents a review of net-to-gross ratio (NTGR) best practices and updates the free-ridership and participant spillover questionnaires and algorithms used in E1's DSM programs so that they are consistent across programs and in line with the latest best practices.

The findings included in this report are drawn from a combination of several references and Econoler's expertise and knowledge. The majority of the findings included in this report are based on the Uniform Methods Project (UMP), and a review of publicly available questionnaires and algorithms contained in evaluation protocols, technical reference manuals (TRMs), and results reporting. Information was reviewed from Massachusetts, the IESO and Enbridge in Ontario, Rhode Island, Maine, and New Jersey.

The review is focussed only on the self-report method, the most commonly used approach to estimate net savings and the current method employed in evaluation. The review includes:

- › A summary of the latest best practices in NTGR algorithm development and survey design, based on a literature review.
- › A review and documentation of the Evaluator's overall approach and detailed rules for NTGR questionnaires and algorithms and how these align with best practices. The set of rules covers topics such as NTGR calculations, algorithm design, triangulation, correct formulation of survey questions, etc.
- › An update to NTGR algorithms used for E1's portfolio of DSM programs to ensure they continue to be aligned with best practices, account for all necessary factors and, where appropriate, use a consistent approach. Please note that this review does not provide an approach to non-participant spillover or market effects.

This document will be used to guide the NTGR data collection and analysis for the programs for which a NTGR update is planned in 2024 (i.e. Efficient Product Installation, Business Energy Rebates-Instant Rebates, and Custom; Instant Savings is excluded because data collection occurs too early in the year) and will be applied to other programs minimally for the remainder of the current DSM Plan period (i.e. 2023-2025) and in principle as long as a self-reporting NTGR approach is used.

This report is divided into several parts: the first concerns best practices and recommendations with respect to NTGR methodology and algorithm design, including study design and sampling; the second is focused on best practices and recommendations with respect to the self-report method, including survey and question design as well as data collection and triangulation. Next, a review of E1's current approach is provided with a summary of recommendations on what elements of the NTGR methodology should be maintained or updated based on this review. Finally, using these recommendations, the algorithms for EPI and BER-IR are reviewed and updated to reflect the recommendations as examples.

## 7 Net-to-gross Ratio (NTGR) Methodology

This section documents best practices and recommendations with respect to NTGR calculations, NTGR methodology, algorithm design, free-ridership (FR) and participant spillover (SO) scoring, consistency checking, as well as study design and sampling.

### 7.1 NTGR Algorithm

#### 7.1.1 The Net-to-gross Ratio Calculation

The NTGR is applied to a program to ensure the savings being attributed to the given program would not have happened naturally without the intervention of the program. It is best practice across all jurisdictions reviewed to include questions to capture, at minimum, free-ridership and spillover levels within a program evaluation scope and embed questions related to free-ridership and spillover within a self-reporting feedback questionnaire or interview guide. The formula associated with calculating a NTGR score is shown below.

$$\text{NTGR} = 1 - \text{Free-ridership} + \text{Spillover}$$

(energy savings that would have occurred without the program)      (additional non-incented savings attributable to the program)

#### Free-ridership Score Components

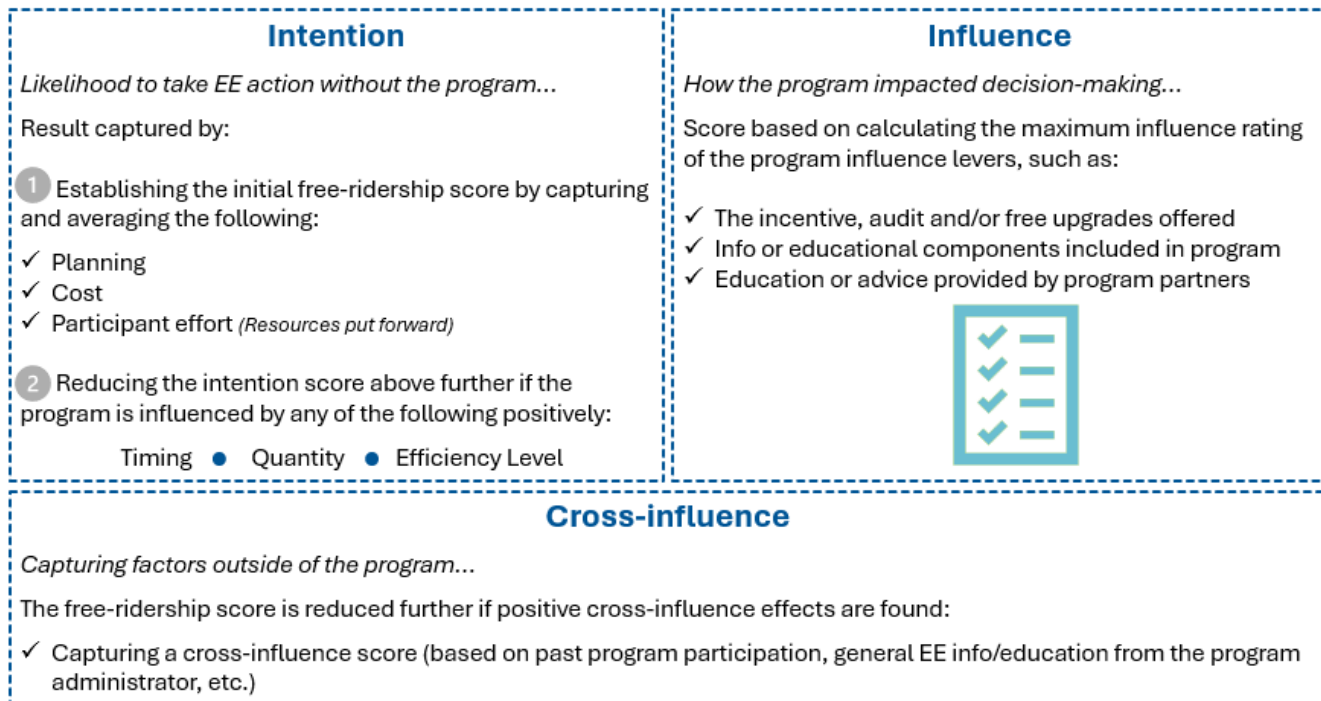
In calculating free-ridership, the self-report method is aimed at establishing how the participant decided to implement the energy efficient or demand response measure(s).

Three factors need to be considered:

- › Intention: The likelihood the participant would have implemented the measure without the program.
- › Influence: How the program impacted the participant's decision-making.
- › Cross-influence: How past efforts on the part of the program administrator influence the participant's intention and/or their decision-making.

Each factor is comprised of several elements to establish the most robust understanding of a participant's decision-making and program influence. Figure 3 below depicts the elements that are accounted for in each factor.

**Figure 3: Components of Free-ridership Score<sup>392</sup>**



**Intention** is scored using responses to a series of questions on several decision factors. Questionnaires typically begin with a simple question to assess whether a participant would have taken action without the program being in market (planning). Whether a participant would have paid for the measure(s) or procured/installed them on their own is also captured at this point in the questionnaire and used to calculate the first step of the intention score (cost, participant effort). To achieve further accuracy in the free-ridership score, another series of questions is asked to understand in more detail what the participant would have done without the program, capturing whether they would have postponed their project (timing), installed fewer or less efficient measures (quantity, efficiency). Responses on timing, quantity, and efficiency are used only to reduce, not increase the intention score. This approach, which was observed across the jurisdictions reviewed, ensures that responses indicating free-ridership are not double counted (e.g. a participant who intended to install a measure without the program (planning) will also likely respond accordingly to questions on quantity or efficiency).

The number and framing of questions to capture intention vary and should be tailored to the program and/or sector. For example, timing questions are generally irrelevant for end-of-life equipment replacement, and the quantity factor is not relevant when there is only one piece of equipment to be replaced (e.g. a water heater for a single-family home). For New Construction programs, the series of intention questions must be adjusted and tailored to the context of new construction projects such as the longer time horizon, impact of the building code in force and the different phases of the project (design, construction etc.).

**Influence** is measured as a single score taking the maximum score of an array of statements relating to program specific influence factors in one matrix-style question. This score accounts for the influence of program incentives, education, and resources provided by the program and advice and information received from program partners only.

<sup>392</sup> To see examples of actual questions used for the Intention and Influence components, please refer to Table 368 and Table 374 in Section 9.

The Evaluator came across two different approaches to account for **cross-influence**. The first approach includes past program participation and general energy efficiency awareness and education provided by the program administrator into the influence score. Therefore, cross-influence is looked at together with program influence factors to form one influence score. In the second approach, a **cross-influence score** is calculated by capturing influences outside the program such as past participation in another program, the program administrator's general education around energy efficiency, etc., and the results are then applied to the total free-ridership score as a further positive effect.<sup>393</sup> This approach considers that cross-influence can impact a participant's intention as well as influence. Only applying cross-influence to the influence score (as in the first approach) would decrease the weight of cross-influence on the scoring. E1 currently uses the second approach in establishing NTGRs, and the Evaluator recommends that this approach be maintained.

Figure 4 below illustrates the recommended **formula for calculating free-ridership**. Averaging the intention and influence scores ensures that intention and influence are weighted as equal decision-making factors, and this was observed in a number of jurisdictions that had recently reviewed and updated their NTGR approaches.<sup>394</sup> This differs from the approach currently applied by E1 where the various components of the participant's intention score are averaged with the influence score, thereby conferring a higher weight to the participant's intention as compared to the program's influence. The Evaluator recommends employing the above approach moving forward to ensure both factors are weighted equally in the free-ridership algorithms. As discussed above, the Evaluator recommends that cross-influence be applied as an overall adjustment.

**Figure 4: Free-ridership Equation**

$$\text{Free-ridership} = \left( \frac{\text{Intention} + \text{Influence}}{2} \right) \times \text{Cross-influence}$$

## Partial Free-riders

Free-ridership scores can vary between 0% and 100%. It is best practice to ensure free-ridership questions are nuanced to enable accounting for partial free-ridership. Partial free-riders are those who fall somewhere in between a full free-rider (100%) and instances where no free-ridership is present (0%). Measuring a series of factors (planning, cost, effort, timing, quantity, efficiency, influence, and cross-influence) allows for the free-ridership score to be adjusted to include partial free-riders.

### 100% score (free-rider):

- › Would have installed in the same timeframe and context
- › Would have installed the same quantity of measures and efficiency level
- › Installed measures prior to learning about program

### Partial free-rider:

- › Program had impact on quantity/timing/efficiency of upgrades, but not full impact
- › Aspects of the program influenced their decision to participate

### 0% score:

- › Would not have taken any action without the program

<sup>393</sup> Massachusetts and Rhode Island calculate a cross-influence score and apply the result to the overall free-ridership score.

<sup>394</sup> Massachusetts in 2022, New Jersey (new to DSM) in 2023, and Efficiency Maine's most recent C&I evaluation in 2023.

## Free-ridership Scoring

In the self-report method, an important consideration is scoring responses that are used to establish the free-ridership result. The scoring of individual scale points may vary based on the algorithm, but it is **best practice to ensure consistency in the number of scale points utilized and the labels associated with each point**. E1's current approach primarily uses a 10-point scale. While there is less consensus among practitioners in scales and scoring, a reduced scale (i.e. three, four or five point) is often used.

Econoler recommends moving to a four-point labelled scale format as outlined in Table 366 below. The four-point scale allows for each scale point to be labelled to enable the Evaluator to define what each scale point means, resulting in more uniform and accurate results. Further, Econoler recommends using an unbalanced scale for free-ridership related questions as each scale point must be scored incrementally and included in an algorithm. Note that the four-point scale is a guideline and may not be applicable to all questions (e.g. questions providing scenarios as the response) depending on the algorithm and program. The scoring presented in Table 366 provides an example and may be adjusted in algorithm development depending on the question and program.

