SAVINGS VERIFICATION REVIEW

Of Efficiency Nova Scotia
Program Year 2023 Evaluation Results

Report for the Nova Scotia Utility and Review Board

07/26/2024

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Verification Review: Program Year 2023

Towards practical and contextually sound measurement, analysis, and reporting…

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Introduction

This report is a savings verification review for Calendar Year 2023 conducted by H. Gil Peach & Associates, LLC for the Nova Scotia Utility and Review Board. The report is focused on verification of electricity energy savings and demand reduction as measured, modeled, and estimated by Econoler, the Independent Evaluator for Efficiency Nova Scotia's Demand Side Management (DSM) energy savings and demand reduction programs.[1] Energy savings are estimated for first year and demand reduction is modeled.

We review, verify, and if appropriate, recommend adjustments to the savings data and estimates. The primary focus is impact evaluation. We also provide limited comments on other parts of the evaluation.

Examination is based on careful review of the evaluation for each program component or initiative in the DSM portfolio, including review of each evaluation's explicit or implicit design, and consideration of evaluation methods and standards, and/or evaluation protocols used in each evaluation. We review calculating methods, conduct due diligence site visits to check installation counts and quality of work for some of the programs. In these site visits, we check installed measures and discussed program experience with customers.

For 2023, we find that the savings developed by the evaluator, Econoler, are solid, and the evaluation designs, methods, and standards observed are appropriate.

I. How Savings Verification fits in the Policy, Planning, Program Cycle

It can be useful in approaching evaluation to review how the Policy, Planning and Program cycle works and where evaluation and savings verification fit.[2] DSM is a

[1] Nova Scotia Power, Inc. served as the DSM Administrator for calendar years 2008 and 2009. Responsibility transferred to Efficiency Nova Scotia Corporation in October 2010. Calendar year 2011 represented the first full program cycle with Efficiency Nova Scotia as the DSM Administrator. The year 2023 is the sixteenth program year from the 2008 start and the eleventh year with full administration by Efficiency Nova Scotia. Generally, Efficiency Nova Scotia's programs are mature programs.

[2] This initial discussion is to provide relevant context for new readers.

cycle of repeated activities with the goal of continuous process improvement.[3] Figure 1 shows the cycle with five centers of focus.[4]