**Table 366: Examples of Four-point Scales and Scoring**

| Scale Point | Influence              | Importance           | Likelihood           | Score                                       |
|-------------|------------------------|----------------------|----------------------|---------------------------------------------|
| 1           | Very influential       | Very important       | Definitely would     | 100%                                        |
| 2           | Somewhat influential   | Somewhat important   | Probably would       | 75%                                         |
| 3           | Not very influential   | Not very important   | Probably would not   | 25%                                         |
| 4           | Not at all influential | Not at all important | Definitely would not | 0%                                          |
| 98          | Don't know             |                      |                      | Remove or adapt if "Don't know" has meaning |
| 99          | Refused/Not applicable |                      |                      |                                             |

## Checking for Consistency

Ensuring consistency in responses is considered best practice according to the UMP and all jurisdictions studied; this is accomplished by including a series of questions to capture any responses that contradict other responses and/or by comparing responses to those of similar questions. E1's current approach includes checking for consistency, which should be maintained. The Evaluator recommends that three types of consistency checks be considered in free-ridership algorithms:

- 1) Including a follow-up question when an inconsistent response is given (i.e. "Just to confirm, ....").
- 2) Comparing responses (e.g. comparing the response to cost intention and cost influence and excluding responses if there is a significant difference between the two questions).
- 3) For BNI customers with larger projects, including open-ended questions to provide contextual information about participant's decision-making process (e.g. "Can you explain why your organization decided to build a better-than-code building?", "You explained that, without an incentive from E1, you would have designed a less efficient building. Can you explain how your building would have been different?").

## Spillover Score Components

Spillover is a component of the NTGR aimed at capturing further positive effects and is generally added to a questionnaire after free-ridership questions. The spillover series of questions is aimed at capturing other energy efficiency-related actions the participant took outside of the program and due to the influence of the program. If participant spillover is found to be attributable to a program, this improves the NTGR.

Table 367 provides the UMP definitions for like and unlike participant spillover.

**Table 367: Participant Spillover Types**

|                  |                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Like Spillover   | Program-induced actions taken outside of the program that are similar to the actions taken as part of the program. (i.e. if a participant in a program that offers rebates on a menu of measures seeks out incentives for some of the measures and after participation purchases/installs further measures incentivized through the program without applying for an incentive.) |
| Unlike Spillover | Program-induced actions taken outside of the program that are NOT similar to the actions taken as part of the program. (i.e. if a program participant installs further energy efficient measures not incentivized by the program but installs those further measures due to the influence of the program.)                                                                      |

Like and Unlike spillover is possible both at the site of the project incented by the program or at another site. Like spillover is most often captured in NTGR studies across the jurisdictions reviewed. Several jurisdictions noted that unlike spillover is difficult to capture via self-report surveys (see Rhode Island, 2021, pages 3, 12-13, 30-31, 53-54)<sup>395</sup>. Asking about further measures installed based on the existing measure list within a program is less complicated to capture in a survey format. Unlike spillover is more often studied when a program is designed to influence participants to take further actions beyond what is included in the program, i.e. when an educational component is part of program design. When a program is not designed to influence unlike spillover, unlike spillover will likely represent low to nil savings and be difficult to capture. The UMP notes that there is always a trade-off between cost and precision and the effort involved in capturing positive effects. The decision to study unlike spillover in a program should be weighed against the possible positive effects that can be reasonably captured. See Table 369 further below for the current approach to capturing spillover in E1's portfolio.

Econoler recommends continuing with the practice of formulating questions to capture like spillover and to consider adding questions to capture unlike spillover where the program is designed to encourage unlike spillover, such as when customer education is a major program component. When site visits are part of planned evaluation activities, these can be good opportunities to collect responses on spillover (e.g. for BNI programs).

Moreover, spillover is typically measured with participants after they have completed their participation in the program, but there are programs where participation may be cancelled or not completed. In these situations, these so-called partial participants may also be targeted for spillover measurement.

<sup>395</sup> See References Section, page 31 for full study information.



## Spillover Scoring

Typically, spillover is captured in a series of three to five questions to discern if any further energy efficiency-related actions took place after the participant took part in the program. If the participant took further energy efficiency actions outside of the program and without incentives, then the level of influence of the program on the participant's decision to take further actions is assessed. The savings<sup>396</sup> associated with the further actions taken AFTER participating are multiplied by the spillover score to obtain total spillover savings. The final spillover level is calculated by dividing the sum of spillover savings by program savings for all respondents.

**Figure 5: Spillover Estimation Equation**



Information to enable the calculation of savings for installed measures must be collected, and a follow-up telephone interview with technical staff to estimate savings should be planned for more complex measures or for measures that generate significant savings.

## 7.2 NTGR Study Design and Sampling

The following considerations are important when designing a study to capture the NTGR for any program.

- › Free-ridership should be explicitly considered for all measures in a program. Where possible, evaluation should serve to ensure every measure has a chance of being sampled to estimate a robust program-level NTGR. In specific cases, it may be necessary to exclude certain measures from the research, but another NTGR approach (see box below) should be used for these measures to establish a NTGR value. If multiple NTGRs are applied within one program, the values should be weighted according to the proportion of savings each measure or measure category contributes to the program. In these cases, if there is a measure-level NTGR calculated, where possible NTGR can be tracked at the measure level.

### Options for Combination Methods in Multi-measure Programs

If there are many measures in a program and the decision is made to include only the measures/measure categories with the highest proportion of savings in the NTGR survey questionnaire, the following approaches can be considered for the remaining measures:

- › Assign a deemed NTGR based on historic values or research in other jurisdictions (or both);
- › Use the NTGR calculated from other measures in the program.

<sup>396</sup> Average savings values are typically used for prescriptive and semi-prescriptive measures and for custom measures; technical questions are asked to quantify savings as accurately as possible.



- › The sample size should be designed to aim for a 90% confidence level and a 10% margin of error when based on the available population of projects in a program. Project-level sampling is best practice as survey questions are posed on a per project basis. However, this may not always be possible in programs with lower participation levels. In cases where a very small population is being studied, a census sampling approach may be appropriate.<sup>397</sup>
- › The target audience should be determined based on the program type and logic. If external stakeholders (e.g. governments, community organisations) or market actors (e.g. distributors, contractors) are involved in the promotion or delivery of the program and influence participants' decision-making around energy efficiency upgrades, their influence should be captured in the study. While feedback collected from program partners or other stakeholders can be simply utilized to confirm results received from participant feedback but not included in the NTGR scoring, Econoler recommends that program partner influence in the NTGR scoring be applied in program scoring as per the guidelines below:
  - › For midstream programs that are designed to augment energy efficiency product stocking and promotional practices, program partner/market actor scores should be included in the NTGR at the overall program level. E1 currently has one program, BER Instant Rebates (IR), that has some characteristics of a midstream program but is not strictly a midstream program as it is marketed by E1 to customers (e.g. contractors or business owners) and the incentive is passed directly to the participant (vs. the distributors retaining part of the incentive for stocking, processing, and promoting the products). Econoler recommends that the approach for BER-IR consider both the participant (end-users and contractors) and distributor perspectives, and that the distributor's influence be used to adjust the free-ridership if the participant was influenced by the distributor and if the distributor changed some of their practices due to the program.
  - › For downstream programs where the end user is the direct participant and recipient of the incentives, two approaches can be considered. The simplest option is to factor into the influence score the participant's perspective on the influence of the program partner's input or recommendations. For programs where the contractor's recommendation<sup>398</sup> is the primary mechanism for participation decision-making and the program is designed to influence channel/program partners, a more complex approach can be used to collect program partner feedback on the program's influence on their recommendations. In these cases, Econoler recommends that program partner responses be used to adjust the planning score of participants who said that they would have implemented the channel/program partner's recommendations in the absence of the program.
  - › The questionnaire should include a series of screening questions that will be utilized to determine if the contacts invited to take part in the study are the key decision-makers for the project/taking part in the DSM program (keep in mind that larger or more complex organizations may have multiple key decision-makers from various internal departments). Where multiple decision-makers are involved, an average of their answers is used.
  - › The frequency of conducting NTGR studies among other jurisdictions varies from every six months to every three years. Some jurisdictions conduct standalone NTGR studies (Massachusetts, gas programs in ON), although the most common practice is to measure NTGR as part of the regular evaluation cycle. The program evaluation timelines can also vary with the typical evaluation framework being three years and each program in a portfolio having a comprehensive evaluation, and thus updating the NTGR, at least once in the three-year cycle as is the case for E1's current framework. E1's Overall Strategic Evaluation Plan outlines its evaluation cycle and rationale.

<sup>397</sup> A census approach entails contacting all participants or channel partners in a program to respond to a survey with all efforts made to achieve a census; however a 100% response rate is not often achieved.

<sup>398</sup> Contractor influence should be validated through both participant surveys and contractor surveys ensuring that the recommendations that contractors are sharing have been influenced by the program.

## 7.3 Best Practices in Survey Design and Data Collection

Although various methods<sup>399</sup> can be used to calculate NTGRs,<sup>400</sup> the self-report survey approach is standard practice due to its overall cost-effectiveness, transparency, and flexibility. To estimate the free-ridership and spillover used in the NTGR calculation, survey questions are generally asked to target program participants, but can be also asked to other audiences, including partial participants, and market actors (e.g. energy managers, distributors, etc.) who may have influenced decision-making process. As explained later in this subsection, various data-collection modes can be used (telephone surveys, web surveys, or a mixture of both).

The elements listed below constitute an overview of the best practices for NTGR surveys, question design, and data collection.<sup>401,402,403,404,405</sup>

### Survey Design Elements

- › Identify the **key decision-maker** and interview others that **could have influenced the decision-making process** (e.g. energy managers, distributors)
- › Use **warm-up questions** to help respondents best recall their decision-making process (for standalone NTGR questionnaires)
- › As discussed above, use **consistency checks** to identify and address responses that contradict earlier answers
- › Use **measure-specific questions** to identify different motivations for installing different measures
- › Keep the survey **as short as possible** to avoid respondent fatigue (ideally no longer than 20 minutes)



### Question Design

- › Use simple words and avoid technical terms and slang
- › Use specific, clear wording rather than general, abstract terms
- › Use words that can be interpreted in only one way to avoid ambiguity
- › Use question wording that aligns with the audience's interpretation
- › Avoid questions with negatives (single or double)
- › Avoid positive (agree) and negative (disagree) responses in question wording (neutral language)
- › Avoid leading questions (meaning questions that direct to a certain answer) or loaded questions (meaning questions that assume something about the respondent) (e.g. You had already made the decision to purchase a heat pump before you learned about X program, correct?)
- › Ask one question at a time; avoid multiple variables in one question
- › (e.g. The program is simple and worthwhile)



<sup>399</sup> Other methods could include experimental design methods (such as randomized control trials), billing analysis, sales and/or market data analysis, expert-based opinion methods (like Delphi panels) or deemed/stipulated ratios applied to program savings.

<sup>400</sup> Alternative methods for evaluating NTGR include billing regression, discrete choice modeling.

<sup>401</sup> Evergreen Economics for Energy Trust of Oregon, 2017. "Current Methods in Free Ridership and Spillover Policy and Estimation".

<sup>402</sup> NEEP (2014). "Decision-Framework for Determining Net Savings Approach" – Supplemental Document #2 to Principles and Guidance.

<sup>403</sup> Violette, D.; Rathbun P. (2017). "Estimating Net Savings – Common Practices" Chapter 21 of *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*.

<sup>404</sup> Baumgartner, R. (2013). "Survey Design and Implementation Cross-Cutting Protocols for Estimating Gross Savings" Chapter 12 of *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*.