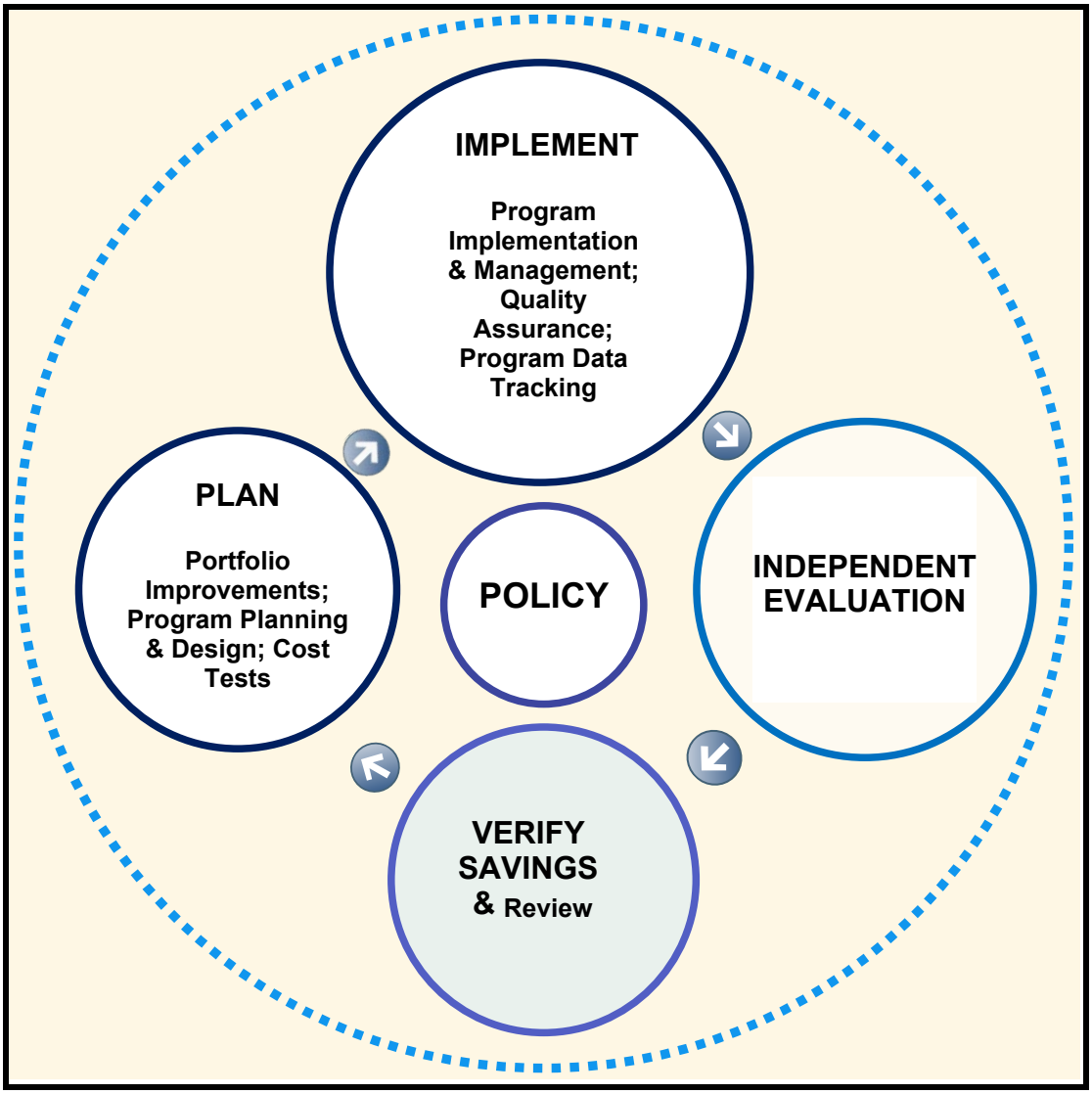

Figure 1: The Policy, Planning, Program Cycle.

[3] Morse, William L. & H. Gil Peach, "Control Concepts in Conservation Supply," Energy, Vol. 14, No. 11, Pp. 727-735, 1989; Gellings, Clark W. & John H. Chamberlin, *Demand-Side Management Planning Concepts & Methods*, Second Edition, Liburn Georgia: The Fairmont Press, 1992; Gellings, Clark W. & John H. Chamberlin, *Demand-Side Management Planning*, Liburn, Georgia: The Fairmont Press, 1993.

[4] There are other parts not shown, including periodic potential studies, other special studies such as socket studies, development of measurement protocols and the development, use and periodic updating of the Technical Reference Manual [including determination of effective useful life (EUL)], review of benefit-cost testing options, and benefit/cost testing.

In Figure 1, arrows show the clockwise direction of the primary flow of effort within a single Policy, Planning and Program cycle. Each step in the Demand-Side Management Cycle feeds information forward. For this report we call attention to only two steps in the cycle: Independent Evaluation and Verify Savings & Review.

Independent Evaluation - The Evaluator for Efficiency One programs is Econoler (https://econoler.com/en/), an international Canadian firm based in Quebec.[5] Econoler's evaluation team includes Equilibrium Engineering, Bouthillette Parizeau, Narrative Research, and Richard Patterson of CDM Energy Solutions. Econoler is the team leader. Throughout the evaluation and the savings verification study, this team and Econoler are referred to as the Evaluator. Evaluation provides independent energy savings and demand reduction results plus, limited market evaluation, process evaluation, and supportive research. The three primary types of evaluation are Impact evaluations, process evaluations, and market evaluations.

Verify Savings and Review - Both the Implementation step and the Evaluation step feed information forward to Savings Verification. This information includes program experience, selection of methods, analysis plans, program documents, tracking records, electrical measurements, and evaluation results. Savings Verification confirms and, when necessary, questions or suggests modifications in the Evaluation data, methods, and reported results.

II. Resource Acquisition and Other Evaluation Frameworks

Efficiency Nova Scotia programs are almost entirely resource acquisition programs that treat saved energy as equivalent to generated energy. This is the original framework for the energy efficiency (EE) subgroup of distributed energy resources (DERs). Efficiency Nova Scotia EE programs are appropriately evaluated within a resource acquisition evaluation framework, which is the approach followed by Econoler.

Market Transformation. However, evaluation frameworks also continue to evolve. For example, there is a history of evolutionary modification to fit programs with codes

[5] Econoler was founded in 1981 by Hydro Quebec and an engineering company, and has been independently owned since the early 2000's. While originally an ESCO, Econoler has developed as an international consulting firm. A major focus is evaluation, as well as "the design, implementation, and financing of energy efficiency and renewable energy projects." Source: Econoler website, go to https://econoler.com/en/about-econoler/.

and standard components and/or programs with market transformation components.[6] The pioneers in the late 1980s were by BC Hydro and Sweden's NUTEK, coupling EE with development of codes. Market transformation has resulted in programs that transform practices and equipment. Typically, these programs end with regulatory bans on inferior practices and products and/or market collapse of inferior products.

When a program works from a market transformation perspective, the evaluator should credit energy savings from the change in market flows to the program. When a program involves codes & standards and/or market transformation objectives, the evaluation framework normally requires a longer time perspective and understanding of market transformation curves. As noted, Efficiency Nova Scotia's current programs are resource acquisition programs. Some of these programs also produce market transformation. Over time, they transform end-use energy efficiency and the building stock for the entire province.

Climate Change. The evaluation paradigm is also evolving to include climate change. However, the practice areas of energy (and water) conservation and climate change (with a focus on resilience and adaptation) are not yet well integrated from either a policy perspective or from an operational perspective. A few jurisdictions have enacted legislative authorizations that more closely coordinate energy and climate policy,[7] but generally authority for energy savings and authority for climate work are separate within government organizations.

Of course, energy people are aware of the climate emergency. Also, themes of energy efficiency conferences are now typically built around climate issues. Missions of energy efficiency staff, including evaluators, are being expressed within climate change frameworks. It is likely that disaster preparedness and climate resiliency will eventually be authorized as explicit goals for energy savings and demand reduction projects. At that point, policy for the evaluation area will be adjusted to fit integrated goals.

What can be said in the absence of systematic authorization is that, for now, there is a duty of anticipation which has been developed for the planet by UNESCO and is expressed in the UNESCO Declaration of Obligations to Future Generations.[8]

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[6] The classic text on market transformation is Rogers, Everett M., *Diffusion of Innovations*, Fifth Edition. New York: Free Press, 2003. First published in 1962.

[7] For example, New York, Massachusetts, Minnesota, California, Oregon, Washington, Colorado, and British Columbia.

[8] UNESCO Declaration of Obligations to Future Generations, https://www.unesco.org/en/legal-affairs/declaration-responsibilities-present-generations-towards-future-generations. On anticipation,

Energy Sufficiency. Over the past 25 years, the program and evaluation framework advanced by the European Council for an Energy Efficient Economy (ECEEE) has moved towards energy sufficiency. The energy sufficiency concept is a return to the early goals of energy conservation, driven by an understanding of resource limits. The energy sufficiency framework includes principles of social responsibility and the program tool of rationing to promote low-income objectives, inclusion, and social justice. This energy sufficiency orientation is also part of the climate change framework.

What is not in place yet in Nova Scotia is the explicit authorization of policy to formally connect broader climate change themes to Efficiency Nova Scotia's DSM program. For now, evaluation is appropriately completed within a resource acquisition perspective. Market effects are considered by the Evaluator, but evaluation is focused on resource acquisition.

What will integration of climate into program goals and evaluation methods look like? We will see what develops. However, what is clear now is that the time perspective for both programs and for evaluation will need to be adjusted to the size and the time scale of climate change. This means that in program planning we will need a look ahead for a few years,[9] as we do now; and we will need to develop the medium term (through 2050) and the longer term (through 2100 or 2150) in our resource plans.