<sup>405</sup> Krosnick, J.A.; Presser, S. (2009). "Question and Questionnaire Design." Wright, J.D.; Marsden, P.V. eds. *Handbook of Survey Research* (2nd Edition). Elsevier: San Diego.

- › Use specific details to reduce recall errors and help set the scene (e.g. participation date, measures/upgrades received, incentive level, support received)
- › Provide **mutually exclusive and exhaustive response** categories
- › Ensure the order of response categories is **randomized** where it makes sense to do so to reduce respondent tendency to select answers earlier (web) or later (telephone) in a list.
- › Use **rating scales** (rather than ranking, which is more difficult for respondents to analyze)
- › Use **consistent scales**
  - › To improve data quality; questions with a lesser number of scale points are said to work best
  - › For numbered scales, labelling each scale point with words ensures consistency among responses
- › Use combinations of open and closed-ended questions for best results, particularly for projects with smaller samples. (Note that closed-ended questions are used more often, being easier to code, process, and analyze. With large sample sizes, a large number of open-ended questions is more time consuming and costly to conduct.)

## Question Order

- › Make **early questions easy and pleasant** to answer (to help settle the respondent)
- › Make **early questions** explicitly about the **survey topic**
- › For customers with larger projects, start the survey with an open-ended question to **uncover the narrative** about how the project came about and the rationale for the choice of energy efficient equipment
- › **Group together** questions on the same topic
- › Move **from more general to specific** questions on the same topic
- › Place **sensitive questions** at the end of the questionnaire
- › Use **filters** to avoid asking questions that are not applicable



## Data Collection Elements

- › **Pretest the survey** to ensure that:
  - › Questions are correctly understood
  - › Questions provide results that are valid and reliable
  - › Skips work as they should
  - › Questions and sections flow well
- › To improve response rates, **send out survey notifications** with utility/program administrator letterheads/logos; do multiple follow-ups; consider the use of incentives
- › Conduct the fieldwork **as soon as possible** after a measure has been installed to minimize recall bias.<sup>406</sup> (Note, however, that this may underestimate spillover since little time may have passed since the installation. A second survey could be conducted later if spillover is likely to have occurred and if budget allows. Spillover results can be higher after a certain time has passed to allow participants to complete further energy efficiency actions. However, recall can be negatively impacted overall, which can lead not only to less accurate FR results, but also less detailed general feedback on the program, such as awareness, motivations, barriers, etc.)
- › Use interviewers who have the necessary expertise



<sup>406</sup> Some jurisdictions use very short, fast feedback surveys (e.g. Energy Trust of Oregon, however, they only report gross savings).

**Table 368: Overview of NTGR Survey and Question Design Best Practices**

|  Survey Design |  Question Design |  Question Order |  Data Collection |
|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| › Identify key decision-maker                                                                   | › Use simple words                                                                                | › Make early questions easy and pleasant                                                         | › Pre-test the survey                                                                               |
| › Use warm-up questions                                                                         | › Ensure specific meaning, not abstract                                                           | › Make early questions survey topic specific                                                     | › Send out notifications and follow-ups                                                             |
| › Conduct consistency checks                                                                    | › Use words that have one clear interpretation to avoid ambiguity                                 | › For larger projects, start with an open-ended question to get a “story”                        | › Conduct fieldwork as soon as possible after installation                                          |
| › Use measure-specific questions                                                                | › Use question wording that aligns with the audience                                              | › Group together questions on same topic                                                         | › Use interviewers with the necessary expertise                                                     |
| › Ensure ideal duration                                                                         | › Avoid negatives (in question wording)                                                           | › Move from general to specific questions                                                        | › Remove missing, inconsistent, or uncertain responses from the data set prior to analysis          |
|                                                                                                 | › Avoid agree/disagree answers (in question wording)                                              | › Position sensitive questions at the end                                                        |                                                                                                     |
|                                                                                                 | › Avoid leading and loaded questions                                                              | › Use filters to avoid “not applicable” answers                                                  |                                                                                                     |
|                                                                                                 | › Avoid multiple variables in a question                                                          |                                                                                                  |                                                                                                     |
|                                                                                                 | › Use specific details to reduce recall errors                                                    |                                                                                                  |                                                                                                     |
|                                                                                                 | › Foster mutually exclusive, exhaustive responses                                                 |                                                                                                  |                                                                                                     |
|                                                                                                 | › Randomize responses                                                                             |                                                                                                  |                                                                                                     |
|                                                                                                 | › Use rating scales                                                                               |                                                                                                  |                                                                                                     |
|                                                                                                 | › Use consistent scales with a lesser number of scale points                                      |                                                                                                  |                                                                                                     |
|                                                                                                 | › Use combinations of open-ended and closed-ended questions                                       |                                                                                                  |                                                                                                     |

## Data-Collection Modes

**Telephone surveys** are relatively low cost, and fielding can be completed relatively quickly (compared to face-to-face interviews) but they may yield low response rates and should be limited in duration when no incentive is given (as is usually the case for NTGR evaluations). While computer-assisted telephone interviewing (CATI)<sup>407</sup> surveys can be administered for large sample sizes, it is standard practice to use non-CATI interviewing for smaller samples where the survey has more open-ended or probing questions.

<sup>407</sup> CATI survey questions and answer options are pre-programmed so that the interviewer reads exactly what they see on screen and selects the appropriate response. Non-CATI surveys allow a more subject-knowledgeable interviewer to probe open-ended questions in more depth to obtain fuller responses and to clarify any issues the respondent may have in understanding a question.



**Web surveys** are usually lower cost than telephone surveys (as there is no human component) and, once programmed, can be completed even more quickly. It is possible to obtain very large sample sizes in a short timeframe and respondents may be more willing to answer sensitive questions. That said, web surveys may not be suitable for certain populations (e.g. older people or those who are not comfortable using or do not have access to internet technology), and questions must be relatively simple to avoid misinterpretation.

**Intercept interviews** whereby an interviewer administers a survey to a consumer who has just purchased a certain product as they come out of the store is a useful, although expensive and time-consuming data-collection technique, particularly for instant rebate products or in programs for which the administrator collects no customer (participant) or product information.

While **mail-in paper questionnaires** are still used on occasion in some jurisdictions, response rates are much lower than for telephone surveys. Moreover, respondents can read ahead to see upcoming questions (which could alter their responses), and questions may be misinterpreted or missed altogether. This approach is becoming increasingly less common. That said, mail-in questionnaires can be helpful in targeting very difficult-to-reach population segments or as part of a mixed-mode approach.

Using **multiple or mixed-mode data-collection methods** has become standard practice in recent years to help reach different population targets and to overcome low response rates and coverage issues. Examples of mixed mode data collection include recruiting for the survey one way (e.g. via email) and collecting the data in another way (e.g. via phone), using different methods to target different study segments (e.g. participants via web and distributors via telephone), or even using different modes for completing separate survey sections (part telephone interview, part web exercise). Results from the various data-collection techniques are then triangulated for completeness and validation. There are no set rules on when to use a specific data-collection mode or in what combination. As mentioned above, it is standard practice to use web or telephone surveys to reach larger sample sizes when there are more closed-ended questions (e.g. for participants) and telephone interviews for smaller sample sizes when there are more open-ended questions (e.g. for distributors). The key element is to collect robust information to feed into the algorithm.

## Incentives

Incentives may be considered when it is necessary to maximize very small sample sizes, when response rates are very low, or to compensate for a lengthy interview duration (e.g. 45 minutes or longer). The amount and type of incentive depends on the sample being targeted.

## Triangulation

As mentioned earlier, triangulation consists of combining one or more data-collection methods. If applied correctly, the combination of methods enables a higher level of precision to be achieved but leads to an increase in time, budget, complexity and, in some cases, a heavier workload for respondents.

Triangulation can be conducted using only self-report approaches – for example, by interviewing program participants as well as market actors – allowing more robust results to be obtained and different respondent group results to be compared.

## 8 Analysis of E1's NTGR Approach

This section provides an overview of E1's current NTGR approach particularly as it relates to measures included in the NTGR calculation and spillover. An overview is presented on how the NTGR approach should be updated (or not) based on a review of best practices.

### 8.1 Review of E1's Current Approach

Table 369 below outlines for each program component, the NTGR results, what measures or sub-categories are included in the NTGR, the current type of spillover measured and the last date the NTGR approach was updated. The results included in Table 369 reflect those used in the 2023 Evaluation. Programs marked with an "\*" indicate program components for which the NTGR will be re-evaluated as part of the 2024 Evaluation. The "Proposed changes?" column provides a recommendation for any changes to be considered given the principles above on spillover and the inclusion of measures. Deemed NTGR ratios of 1 are used for programs targeted at low-income participants (MHEEP, ASFH, AMH) as well as SEM.

**Table 369: Summary of E1's Current NTGR Approach**

| Program Component | Measures for Which FR Is Established                                                                                                                            | Year of Last FR Update | Current Spillover Methodology                                                                                                                         | Year of Last Spillover Update | Proposed Changes                                                                                                                                          |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| ARet              | FR determined for all measures except dehumidifiers, FR deemed as nil for dehumidifiers, <sup>408</sup> FR established at 43% for fridges and 45% for freezers. | 2022                   | Like spillover established at 0%.                                                                                                                     | 2018                          | N/A                                                                                                                                                       |
| IS*               | FR determined for LED bulbs (59%) and fixtures (49%). For other measures, FR deemed as nil.                                                                     | 2023                   | Like spillover is captured by measuring market effects <sup>409</sup> at the retailer level, established at 9% for LED lamps and 2% for LED fixtures. | 2023                          | Review and update NTGR approach given product mix is expected to change significantly in 2025, including a review of assumptions for any deemed measures. |
| HEA*              | FR determined for all measures. NTGR established overall and by category – solar PV (26%) and energy efficiency upgrades (17%).                                 | 2023                   | Like spillover established at 1%. Partial participant spillover (for those who complete D but not E assessment) established using a deemed value.     | 2023                          | Include unlike SO since there is an education component in HEA.                                                                                           |
| GH                | FR determined for all measures. NTGR established overall and by category – biomass (47%), MSHPs (48%), and DR measures (9%).                                    | 2023                   | None as opportunity for spillover deemed limited.                                                                                                     | N/A                           | Consider collecting information on like spillover for completeness (e.g. installing MSHPs in second homes).                                               |

<sup>408</sup> The participation levels for the retirement of other appliance types were too low to reliably assess free-ridership using the survey; thus, for air conditioners and small appliances, the free-ridership levels from the 2018 evaluation were used, while no free-ridership and secondary market impacts were applied for dehumidifiers since none was measured in past surveys.