Climate change goes in one direction and its nature and scale is not a human scale. So, if we are to be practical, it is prudent to train ourselves to think in the near term, 50 years, and 150-year medium-term planning as a starting point. To make an optimal decision for the near term, we must know what happens in the medium-term and the long term, otherwise we may make the wrong investments now. Efficiency Nova Scotia published an extensive whitepaper in 2021 on the comprehensive integration strategies needed to achieve net-zero carbon by 2050.[10] However, the ENS whitepaper does not include potential economic or resiliency impacts that will occur due to the current trajectory of climate change. These issues will also need to be taken into consideration as work is done to formulate an appropriate response to

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see Bruce Tonn, *Anticipation, Sustainability, Futures, and Human Extinction*. London and New York: Routledge, 2021, Pp. 3-4, and P. 55.

[9] We often do 20-year or 30-year resource plans, but these usually only relevant for the next few years; then they are replaced by another 20 or 30-year plan. So, the operative part our resource planning is typically only 3-5 years.

[10] Efficiency One, *2050: Net-Zero Carbon Nova Scotia White Paper*, September 2021, https://ens-efficiency-one-prod-offload-647701102377-ca-central-1.s3.ca-central-1.amazonaws.com/wp-content/uploads/2021/09/22200828/White-Paper_September_2021_FINAL_VERSION.pdf

the climate crisis.

The principle of least-cost planning will have to be modified to incorporate the knowledge that the future will not, in most respects, be better than the present – that it will be harder to find money for necessary projects then in the context of many competing climate needs. The method of economic discounting of the future will need to be reversed (same mathematical method, just inverted). The hard reality that a climate perspective brings is that we must work to extend measure life to match a much longer planning horizon, and that if we want the electric system to be functional and fully adequate in 2050, 2100, and 2150 we need to be working on some higher cost components now and save some of the least-cost components for later.[11]

New methods of analysis have been developed, primarily in relation to water utilities, to accommodate climate change.[12] These approaches can be expected to develop for application across utilities (electric, gas, and water) with evolving knowledge of climate change. From a macro view it looks like the overall paradigm will be disaster preparedness and resilience, with the electricity and energy conservation goals proceeding in that context.

III. Evaluation Standards

In this section we highlight three standards for evaluation: independence, transparency, and the desirability of familiarity with current evaluation guidelines.

(1) **Independent Evaluator** – In energy efficiency evaluation, the primary standard is that evaluation must be conducted by an independent evaluator to guarantee the integrity of reported savings and prevent conflict of interest. The Evaluator meets this standard.

(2) **Transparency** - Reports and calculation methods are made public and are open to inspection by any party. Third party review of evaluations helps ensure objectivity and credibility, and, when

[11] Costs escalate due to expected inflation, worldwide crop failures, increasing and overlapping climate disaster events, and the problem of scarce resources, the technical regret embodied in offshoring production through globalization, and the breakdown of supply chains as many countries need the same electrical components at the same time.

[12] See Popper, Steven W., Warren E. Walker, Pieter J.T.M. Bloemen, and Vincent A.W.J. Marchau, eds., *Decision Making under Deep Uncertainty*, *From Theory to Practice*. Open Access edition, Saint Phillip Street Press, October 9, 2020, originally published in Cham, Switzerland: Springer Nature, 2019.

necessary, revision of evaluation results. Methods of analysis are clearly shown and discussed. The Efficiency Nova Scotia process coupled with the Evaluator's 2023 evaluation process meets this standard.

(3) **Evaluation Protocols** – In the energy efficiency evaluation area, there has been a successive development of evaluation protocols. Current protocols are associated with the Uniform Methods Project evaluation guides and other related protocols. These provide current generally accepted guidelines for evaluation. The Evaluator's 2023 evaluations are consistent with current methodological guidance in this field.

IV. Summary of Evaluated Savings Results

Evaluation of demand savings, first year energy savings, and lifetime net energy savings at the generator as reported by the Evaluator are summarized in this section.

Evaluated Net Demand Reduction at the Generator

In 2023, Efficiency Nova Scotia operated three residential programs with nine components, three business, non-profit and institutional programs with four components and one demand response program with two components.[13] In Table 1, evaluated values for net peak demand reduction at generator are shown for the programs and program components. Econoler reports a portfolio net peak demand reduction of 27.577 MW at the generator.