<sup>409</sup> Market effects capture sales of eligible products that may have occurred due to the influence of Instant Savings even if no discount was offered, for example from retailer staff having better knowledge and awareness of energy efficient products or changes in retailer offerings.



| Program Component | Measures for Which FR Is Established                                                                                                                                    | Year of Last FR Update                                                                                                                   | Current Spillover Methodology                                                                                  | Year of Last Spillover Update | Proposed Changes                                                                                   |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------|----------------------------------------------------------------------------------------------------|
| EPI*              | FR established at 25% for LED, 10% for low-flow showerheads. For all other measures, FR deemed as nil. Low-income participants deemed NTGR=1.                           | 2021                                                                                                                                     | Like and unlike spillover (asked about all energy efficiency measures implemented) established at 10%.         | 2021                          | Update to ensure highest savings measures are measured and review assumptions for deemed measures. |
| MHEEP             | Deemed NTGR = 1                                                                                                                                                         |                                                                                                                                          |                                                                                                                |                               |                                                                                                    |
| AMH               | Deemed NTGR = 1                                                                                                                                                         |                                                                                                                                          |                                                                                                                |                               |                                                                                                    |
| ASFH              | Deemed NTGR = 1                                                                                                                                                         |                                                                                                                                          |                                                                                                                |                               |                                                                                                    |
| BER-IR*           | FR established at 14% for LED fixtures, 27% for linear lamps, and 18% for outdoor fixtures. For other measures, FR deemed as nil. Major update to FR algorithm in 2022. | 2022                                                                                                                                     | N/A – midstream so no potential for like spillover.                                                            | N/A                           | Review assumptions for deemed measures.                                                            |
| BER-AR            | FR established at 26% for all measures. NTGR established overall.                                                                                                       | 2021                                                                                                                                     | Like spillover established at 0%.                                                                              | 2021                          |                                                                                                    |
| Custom-Retrofit*  | FR determined for all categories. NTGR established overall and by category – 25% for regular retrofit, 16% for compressed air, and 38% for solar PV.                    | <ul style="list-style-type: none"> <li>› 2023 – regular retrofit</li> <li>› 2023 - solar</li> <li>› 2021 - for compressed air</li> </ul> | Like and unlike spillover (asked about all energy efficiency measures implemented) determined at 2%.           | 2023                          |                                                                                                    |
| Custom – BOpt     | FR determined at 9%. NTGR established overall.                                                                                                                          | 2021                                                                                                                                     | Like and unlike spillover was determined as 0%.                                                                | 2021                          |                                                                                                    |
| Custom – NC*      | FR determined at 31% for all projects. NTGR established overall. Major update to FR algorithm in 2021.                                                                  | 2023                                                                                                                                     | None as opportunity for spillover deemed limited                                                               | N/A                           |                                                                                                    |
| SEM               | Deemed NTGR = 1                                                                                                                                                         |                                                                                                                                          |                                                                                                                |                               |                                                                                                    |
| SBES              | FR determined at 20% for DIY and 12% for Audit path. NTGR established by path - audit, DIY.                                                                             | <ul style="list-style-type: none"> <li>› 2023 - DIY</li> <li>› 2019 - Audit</li> </ul>                                                   | Like participant spillover and partial participant spillover (from dropped-out participants) determined at 0%. | 2023                          |                                                                                                    |

\* NTGR to be updated as part of 2024 evaluation. Note for HEA, only partial participant spillover will be updated in 2024.

## 8.2 Summary of Recommendations

Based on Econoler's review of NTGR best practices using the self-report approach, Econoler has identified several aspects of the current approach that should be maintained and other areas that should be consistently updated across the portfolio moving forward. The free-ridership and spillover questionnaires and algorithms for E1 evaluated DSM programs will be updated where necessary based on the elements below.



## Aspects Maintained

- › The overall adjustment approach to **cross-influence** currently used in E1 algorithms. This approach captures influences outside the program (e.g. past participation, educational initiatives, etc.), the results of which are then applied to total free-ridership score results.
- › The current method of capturing **spillover** with a focus on like spillover. Unlike spillover should be considered when a program is designed to influence participants to take further actions beyond what is included in the program (e.g. the educational aspect of EPI).
- › **Consistency checks.** Questions that serve to check for contradictions, compare responses to similar questions, and remove inconsistencies from the NTGR calculation continue to be important. Open-ended questions can be included for programs involving larger projects to provide context and a further consistency check.
- › **Number of questions.** The current questionnaire design (number of questions and framing) can be maintained, although language efficiencies may be employed where appropriate (see Key Changes below).

## Key Changes

- › **Averaging the intention and influence scores** to calculate free-ridership. This updated approach adopted by several jurisdictions ensures that both variables carry an equal weighting as decision-making factors. Econoler recommends that E1 move away from their current approach which weighs intention score higher than influence to this new approach.
- › Using a **four-point unbalanced scale** for free-ridership and spillover. Answer scales in E1 algorithms primarily use a 10-point numbered scale approach whereby only the first and last points of the scale are labelled. Econoler recommends moving to a four-point ordinal scale whereby all points are distinctly labelled for improved survey participant comprehension. The proposed scale is unbalanced since each scale point must be scored incrementally for the free-ridership algorithm.
- › **Simplifying question wording where possible.** Simple questions where possible help ensure clarity and comprehension for survey respondents. Econoler will continue to pre-test questionnaire changes among small respondent samples to ensure that questions are correctly understood before fully launching any survey.
- › Ensuring that the NTGR is considered for all measures, either utilizing a **deemed ratio or program-level ratio when not measured.** This would be the case for multi-measure programs (e.g. EPI) where it is not possible to collect data on all measures.



## 9 Program Algorithms

In the subsections that follow, two E1 program algorithms are evaluated in more detail – those of EPI and BER-IR as examples as the NTGR for these programs will be updated as part of the 2024 Evaluation. For each algorithm, the Evaluator reviews the elements listed below to ensure they are aligned with best practices and the guidelines above and, if not, makes adjustments.

- › Algorithm variables included
- › Question design
- › Question wording
- › Response categories and scales
- › Scoring mechanism
- › Consistency checks

The tables for each algorithm are organized into two main sections: One for the questions, answers, scoring mechanisms, and consistency checks currently used in the algorithm (columns under the “Current Algorithm” heading); and one for the questions, answers, scoring mechanisms, and consistency checks recommended for the revised algorithm (columns under the “Adjusted Algorithm” heading). Any revisions made are presented using a light green background.

## 9.1.1 Efficient Product Install Algorithm

Below is an example of the free-ridership algorithm for the measure that generates the highest savings in EPI: LED lamps. Please see Section 9.1.3 for an example calculation. Econoler will adapt the free-ridership algorithms for the other EPI measures generating significant proportions of savings for the program (smart thermostats and domestic hot water measures). For the measures that constitute low proportions of the savings, Econoler will use a deemed NTGR based on historic values or research in other jurisdictions (or both).

**Table 370: Free-Ridership – LEDs**

| Current Algorithm |                                                                                                                                                                                                                                                      |                            |                     | Adjusted Algorithm                                                                                                                                                                                                  |                                                                                                                                          |                     |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Question          |                                                                                                                                                                                                                                                      | Answer                     | Score               | Question                                                                                                                                                                                                            | Answer                                                                                                                                   | Score               |
| INTENTION         |                                                                                                                                                                                                                                                      |                            |                     |                                                                                                                                                                                                                     |                                                                                                                                          |                     |
| Planning          |                                                                                                                                                                                                                                                      |                            |                     |                                                                                                                                                                                                                     |                                                                                                                                          |                     |
| E1                | Had you already decided to purchase and install LED bulbs before learning about the Efficient Product Installation Service?                                                                                                                          | 1) Yes                     | Use E2              | Before learning about the Efficient Product Installation Service, had you already decided to purchase and install LED bulbs in your home?                                                                           | 1) Yes                                                                                                                                   | Use E2              |
|                   |                                                                                                                                                                                                                                                      | 2) No                      | 0%                  |                                                                                                                                                                                                                     | 2) No                                                                                                                                    | 0%                  |
|                   |                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused  |                     |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                |                     |
| E2                | [IF E1=YES] Just to confirm: Before you learned about the Efficient Product Installation Service, you had already made the decision to purchase and install LED bulbs in your home?                                                                  | 1) Yes                     | 100%                | [IF E1=YES] Just to confirm: Have I understood correctly that you had already made the decision to purchase and install LED bulbs in your home before you learned about the Efficient Product Installation Service? | 1) Yes, correct (already made decision)                                                                                                  | 100%                |
|                   |                                                                                                                                                                                                                                                      | 2) No                      | 0%                  |                                                                                                                                                                                                                     | 2) No, incorrect (not already made decision)                                                                                             | 0%                  |
|                   |                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused  |                     |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                |                     |
|                   | Planning Score (PA1)                                                                                                                                                                                                                                 |                            | E1 adjusted with E2 | Planning Score (PS)                                                                                                                                                                                                 |                                                                                                                                          | E1 adjusted with E2 |
| Cost              |                                                                                                                                                                                                                                                      |                            |                     |                                                                                                                                                                                                                     |                                                                                                                                          |                     |
| E3                | If Efficiency Nova Scotia had not installed these LED bulbs at no charge as part of the Efficient Product Installation Service, how likely would you have been to purchase and pay for those LED bulbs, knowing that the cost is about \$4 per bulb? | 1) Answer: __ (scale 0-10) | Answer x 10%        | Without the Efficient Product Installation Service, what is the likelihood you would have paid for the LED bulbs, knowing that the cost is about \$2 to \$4 per bulb?                                               | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%)          |
|                   |                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused  | EMPTY               |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                | EMPTY               |
|                   |                                                                                                                                                                                                                                                      |                            |                     | Cost Score (CS)                                                                                                                                                                                                     |                                                                                                                                          | E3                  |

| Current Algorithm |                                                                                                                                                                                                                                               |                            |                     | Adjusted Algorithm                                                                                                                                                                |                                                                                                                                                                                                      |            |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Effort            |                                                                                                                                                                                                                                               |                            |                     |                                                                                                                                                                                   |                                                                                                                                                                                                      |            |
| E4                | If there was no Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them yourself in your home?                                                        | 1) Answer: __ (scale 0-10) | Answer x 10%        | Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them in your home?         | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%)                                                             | Answer (%) |
|                   |                                                                                                                                                                                                                                               | 98/99) Don't know/Refused  | EMPTY               |                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                                            | EMPTY      |
|                   | Cost & Effort Score (PA2)                                                                                                                                                                                                                     |                            | MEAN (E3; E4)       | Effort Score (ES)                                                                                                                                                                 |                                                                                                                                                                                                      | E4         |
| Question          |                                                                                                                                                                                                                                               | Answer                     | Score               | Question                                                                                                                                                                          | Answer                                                                                                                                                                                               | Score      |
| Timing            |                                                                                                                                                                                                                                               |                            |                     |                                                                                                                                                                                   |                                                                                                                                                                                                      |            |
| E5                | [IF E4 ≥ 5] If there was no Efficient Product Installation Service, how likely would you have been to postpone by at least one year replacing your bulbs with LEDs?                                                                           | 1) Answer: __ (scale 0-10) | (10 – Answer) x 10% | [IF CODES 1,2,3,4 AT E4] Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your bulbs with LEDs by at least one year? | 1) Definitely would have (0%)<br>2) Probably would have (25%)<br>3) Probably would not have (75%)<br>4) Definitely would not have (100%)                                                             | Answer (%) |
|                   |                                                                                                                                                                                                                                               | 98/99) Don't know/Refused  | EMPTY               |                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                                            | EMPTY      |
|                   | Timing Score (PA3)                                                                                                                                                                                                                            |                            | E5                  |                                                                                                                                                                                   | Timing Score (TS)                                                                                                                                                                                    | E5         |
| Quantity          |                                                                                                                                                                                                                                               |                            |                     |                                                                                                                                                                                   |                                                                                                                                                                                                      |            |
| E6                | [ASK IF LED BULBS QUANTITY>1] If there was no Efficient Product Installation service, how likely would you have been to purchase and install all [QUANTITY] LED bulbs that were installed through the Efficient Product Installation Service? | 1) Answer: __ (scale 0-10) | Answer x 10%        | [ASK IF LED BULBS QUANTITY>1 AND IF CODES 1, 2, 3 AT E4] Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred?    | You would have purchased and installed ....<br>1) ...exactly the same number of LED bulbs (100%)<br>2) ... fewer LED bulbs (50%)<br>3) You would not have purchased nor installed any LED bulbs (0%) | Answer (%) |
|                   |                                                                                                                                                                                                                                               | 98/99) Don't know/Refused  | EMPTY               |                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                                            | EMPTY      |



| Current Algorithm                                   |                                                                                                                                                                                                                                                                                                        |                                                                                   |                  | Adjusted Algorithm                                                                                                                                                                                                                                                                       |                                                                                                                                                                 |                                    |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|                                                     | Quantity Score (PA4)                                                                                                                                                                                                                                                                                   |                                                                                   | E6               |                                                                                                                                                                                                                                                                                          | Quantity Score (QS)                                                                                                                                             | E6                                 |
|                                                     | Inconsistency Test                                                                                                                                                                                                                                                                                     | IF E1=100% AND<br>IF E3<70% OR E4<70%                                             | E1=EMPTY         | Inconsistency Test                                                                                                                                                                                                                                                                       | IF E1=100% AND<br>IF E3<75% OR E4<75%                                                                                                                           | E1=EMPTY                           |
|                                                     | Inconsistency Test                                                                                                                                                                                                                                                                                     | IF ABS(E3–E4) ≥50%                                                                | MIN (E3; E4)     | Inconsistency Test                                                                                                                                                                                                                                                                       | IF E4 <> EMPTY AND<br>ABS (E4-E13a) > 50%                                                                                                                       | E4=EMPTY                           |
|                                                     |                                                                                                                                                                                                                                                                                                        |                                                                                   |                  | INTENTION Score: MIN [MEAN (PS; CS; ES); MEAN (PS; CS; ES; TS); MEAN (PS; CS; ES; TS; QS); MEAN (PS; CS; ES; QS)]                                                                                                                                                                        |                                                                                                                                                                 |                                    |
| INFLUENCE                                           |                                                                                                                                                                                                                                                                                                        |                                                                                   |                  |                                                                                                                                                                                                                                                                                          |                                                                                                                                                                 |                                    |
| E19                                                 | I would like you to rate the influence of the following two factors in your decision to have the energy-efficient products installed in your home.<br>a) The installation of energy-efficient products, at no charge, offered by the service<br>b) Information or advice provided by the service staff | 1) Answer: __ (scale 0-10)<br><br>97/98/99) Not applicable/<br>Don't know/Refused | MAX (E13a; E13b) | How influential were the following two factors in your decision to have energy efficient products installed in your home? [RANDOMIZE]<br>a) The free installation of energy efficient products offered through the service<br>b) The information or advice provided by the service staff | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%)<br><br>98/99) Don't know/Refused | MIN (E13a Answer; E13b Answer) (%) |
|                                                     | INFLUENCE Score (PA5): (10–E13) x 10%                                                                                                                                                                                                                                                                  |                                                                                   |                  | INFLUENCE Score (IS): E13                                                                                                                                                                                                                                                                |                                                                                                                                                                 |                                    |
| Free-Ridership (FR): MEAN (PA1; PA2; PA3; PA4; PA5) |                                                                                                                                                                                                                                                                                                        |                                                                                   |                  | Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                                                                                                                                                                                                           |                                                                                                                                                                 |                                    |

**Table 371: Cross-Influence – LEDs**

| Current Algorithm                                                                              |                                                                                                                                                                                                                                                                                       |                                                                                                      |       | Adjusted Algorithm                                                                                                                                                                                                                                                  |                           |                                                                                                       |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------|
| Question                                                                                       |                                                                                                                                                                                                                                                                                       | Answer                                                                                               | Score | Question                                                                                                                                                                                                                                                            | Answer                    | Score                                                                                                 |
| Cross-Influence                                                                                |                                                                                                                                                                                                                                                                                       |                                                                                                      |       |                                                                                                                                                                                                                                                                     |                           |                                                                                                       |
| F2                                                                                             | [IF F1=1] Your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home.                                                                                                   | 1) Agree                                                                                             | 1     | Do you agree or disagree that ...<br>[IF F1=1] ...your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home?                                         | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F4                                                                                             | [IF F1=1] Because of your previous participation in another Efficiency Nova Scotia program or Service and what you learned by participating in this program, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home. | 1) Agree                                                                                             | 1     | [IF F1=1] ...because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home? | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F7                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                                     | 1) Agree                                                                                             | 1     | [IF F5=1] ... the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                           | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| F8                                                                                             | [IF F5=1] The promotion of energy efficiency carried out by Efficiency Nova Scotia prompted you to take into account the savings on your energy bill when evaluating different energy-efficient products for your home.                                                               | 1) Agree                                                                                             | 1     | [IF F5=1] ... you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia?                                                          | 1) Agree                  | 1                                                                                                     |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 2) Disagree                                                                                          | EMPTY |                                                                                                                                                                                                                                                                     | 2) Disagree               | EMPTY                                                                                                 |
|                                                                                                |                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                                                                            | EMPTY |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused | EMPTY                                                                                                 |
| Cross-Influence (CI):<br>IF(F2 OR F6=Agree; 1) + IF(F3 OR F7=Agree; 1) + IF(F4 OR F8=Agree; 1) |                                                                                                                                                                                                                                                                                       |                                                                                                      |       | Cross-Influence (CI):<br>IF(F2 =Agree; 1) + IF (F7=Agree; 1) + IF(F4 OR F8=Agree; 1)                                                                                                                                                                                |                           |                                                                                                       |
| Revised Free-Ridership:                                                                        |                                                                                                                                                                                                                                                                                       | IF CI = 0 or 1: Revised FR = FR<br>IF CI =2: Revised FR = FR*0.75<br>IF CI = 3: Revised FR = FR*0.50 |       | Revised Free-Ridership:                                                                                                                                                                                                                                             |                           | IF CI = 0: Revised FR = FR<br>IF CI = 1: Revised FR = FR*0.75<br>IF CI = 2 OR 3: Revised FR = FR*0.50 |

**Table 372: Spillover (for Electrical Savings)**

| Current Algorithm |                                                                                                                                       |                           |                                                                    | Adjusted Algorithm                                                                                                                           |                           |                                                          |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------------------------------|
| Question          |                                                                                                                                       | Answer                    | Score                                                              | Question                                                                                                                                     | Answer                    | Score                                                    |
| G1                | Since participating in the Efficient Product Installation Service, have you installed any additional efficient products in your home? | 1) Yes                    | CONTINUE                                                           | Since participating in the Efficient Product Installation Service, have you installed any additional energy-efficient products in your home? | 1) Yes                    | CONTINUE                                                 |
|                   |                                                                                                                                       | 2) No                     | GO TO G5                                                           |                                                                                                                                              | 2) No                     | GO TO G9                                                 |
|                   |                                                                                                                                       | 98/99) Don't know/Refused |                                                                    |                                                                                                                                              | 98/99) Don't know/Refused |                                                          |
| G2                | What energy-efficient products have you installed in your home since participating in the Efficient Product Installation Service?     |                           | SO1=SUM<br>(energy savings associated with each upgrade)           | What energy-efficient products have you installed in your home since participating in the Efficient Product Installation Service?            | List of products provided | SO1=SUM<br>(energy savings associated with each upgrade) |
| G3                | How many (item) did you purchase and install?                                                                                         |                           |                                                                    | How many [INSERT PRODUCT FROM G2] did you purchase and install?                                                                              |                           |                                                          |
| G4                | Did you receive an instant rebate at the cashier for the [INSERT PRODUCT FROM G3] you purchased?                                      | 1) Yes                    | SO2=0 for the measure                                              | Did you receive an instant rebate at the cashier for the [INSERT PRODUCT FROM G2 IF G2>0] you purchased?                                     | 1) Yes                    | SO2=0 for the measure                                    |
|                   |                                                                                                                                       | 2) No                     | SO2=1                                                              |                                                                                                                                              | 2) No                     | SO2=1                                                    |
|                   |                                                                                                                                       | 98/99) Don't know/Refused |                                                                    |                                                                                                                                              | 98/99) Don't know/Refused |                                                          |
| G5                | Since participating in the Efficient Product Installation Service, have you retired any old appliances in your home?                  | 1) Yes                    | CONTINUE                                                           | Question discontinued                                                                                                                        |                           |                                                          |
|                   |                                                                                                                                       | 2) No                     | GO TO G7                                                           |                                                                                                                                              |                           |                                                          |
|                   |                                                                                                                                       | 98/99) Don't know/Refused |                                                                    |                                                                                                                                              |                           |                                                          |
| G6                | What appliances have you retired since participating in the Efficient Product Installation Service?                                   |                           | SO3=SUM<br>(energy savings associated with each retired appliance) |                                                                                                                                              |                           |                                                          |
| G7                | How many [INSERT RESPONSE IN G6] have you retired?                                                                                    |                           |                                                                    |                                                                                                                                              |                           |                                                          |
| G8                | Did you receive a rebate or assistance from a program for the [INSERT APPLIANCE FROM G7] you retired?                                 | 1) Yes                    | SO4=0 for the measure                                              |                                                                                                                                              |                           |                                                          |
|                   |                                                                                                                                       | 2) No                     | SO4=1                                                              |                                                                                                                                              |                           |                                                          |
|                   |                                                                                                                                       | 98/99) Don't know/Refused |                                                                    |                                                                                                                                              |                           |                                                          |
|                   | Additional Products and Retirement Savings: SO5 = (SO1 x SO2) + (SO3 x SO4)                                                           |                           |                                                                    | Additional Products and Retirement Savings: SO5 = (SO1 x SO2) + (SO3 x SO4)                                                                  |                           |                                                          |



| Current Algorithm                                                                                                   |                                                                                                                                                                                                     |                            |                  | Adjusted Algorithm                                                                                                                                          |                                                                                                                                |                 |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Attribution Level                                                                                                   |                                                                                                                                                                                                     |                            |                  |                                                                                                                                                             |                                                                                                                                |                 |
| G9                                                                                                                  | How influential was your experience with the Efficient Product Installation Service in your decision to install these additional energy-efficient products or retire these appliances in your home? | 1) Answer: __ (scale 0-10) | SO6=Answer x 10% | How influential was your experience with the Efficient Product Installation Service in your decision to install these additional energy-efficient products? | 1) Very influential (100%)<br>2) Somewhat influential (75%)<br>3) Not very influential (25%)<br>4) Not at all influential (0%) | SO6= Answer (%) |
|                                                                                                                     |                                                                                                                                                                                                     | 98/99) Don't know/Refused  | SO6= EMPTY       |                                                                                                                                                             | 98/99) Don't know/Refused                                                                                                      | SO6= EMPTY      |
| Final Spillover Level = <u>SUM of (SO5 x SO6) for All Respondents</u><br>SUM of Program Savings for All Respondents |                                                                                                                                                                                                     |                            |                  | Final Spillover Level = <u>SUM of (SO5 x SO6) for All Respondents</u><br>SUM of Program Savings for All Respondents                                         |                                                                                                                                |                 |