[13] Although Efficiency Nova Scotia does work to support Codes and Standards, direction in this area is seen as coming primarily from the federal or provincial levels, and so energy savings from Codes and Standards are treated as outside countable energy savings by Efficiency Nova Scotia and the Evaluator. There are also two demand response programs, discussed later.

2023 DSM Portfolio Net Evaluated Peak Demand Reduction (at Generator)			
Residential		**Demand Reduction (MW)**	
Rebates	Appliance Retirement	0.243	1.702
	Instant Savings	1.459	
Existing	Home Energy Assessment	7.820	13.042
	Green Heat	2.561	
	Efficient Product Installation	0.920	
	Mi'kmaw Home Energy Efficiency Project	0.373	
	Affordable Multifamily Housing	0.741	
	Affordable Single-family Homes	0.627	
New	New Home Construction	1.909	1.909
	Residential Subtotal	16.653	
Business, Non-Profit, Institutional		**Demand Reduction (MW)**	
Rebates	Business Energy Rebates	6.014	6.014
Custom Incentives	Custom	3.053	3.419
	Strategic Energy Management (SEM)	0.366	
Direct Installation	Small Business Energy Solutions	1.491	1.491
	BNI Subtotal	10.924	
Overall DSM Portfolio Total		27.577	

Source: Data from Table 6: Comparison of 2023 Evaluated and Tracked Peak Demand Savings at the Generator, P. 17 in *2023 DSM Programs Evaluation Final Report Executive Summary, Efficiency One, Final Report*, Econoler, March 28, 2024.

Table 1: Net Demand Reduction at Generator.

It is useful to note that the demand reductions at peak shown in Table 1 are not one-time demand reductions. To the extent that they are caused by installation of physical measures, they will repeat over several years. This type of program contrasts with, for example, a load shedding cooperative which reduces demand by its members for a short period each time the utility calls an event. Another contrast would be to public emergency demand reduction, a behavioral approach in which government calls for people to, for example, not charge their electric cars during certain hours, or to not use electrical appliances or equipment except on certain days

or at certain times. Behavior reductions of demand can also work well in emergency situations when the public is fully attuned to an existential threat emergency but are not associated with the permanence of demand reductions based on engineering analysis of physical measures.

In Figure 2, the program components are sorted from lowest to highest contribution to net peak demand reduction. MW values are presented on the Y-axis and programs are listed in rank order from lowest to highest across the X-axis.

The portfolio components that provide the largest BNI peak reductions are Business Energy Rebates and Custom. For Residential, the largest peak reductions are from Home Energy Assessment, Green Heat, and New Home Construction.