## 9.1.2 BER-IR Algorithm

**Table 373: Instant Rebates Distributor Influence Level Algorithm**

| Current Algorithm |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                            | Adjusted Algorithm |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                          |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Question          | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Score                      | Question           | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Score                                                                                                                                                    |
| Influence 1       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                            |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                          |
| B3                | [ASK IF B1=1-6 OR 96 OR B2=2] I'd like to learn more about what influenced your organization's decisions to use these strategies to sell <EFFICIENT PRODUCT> this year. For each of the six following items, answer using a 0-10 scale, where 0 means that the item did not influence at all your organization's decisions to use these sales strategies, and 10 means that the item had a great deal of influence on your use of the sales strategies. To what extent did you use these sales strategies because of?<br>a. The incentives offered by ENS<br>b. The educational, promotional and marketing efforts and support provided or driven by ENS<br>c. The quality or great value of <EFFICIENT PRODUCT><br>d. Your organization's policies and desire to support sustainability<br>e. Your organization's interest in increasing your sales and profits | 1) Answer: __ (scale 0-10) | MAX(B3a; B3b)      | [ASK IF B1=1-6 OR 96 OR B2=2] Please indicate the influence of the following six factors on your company's decision to use the strategies we just talked about to increase your sales of <EFFICIENT PRODUCT> this year. Was [INSERT FACTOR] very, somewhat, not very, or not at all influential on your company's choice of these sales strategies?<br>a. The incentives offered by ENS<br>b. The educational, promotional and marketing efforts and support provided or driven by ENS<br>c. The quality or value of <EFFICIENT PRODUCT><br>d. Your company/organization's policies and desire to support sustainability<br>e. Your company/organization's interest in increasing your sales and profits | 1) Very influential (100%)<br>2) Somewhat influential (75%)<br>3) Not very influential (25%)<br>4) Not at all influential (0%)<br><br>MAX (B3a; B3b) (%) |
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 98/99) Don't know/Refused  | EMPTY              | 98/99) Don't know/Refused<br><br>EMPTY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                          |
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Influence Score (IS1)      |                    | B3 x 10%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Influence Score (IS1)                                                                                                                                    |



| Current Algorithm     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                   |                  | Adjusted Algorithm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                   |                  |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|------------------|
| Influence 2           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                   |                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                   |                  |
| B4                    | [ASK IF B1=1-6 OR 96 OR B2=2] The factors we just discussed can be divided into two categories: those that relate to the BER program (the incentive, the educational, promotional and marketing efforts and support provided or driven by ENS), and those that are external to the program (the product quality, your organization's sustainability policies or your organization's desire for increased sales).<br><br>I'd like to know the influence of each of those categories on your organization's decision to use the sales strategies we discussed earlier. In percentage points, out of 100% in total, what would be the influence of the program-related factors versus the influence of the non-program-related factors on your organization's decision to use these sales strategies? In other words, what is more or less likely to explain why you use these strategies? [MAKE SURE THAT B4a+B4b=100%] | a) Points awarded to program factors: _____%      | B4a = Answer (%) | [ASK IF B1=1-6 OR 96 OR B2=2]<br>The factors we just discussed can be divided into two categories: those that relate to the BER program (the incentive, the educational, promotional and marketing efforts and support provided or driven by ENS), and those that are external to the program (the product quality, your organization's sustainability policies or your organization's desire for increased sales).<br><br>I'd like to know the influence of each of those categories on your organization's decision to use the sales strategies we discussed earlier. In percentage points, out of 100% in total, what would be the influence of the program-related factors versus the influence of the non-program-related factors on your organization's decision to use these sales strategies? In other words, what is more or less likely to explain why you used these strategies? [MAKE SURE THAT B4a+B4b=100%] | a) Points awarded to program factors: _____%      | B4a = Answer (%) |
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | b) Points awarded to non-program factors: _____ % | EMPTY            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | b) Points awarded to non-program factors: _____ % | EMPTY            |
|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused                         | EMPTY            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 98/99) Don't know/Refused                         | EMPTY            |
| Influence Score (IS2) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                   | B4a              | Influence Score (IS2)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                   | B4a              |



| Current Algorithm                                                                                                                                          |                                                                                                                                                                                                                                                                                                 |                                                  |                                        | Adjusted Algorithm                                                                                                                                                                                                            |                                                                                                                                                                                                                                              |                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Influence 3                                                                                                                                                |                                                                                                                                                                                                                                                                                                 |                                                  |                                        |                                                                                                                                                                                                                               |                                                                                                                                                                                                                                              |                                        |
| B5                                                                                                                                                         | [ASK IF B1=1-6 OR 96. DO NOT ASK IF B4=0%] Using a scale from 0 to 10, where 0 is “Not at all likely” and 10 is “Extremely likely”, if the BER program had not been available this year, what is the likelihood that you would have used the same sales strategies to sell <EFFICIENT PRODUCT>? | 1) Answer: __ (scale 0-10)                       | B5 = Answer                            | [ASK IF B1=1-6 OR 96. DO NOT ASK IF B4a=0%] If the BER program had not been available this year, what is the likelihood that you would have used the same sales strategies as you used this year to sell <EFFICIENT PRODUCT>? | 1) Definitely would have used the same strategies (0%)<br>2) Probably would have used the same strategies (25%)<br>3) Probably would not have used the same strategies (75%)<br>4) Definitely would not have used the same strategies (100%) | Answer (%)                             |
|                                                                                                                                                            |                                                                                                                                                                                                                                                                                                 | 98/99) Don't know/Refused                        | EMPTY                                  |                                                                                                                                                                                                                               | 98/99) Don't know/Refused                                                                                                                                                                                                                    | EMPTY                                  |
|                                                                                                                                                            |                                                                                                                                                                                                                                                                                                 | Influence Score 3 (IS3)                          |                                        |                                                                                                                                                                                                                               | (10-B5) x 10%                                                                                                                                                                                                                                | Influence Score 3 (IS3)                |
|                                                                                                                                                            | Inconsistency Test                                                                                                                                                                                                                                                                              | IF IS3>70% & IS1<30% OR<br>IF IS3<30% & IS1>70%: | IS3 = MEAN (IS1; IS3) &<br>IS1 = EMPTY | IF IS3≥75% & IS1≤25% OR<br>IF IS3≤25% & IS1≥75%                                                                                                                                                                               |                                                                                                                                                                                                                                              | IS3 = MEAN (IS1; IS3) &<br>IS1 = EMPTY |
|                                                                                                                                                            | Inconsistency Test                                                                                                                                                                                                                                                                              | IF IS2>70% & IS1<30% OR<br>IF IS2<30% & IS1>70%: | IS2 = MEAN (IS1; IS2) &<br>IS1 = EMPTY | IF IS2≥75% & IS1≤25% OR<br>IF IS2≤25% & IS1≥75%:                                                                                                                                                                              |                                                                                                                                                                                                                                              | IS2 = MEAN (IS1; IS2) &<br>IS1 = EMPTY |
| Distributor Influence Level: IF B2 = 1 OR IF MEAN (IS1; IS2; IS3) = 100%:<br>Dist Influence = EMPTY<br>OTHERWISE:<br>Dist Influence = MEAN (IS1; IS2; IS3) |                                                                                                                                                                                                                                                                                                 |                                                  |                                        | Distributor Influence Level: IF B2 = 1 OR IF MEAN (IS1; IS2; IS3) = 0%:<br>Dist Influence = EMPTY<br>OTHERWISE:<br>Dist Influence = MEAN (IS1; IS2; IS3)                                                                      |                                                                                                                                                                                                                                              |                                        |

**Table 374: Free-Ridership (Participants)**

| Current Algorithm                                              |                                                                                                                                                                                                                                                                                                          |                            |              | Adjusted Algorithm                                                                                                                                                                                                                                                                                                                              |                                                                                                                                          |            |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Question                                                       |                                                                                                                                                                                                                                                                                                          | Answer                     | Score        | Question                                                                                                                                                                                                                                                                                                                                        | Answer                                                                                                                                   | Score      |
| INTENTION                                                      |                                                                                                                                                                                                                                                                                                          |                            |              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |            |
| Cost                                                           |                                                                                                                                                                                                                                                                                                          |                            |              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |            |
| D7                                                             | Efficiency Nova Scotia offered a rebate for the purchase of efficient lighting products. If your organization had not received the rebate and the cost for <EFFICIENT PRODUCT> had been about \$[REBATE AVERAGE VALUE BY CATEGORY] higher, would you have paid the full cost of the <EFFICIENT PRODUCT>? | 1) Answer: __ (scale 0-10) | Answer x 10% | Efficiency Nova Scotia offered a rebate for the purchase of efficient lighting products. If your company/organization had not received the rebate and the cost of <EFFICIENT PRODUCT> had been about \$<REBATE AVERAGE VALUE BY CATEGORY> higher per unit, what is the likelihood you would have paid the full cost of the <EFFICIENT PRODUCT>? | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%) |
|                                                                |                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused  | EMPTY        |                                                                                                                                                                                                                                                                                                                                                 | 98/99) Don't know/Refused                                                                                                                | EMPTY      |
|                                                                |                                                                                                                                                                                                                                                                                                          |                            |              |                                                                                                                                                                                                                                                                                                                                                 | Cost Score (CS)                                                                                                                          | D7         |
| Efficiency                                                     |                                                                                                                                                                                                                                                                                                          |                            |              |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |            |
| D8                                                             | If BER rebate had not been offered, what is the likelihood that you would have purchased the exact same model of premium lighting products?                                                                                                                                                              | 1) Answer: __ (scale 0-10) | Answer x 10% | Without the BER rebate, what is the likelihood that you would have purchased the exact same model of premium lighting products?                                                                                                                                                                                                                 | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%) | Answer (%) |
|                                                                |                                                                                                                                                                                                                                                                                                          | 98/99) Don't know/Refused  | EMPTY        |                                                                                                                                                                                                                                                                                                                                                 | 98/99) Don't know/Refused                                                                                                                | EMPTY      |
|                                                                |                                                                                                                                                                                                                                                                                                          |                            |              |                                                                                                                                                                                                                                                                                                                                                 | Efficiency Score (ηS)                                                                                                                    | D8         |
| Cost + Efficiency Score (PA1)                                  |                                                                                                                                                                                                                                                                                                          |                            | MEAN(D7; D8) |                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |            |
| Inconsistency Test<br>IF ABS (D7 – D8) ≥ 50%: CS= MIN (D7; D8) |                                                                                                                                                                                                                                                                                                          |                            |              | Inconsistency Test<br>IF ABS (D7 – D8) ≥ 75%: CS= MIN (D7; D8)                                                                                                                                                                                                                                                                                  |                                                                                                                                          |            |



| Current Algorithm |                                                                                                                                                                                                |                               |              | Adjusted Algorithm                                                                                                                                                      |                                                                                                                                                                                                                                                |            |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Planning          |                                                                                                                                                                                                |                               |              |                                                                                                                                                                         |                                                                                                                                                                                                                                                |            |
| D1                | Were you aware that you received a rebate when purchasing these <EFFICIENT PRODUCT>?                                                                                                           | 1) Yes                        |              | Were you aware that you received a rebate when purchasing these <EFFICIENT PRODUCT>?                                                                                    | 1) Yes                                                                                                                                                                                                                                         |            |
|                   |                                                                                                                                                                                                | 2) No                         |              |                                                                                                                                                                         | 2) No                                                                                                                                                                                                                                          |            |
|                   |                                                                                                                                                                                                | 98/99) Don't know/Refused     |              |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      |            |
| D2                | [ASK IF D1=2 OR 98] I want to make sure I understand. When you purchased these <EFFICIENT PRODUCT>, you were not aware that a rebate would be given to reduce the product's total cost?        | 1) Yes, unaware of the rebate |              | [ASK IF D1=2 OR 98] Have I understood correctly that you were <u>not</u> aware that a rebate would be given on the product's total cost when you purchased these items? | 1) Yes, correct (unaware of the rebate)                                                                                                                                                                                                        |            |
|                   |                                                                                                                                                                                                | 2) No, aware of the rebate    |              |                                                                                                                                                                         | 2) No, incorrect (aware of the rebate)                                                                                                                                                                                                         |            |
|                   |                                                                                                                                                                                                | 98/99) Don't know/Refused     |              |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      |            |
| D6                | [ASK IF AWARE (D1=1 or D2=2)] Had you already decided to purchase these <EFFICIENT PRODUCT> before knowing that these products were rebated?                                                   | 1) Yes                        | 100%         | [ASK IF AWARE (D1=1 or D2=2)] Had you already decided to purchase these <EFFICIENT PRODUCT> before knowing that these efficient products were rebated?                  | 1) Yes                                                                                                                                                                                                                                         | 100%       |
|                   |                                                                                                                                                                                                | 2) No                         | 0%           |                                                                                                                                                                         | 2) No                                                                                                                                                                                                                                          | 0%         |
|                   |                                                                                                                                                                                                | 98/99) Don't know/Refused     |              |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      |            |
|                   | Planning Score (PA2)                                                                                                                                                                           |                               | D6           | Planning Score (PS)                                                                                                                                                     |                                                                                                                                                                                                                                                | D6         |
| Quantity          |                                                                                                                                                                                                |                               |              |                                                                                                                                                                         |                                                                                                                                                                                                                                                |            |
| D10               | [ASK IF TOTAL MEASURE CATEGORY QTY>1] If the rebate had not been offered, what is the likelihood that you would have purchased exactly the same quantity of lighting products that you bought? | 1) Answer: __ (scale 0-10)    | Answer x 10% | [ASK IF TOTAL MEASURE CATEGORY QTY>1] Without the rebate, which of the following scenarios would have most likely occurred?                                             | You would have purchased...<br>1) ...exactly the same number of efficient lighting products (100%)<br>2) ...some, but not all of the efficient lighting products (50%)<br>3) You would not have purchased any efficient lighting products (0%) | Answer (%) |
|                   |                                                                                                                                                                                                | 98/99) Don't know/Refused     | EMPTY        |                                                                                                                                                                         | 98/99) Don't know/Refused                                                                                                                                                                                                                      | EMPTY      |
|                   | Quantity Score (QS)                                                                                                                                                                            |                               | D10          |                                                                                                                                                                         | Quantity Score (QS)                                                                                                                                                                                                                            | D10        |



| Current Algorithm |                                                                                                                                                                            |                            |                     | Adjusted Algorithm                                                                                                                                                                            |                                                                                                                                          |            |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Timing            |                                                                                                                                                                            |                            |                     |                                                                                                                                                                                               |                                                                                                                                          |            |
| D11               | [ASK IF D7≥5] If the program rebate had not been offered, what is the likelihood that you would have postponed the purchase of the lighting products by at least one year? | 1) Answer: __ (scale 0-10) | (10 – Answer) x 10% | [ASK END USERS ONLY AND IF D7=1 OR 2] Without the program rebate, what is the likelihood that you would have postponed the purchase of the efficient lighting products by at least one year?  | 1) Definitely would have (0%)<br>2) Probably would have (25%)<br>3) Probably would not have (75%)<br>4) Definitely would not have (100%) | Answer (%) |
|                   |                                                                                                                                                                            | 98/99) Don't know/Refused  | EMPTY               |                                                                                                                                                                                               | 98/99) Don't know/Refused [CONTRACTORS]                                                                                                  | EMPTY      |
|                   | Timing Score (TS)                                                                                                                                                          |                            | D11                 |                                                                                                                                                                                               | Timing Score (TS)                                                                                                                        | D11        |
|                   | Inconsistency Test<br>IF D6 = 100% AND D7 < 70%: PS = EMPTY                                                                                                                |                            |                     | Inconsistency Test:<br>IF D6 = 100% AND D7 < 60%: PS = EMPTY                                                                                                                                  |                                                                                                                                          |            |
|                   |                                                                                                                                                                            |                            |                     | INTENTION SCORE: MIN [MEAN (PS; CS); MEAN (PS; CS; ηS); MEAN (PS; CS; TS); MEAN (PS; CS; QS); MEAN (PS; CS; ηS; TS); MEAN (PS; CS; ηS; QS); MEAN (PS; CS; TS; QS); MEAN (PS; CS; ηS; TS; QS)] |                                                                                                                                          |            |



| Current Algorithm                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              |                                                                                                                                          | Adjusted Algorithm                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                |                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| INFLUENCE                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                |                                                                                                                                              |
| D5                                                                                                                                | Had you already decided to purchase these <EFFICIENT PRODUCT> before talking to a distributor?                                                                                                                                                                                                                                                                                                                                                                          | 1) Yes                                       |                                                                                                                                          | Had you already decided to purchase these <EFFICIENT PRODUCT> before talking to a distributor?                                                                                                                                                                                                                                                                                                                                            | 1) Yes                                                                                                                         | Question used for scoring in D12                                                                                                             |
|                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2) No                                        |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2) No                                                                                                                          |                                                                                                                                              |
|                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 98/99) Don't know/Refused                    |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                           | 98/99) Don't know/Refused                                                                                                      |                                                                                                                                              |
| D12                                                                                                                               | Using a scale from 0 to 10, please rate the influence of each of the following in your organization's decision to purchase <EFFICIENT PRODUCT><br>a) [ASK IF D1=1 OR D2=2] The program rebate<br>b) Information received from an ENS program representative on high efficiency lighting products<br>c) Information received from a distributor on high-efficiency lighting products<br>d) Prevalence of LED products among products that met your lighting requirements | 1) Answer: __ (scale 0-10)                   | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c<7 & D12d<7:<br>D12 = MAX(D12a; D12b)<br>OTHERWISE:<br>D12 = MAX(D12a; D12b; D12c; D12d) | How influential were the following four factors in your decision to purchase <EFFICIENT PRODUCT>?<br>[RANDOMIZE]<br>a) [ASK IF D1=1 OR D2=2] The program rebate<br>b) Information received from an ENS program representative on high efficiency lighting products<br>c) Information received from a distributor on high-efficiency lighting products<br>d) Prevalence of LED products among products that met your lighting requirements | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%) | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c≥75% & D12d≥75%:<br>D12 = MIN(D12a; D12b)<br>OTHERWISE:<br>D12 = MIN(D12a; D12b; D12c; D12d) |
|                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 97/98/99) Not applicable/ Don't know/Refused |                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                |                                                                                                                                              |
| Influence Score (IS)                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              | (10–D12) x 10%                                                                                                                           | INFLUENCE Score (IS)                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                |                                                                                                                                              |
| Participant Free-Ridership (FR): MIN (MEAN (CS; PS; IS); MEAN (CS; PS; IS; QS); MEAN (CS; PS; IS; QS; TS); MEAN (CS; PS; IS; TS)) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                              |                                                                                                                                          | Participant Free-Ridership (FR): (INTENTION + INFLUENCE)/2                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                |                                                                                                                                              |

| Current Algorithm |                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                   |       | Adjusted Algorithm                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                   |       |  |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--|
| Cross-Influence   |                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                   |       |                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                   |       |  |
| E1                | Before participating in the Business Energy Rebates program in <APPLICATION DATE>, had your organization at any time in the past already participated in the Business Energy Rebates program or any other Efficiency Nova Scotia programs?                                                        | 1. Yes, in Business Energy Rebates<br>2. Yes, in another program(s)<br>3. Yes, in both Business Energy Rebates and another program(s)<br>4. No<br>98.(Don't know)<br>99.(Refused) |       | Before participating in the Business Energy Rebates program in <MONTH OF PURCHASE>, had your company/organization at any time in the past already participated in the Business Energy Rebates program or any other Efficiency Nova Scotia programs?                                                                                                         | 1. Yes, in Business Energy Rebates<br>2. Yes, in another program(s)<br>3. Yes, in both Business Energy Rebates and another program(s)<br>4. No<br>98.(Don't know)<br>99.(Refused) |       |  |
| E5                | Before participating in the Business Energy Rebates program, had you at any time in the past seen Efficiency Nova Scotia promotional materials advertising the benefits of energy efficiency?                                                                                                     | 1. Yes<br>2. No<br>98.(Don't know)<br>99.(Refused)                                                                                                                                |       | Before participating in the Business Energy Rebates program, had you at any time in the past seen Efficiency Nova Scotia promotional materials advertising the benefits of energy efficiency?                                                                                                                                                               | 1. Yes<br>2. No<br>98.(Don't know)<br>99.(Refused)                                                                                                                                |       |  |
| E2                | [IF E1=1, 2 OR 3] Your organization's previous participation in an Efficiency Nova Scotia program was a major factor in the decision to purchase <EFFICIENT PRODUCT>.                                                                                                                             | 1) Agree                                                                                                                                                                          | 1     | [IF E1=1, 2 OR 3] Do you agree or disagree that your company/ organization's previous participation in an Efficiency Nova Scotia program was a major factor in the decision to purchase <EFFICIENT PRODUCT>?                                                                                                                                                | 1) Agree                                                                                                                                                                          | 1     |  |
|                   |                                                                                                                                                                                                                                                                                                   | 2) Disagree                                                                                                                                                                       | EMPTY |                                                                                                                                                                                                                                                                                                                                                             | 2) Disagree                                                                                                                                                                       | EMPTY |  |
|                   |                                                                                                                                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                         | EMPTY |                                                                                                                                                                                                                                                                                                                                                             | 98/99) Don't know/Refused                                                                                                                                                         | EMPTY |  |
| E3                | [IF E1=1, 2 OR 3] Because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative asked a contractor or a technical staff member to examine the energy efficiency options for your facility | 1) Agree                                                                                                                                                                          | 1     | [IF END USER AND E1=1, 2 OR 3] Do you agree or disagree that because of your company/ organization's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative asked a contractor or a technical staff member to examine the energy efficiency options for your facility? | 1) Agree                                                                                                                                                                          | 1     |  |
|                   |                                                                                                                                                                                                                                                                                                   | 2) Disagree                                                                                                                                                                       | EMPTY |                                                                                                                                                                                                                                                                                                                                                             | 2) Disagree                                                                                                                                                                       | EMPTY |  |
|                   |                                                                                                                                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                                         | EMPTY |                                                                                                                                                                                                                                                                                                                                                             | 98/99) Don't know/Refused                                                                                                                                                         | EMPTY |  |

| Current Algorithm |                                                                                                                                                                                                                                                                                                                                       |                           |       | Adjusted Algorithm                                                                                                                                                                                                                                                                                                                                                   |                                         |       |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------|
| E4                | [IF E1=1, 2 OR 3] Because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative took into account the cost-effectiveness of energy-efficient <MEASURE CATEGORY> measures when evaluating different options for your facility. | 1) Agree                  | 1     | [IF E1=1, 2 OR 3] Do you agree or disagree that because of your company's previous participation in an Efficiency Nova Scotia program and what was learned by participating in that program, a company representative took into account the cost-effectiveness of energy-efficient <EFFICIENT PRODUCT> measures when evaluating different options for your facility? | 1) Agree                                | 1     |
|                   |                                                                                                                                                                                                                                                                                                                                       | 2) Disagree               | EMPTY |                                                                                                                                                                                                                                                                                                                                                                      | 2) Disagree                             | EMPTY |
|                   |                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused | EMPTY |                                                                                                                                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused               | EMPTY |
| E6                | [IF E5=1] Efficiency Nova Scotia promotional materials or communications were a major factor in the company's decision to purchase <EFFICIENT PRODUCT>.                                                                                                                                                                               | 1) Agree                  | 1     | [IF E5=1] Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications were a major factor in your company/organization's decision to purchase <EFFICIENT PRODUCT>?                                                                                                                                                                  | 1) Agree                                | 1     |
|                   |                                                                                                                                                                                                                                                                                                                                       | 2) Disagree               | EMPTY |                                                                                                                                                                                                                                                                                                                                                                      | 2) Disagree                             | EMPTY |
|                   |                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused | EMPTY |                                                                                                                                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused               | EMPTY |
| E7                | [IF E5=1] Efficiency Nova Scotia promotional materials or communications prompted a company representative to ask a contractor or a distributor about efficient lighting options for your organization.                                                                                                                               | 1) Agree                  | 1     | [IF END USER AND IF E5=1] Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to ask a contractor or a distributor about efficient lighting options for your organization?                                                                                                                | 1) Agree                                | 1     |
|                   |                                                                                                                                                                                                                                                                                                                                       | 2) Disagree               | EMPTY |                                                                                                                                                                                                                                                                                                                                                                      | 2) Disagree                             | EMPTY |
|                   |                                                                                                                                                                                                                                                                                                                                       | 98/99) Don't know/Refused | EMPTY |                                                                                                                                                                                                                                                                                                                                                                      | 98/99) Don't know/Refused [CONTRACTORS] | EMPTY |



| Current Algorithm                                                                              |                                                                                                                                                                                                                                   |                                                                                                                                                                   |       | Adjusted Algorithm                                                                                                                                                                                                                                              |                                                                                                                                                                    |       |
|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| E8                                                                                             | [IF E5=1] Efficiency Nova Scotia promotional materials or communications prompted a company representative to take into account the cost-effectiveness of <EFFICIENT PRODUCT> when evaluating different options for the facility. | 1) Agree                                                                                                                                                          | 1     | [IF E5=1] Do you agree or disagree that Efficiency Nova Scotia promotional materials or communications prompted a company representative to take into account the cost-effectiveness of <EFFICIENT PRODUCT> when evaluating different options for the facility? | 1) Agree                                                                                                                                                           | 1     |
|                                                                                                |                                                                                                                                                                                                                                   | 2) Disagree                                                                                                                                                       | EMPTY |                                                                                                                                                                                                                                                                 | 2) Disagree                                                                                                                                                        | EMPTY |
|                                                                                                |                                                                                                                                                                                                                                   | 98/99) Don't know/Refused                                                                                                                                         | EMPTY |                                                                                                                                                                                                                                                                 | 98/99) Don't know/Refused                                                                                                                                          | EMPTY |
| Cross-Influence (CI):<br>IF(E2 OR E6=Agree; 1) + IF(E3 OR E7=Agree; 1) + IF(E4 OR E8=Agree; 1) |                                                                                                                                                                                                                                   |                                                                                                                                                                   |       | Cross-Influence (CI):<br>IF(E2 OR E6=Agree; 1) + IF(E3 OR E7=Agree; 1) + IF(E4 OR E8=Agree; 1)                                                                                                                                                                  |                                                                                                                                                                    |       |
| Revised Participant Free-Ridership:                                                            |                                                                                                                                                                                                                                   | IF CI = 0 OR 1: Revised FR = Part FR<br>IF CI = 2: Revised FR = Part FR*0.75<br>IF CI = 3: Revised FR = Part FR*0.50                                              |       | Revised Participant Free-Ridership (End Users):                                                                                                                                                                                                                 | IF CI = 0 OR 1: Revised FR = Part FR<br>IF CI = 2: Revised FR = Part FR*0.75<br>IF CI = 3: Revised FR = Part FR*0.50                                               |       |
|                                                                                                |                                                                                                                                                                                                                                   |                                                                                                                                                                   |       | Revised Participant Free-Ridership (Contractors)                                                                                                                                                                                                                | IF CI = 0 OR 1: Revised FR = Part FR<br>IF CI = 2: Revised FR = Part FR*0.75                                                                                       |       |
| Overall Free Ridership:                                                                        |                                                                                                                                                                                                                                   | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c < 7 & D12d < 7 :<br>Overall FR = Rev Part FR<br>OTHERWISE:<br>Overall FR = Rev Part FR * (100% - Dist Influence) |       | Overall Free Ridership:                                                                                                                                                                                                                                         | IF Dist Influence = EMPTY OR<br>IF D5 = 1 & D12c ≥70% & D12d ≥70%:<br>Overall FR = Rev Part FR<br>OTHERWISE:<br>Overall FR = Rev Part FR * (100% - Dist Influence) |       |

### 9.1.3 Calculation Example

Below is a calculation example of the adjusted free-ridership algorithm for LED lamps in EPI for one participant's responses (responses indicated by green highlight).

**Table 375: Free-Ridership – LEDs**

| Adjusted Algorithm |                                                                                                                                                                                                                     |                                                                                                                                                                                                      |            |     |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|
| Question           |                                                                                                                                                                                                                     | Answer                                                                                                                                                                                               | Score      |     |
| E1                 | Before learning about the Efficient Product Installation Service, had you already decided to purchase and install LED bulbs in your home?                                                                           | 1) Yes                                                                                                                                                                                               | Use E2     |     |
|                    |                                                                                                                                                                                                                     | 2) No                                                                                                                                                                                                | 0%         | 0%  |
|                    |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                                                                            |            |     |
| E2                 | [IF E1=YES] Just to confirm: Have I understood correctly that you had already made the decision to purchase and install LED bulbs in your home before you learned about the Efficient Product Installation Service? | 1) Yes, correct (already made decision)                                                                                                                                                              | 100%       |     |
|                    |                                                                                                                                                                                                                     | 2) No, incorrect (not already made decision)                                                                                                                                                         | 0%         |     |
|                    |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                                                                            |            |     |
|                    | Planning Score (PS)                                                                                                                                                                                                 |                                                                                                                                                                                                      | E1         | 0%  |
| E3                 | Without the Efficient Product Installation Service, what is the likelihood you would have paid for the LED bulbs, knowing that the cost is about \$2 to 4 per bulb?                                                 | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%)                                                             | Answer (%) | 25% |
|                    |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                                                                            | EMPTY      |     |
|                    | Cost Score (CS)                                                                                                                                                                                                     |                                                                                                                                                                                                      | E3         | 25% |
| E4                 | Without the Efficient Product Installation Service, how likely would you have been to take the initiative to purchase LED bulbs at a store and install them in your home?                                           | 1) Definitely would have (100%)<br>2) Probably would have (75%)<br>3) Probably would not have (25%)<br>4) Definitely would not have (0%)                                                             | Answer (%) | 25% |
|                    |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                                                                            | EMPTY      |     |
|                    | Effort Score (ES)                                                                                                                                                                                                   |                                                                                                                                                                                                      | E4         | 25% |
| E5                 | [IF CODES 1,2,3,4 AT E4] Without the Efficient Product Installation Service, what is the likelihood you would have postponed replacing your bulbs with LEDs by at least one year?                                   | 1) Definitely would have (0%)<br>2) Probably would have (25%)<br>3) Probably would not have (75%)<br>4) Definitely would not have (100%)                                                             | Answer (%) | 0%  |
|                    |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                                                                            | EMPTY      |     |
|                    |                                                                                                                                                                                                                     | Timing Score (TS)                                                                                                                                                                                    | E5         | 0%  |
| E6                 | [ASK IF LED BULBS QUANTITY>1 AND IF CODES 1, 2, 3 AT E4] Without the Efficient Product Installation Service, which of the following scenarios would have most likely occurred?                                      | You would have purchased and installed ....<br>1) ...exactly the same number of LED bulbs (100%)<br>2) ... fewer LED bulbs (50%)<br>3) You would not have purchased nor installed any LED bulbs (0%) | Answer (%) | 0%  |
|                    |                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                                                                                                                            | EMPTY      |     |

| Adjusted Algorithm                                                                                                                                                                                                                |                                                                                                                                                                                                                            |                                                                                                                                |                                          |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----|
|                                                                                                                                                                                                                                   |                                                                                                                                                                                                                            | Quantity Score (QS)                                                                                                            | E6                                       | 0%  |
|                                                                                                                                                                                                                                   | Inconsistency Test                                                                                                                                                                                                         | IF E1=100% AND<br>IF E3<75% OR E4<75%                                                                                          | E1=EMPTY                                 | N/A |
|                                                                                                                                                                                                                                   | Inconsistency Test                                                                                                                                                                                                         | IF E4 <> EMPTY AND ABS (E4-E13a) > 50%                                                                                         | E4=EMPTY                                 | N/A |
| INTENTION Score: MIN [MEAN(PS;CS;ES); MEAN(PS;CS;ES;TS); MEAN(PS;CS;ES;TS;QS); MEAN(PS;CS;ES;QS)]<br>= MIN [MEAN(0%;25%;25%); MEAN(0%;25%;25%;0%); MEAN(0%;25%;25%;0%;0%); MEAN(0%;25%;25%;0%)]<br>= MIN [16.7%; 12.5%; 10%; 13%] |                                                                                                                                                                                                                            |                                                                                                                                |                                          | 10% |
| E13                                                                                                                                                                                                                               | How influential were the following two factors in your decision to have energy efficient products installed in your home? [RANDOMIZE]<br>a) The free installation of energy efficient products offered through the service | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%) | MIN (E13a Answer;<br>E13b Answer)<br>(%) | 0%  |
|                                                                                                                                                                                                                                   |                                                                                                                                                                                                                            | 98/99) Don't know/Refused                                                                                                      |                                          |     |
|                                                                                                                                                                                                                                   | b) The information or advice provided by the service staff                                                                                                                                                                 | 1) Very influential (0%)<br>2) Somewhat influential (25%)<br>3) Not very influential (75%)<br>4) Not at all influential (100%) |                                          |     |
|                                                                                                                                                                                                                                   |                                                                                                                                                                                                                            | 98/99) Don't know/Refused                                                                                                      |                                          |     |
| INFLUENCE Score: E13                                                                                                                                                                                                              |                                                                                                                                                                                                                            |                                                                                                                                |                                          | 0%  |
| Free-Ridership (FR): (INTENTION + INFLUENCE)/2<br>= (10% + 0%)/2                                                                                                                                                                  |                                                                                                                                                                                                                            |                                                                                                                                |                                          | 5%  |

**Table 376: Cross-Influence – LEDs**

|                                                                                                  | Adjusted Algorithm                                                                                                                                                                                                                                                  |                                                                                                  |       |                |
|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-------|----------------|
|                                                                                                  | Question                                                                                                                                                                                                                                                            | Answer                                                                                           | Score |                |
| F2                                                                                               | Do you agree or disagree that ...<br>[IF F1=1] ...your previous participation in an Efficiency Nova Scotia program or service was a major factor in your decision to have energy-efficient products installed in your home?                                         | 1) Agree                                                                                         | 1     |                |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 2) Disagree                                                                                      | EMPTY | EMPTY          |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                        | EMPTY |                |
| F4                                                                                               | [IF F1=1] ...because of your previous participation in an Efficiency Nova Scotia program or service and what you learned by participating, you took into account the savings on your energy bill when evaluating different energy-efficient products for your home? | 1) Agree                                                                                         | 1     |                |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 2) Disagree                                                                                      | EMPTY | EMPTY          |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                        | EMPTY |                |
| F7                                                                                               | [IF F5=1] ... the promotion of energy efficiency by Efficiency Nova Scotia prompted you to ask for the installation of energy-efficient products at no cost in your home.                                                                                           | 1) Agree                                                                                         | 1     | 1              |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 2) Disagree                                                                                      | EMPTY |                |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                        | EMPTY |                |
| F8                                                                                               | [IF F5=1] ... you took into account the savings on your energy bill when evaluating different energy-efficient products for your home due to the promotion of energy efficiency by Efficiency Nova Scotia?                                                          | 1) Agree                                                                                         | 1     |                |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 2) Disagree                                                                                      | EMPTY | EMPTY          |
|                                                                                                  |                                                                                                                                                                                                                                                                     | 98/99) Don't know/Refused                                                                        | EMPTY |                |
| Cross-Influence (CI): IF(F2 =Agree; 1) + IF(F7=Agree; 1) + IF(F4 OR F8=Agree; 1) = 0 + 1 + 0 = 1 |                                                                                                                                                                                                                                                                     |                                                                                                  |       | 1              |
| Revised Free-Ridership:                                                                          |                                                                                                                                                                                                                                                                     | IF CI = 0: Revised FR = FR<br>IF CI = 1: Revised FR = FR*0.75<br>IF CI = 2: Revised FR = FR*0.50 |       | 5%*0.75 = 3.8% |



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