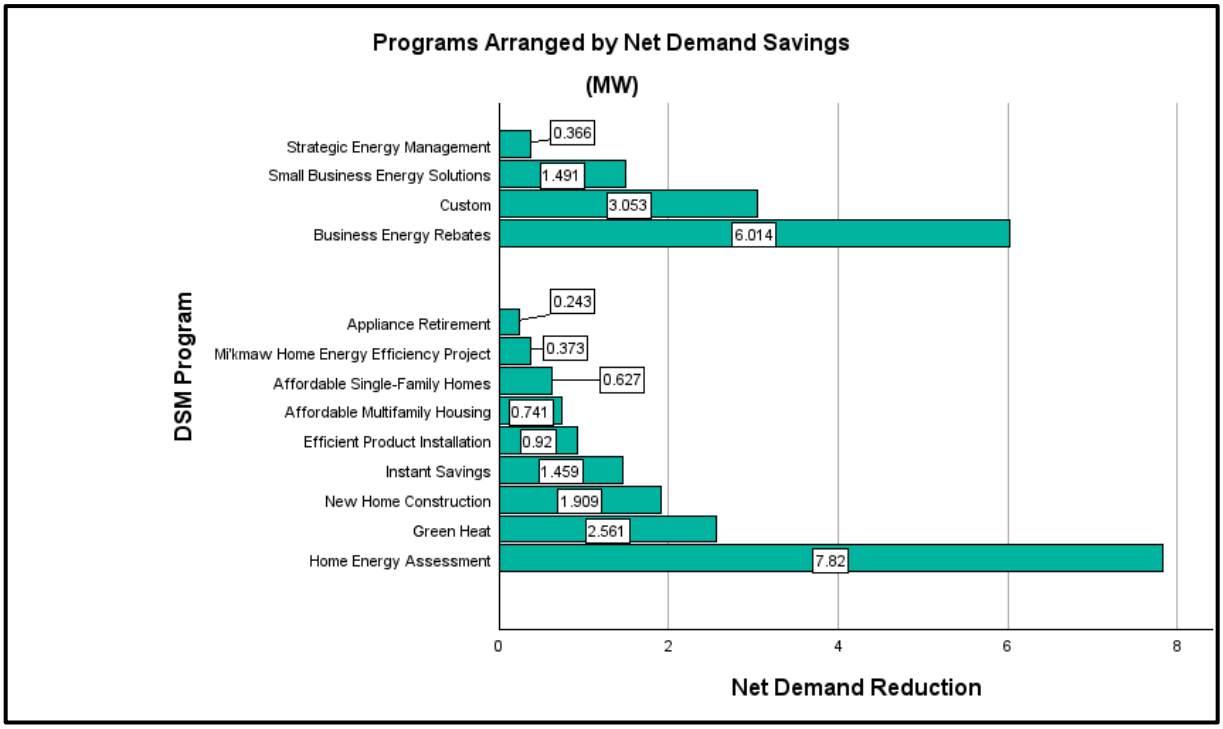

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Figure 2: Program Components in Rank Order for Demand Reduction.

Since all of these program components were designed primarily to produce energy savings rather than to meet a practical demand reduction constraint, the energy savings are a more important metric, and it is useful assess programs in terms of lifetime energy savings.

Evaluated Net First-Year Energy Savings at the Generator

Table 2 presents first-year savings, and lifetime energy savings from the Econoler evaluations.

Table 2: First Year and Lifetime Net Energy Savings at the Generator.

2023 Net Evaluated Energy Savings (at Generator)					
Program	**Residential**	**Annual Evaluated Net Savings (GWh)**		**Lifetime Evaluated Net Savings (GWh)**	
Residential Efficient Products Rebates	Appliance Retirement	1.698	13.174	6.776	86.246
	Instant Savings	11.476		79.470	
Existing Residential	Home Energy Assessment	25.966	40.278	600.938	786.561
	Green Heat	2.918		52.526	
	Efficient Product Installation	9.357		66.977	
	Mi'kmaw Home Energy Efficiency Project	0.577		11.663	
	Affordable Multifamily Housing	1.460		25.465	
	Affordable Single-Family Homes	1.444		28.992	
New Residential	New Home Construction	5.281	5.281	162.658	162.658
	Residential Subtotal		60.177		1035.465
Program	**Business, Non-Profit, Institutional**	**Annual Evaluated Net Savings (GWh)**		**Lifetime Evaluated Net Savings (GWh)**	
Efficient Product Rebates	Business Energy Rebates	38.814	38.814	556.298	556.298
Custom Incentives	Custom	21.746	25.127	189.031	207.474
	Strategic Energy Management	3.381		18.443	
Direct Installation	Small Business Energy Solutions	7.451	7.451	113.821	113.821
	BNI Subtotal		71.392		877.593
	Overall DSM Portfolio Total		131.569		1,913.058

Source: Annual and Lifetime GWh from Table 8, 2023 Evaluated Net Lifetime Energy Savings at Generator, P. 24, Econoler Overall Executive Summary, *Efficiency One 2023 DSM Programs Evaluation Reports, Final DSM Reports* , March 28, 2024.

The relation of evaluated lifetime energy savings to net first year evaluated energy savings is shown in Figure 3. The programs are on the vertical axis and the multiplier for each program (rounded to the nearest whole number) is shown on the horizontal

axis. The multiplier is the ratio of Lifetime Evaluated Net Savings (GWh) to Annual Evaluated Net Savings (GWh) from Table 2.[14]

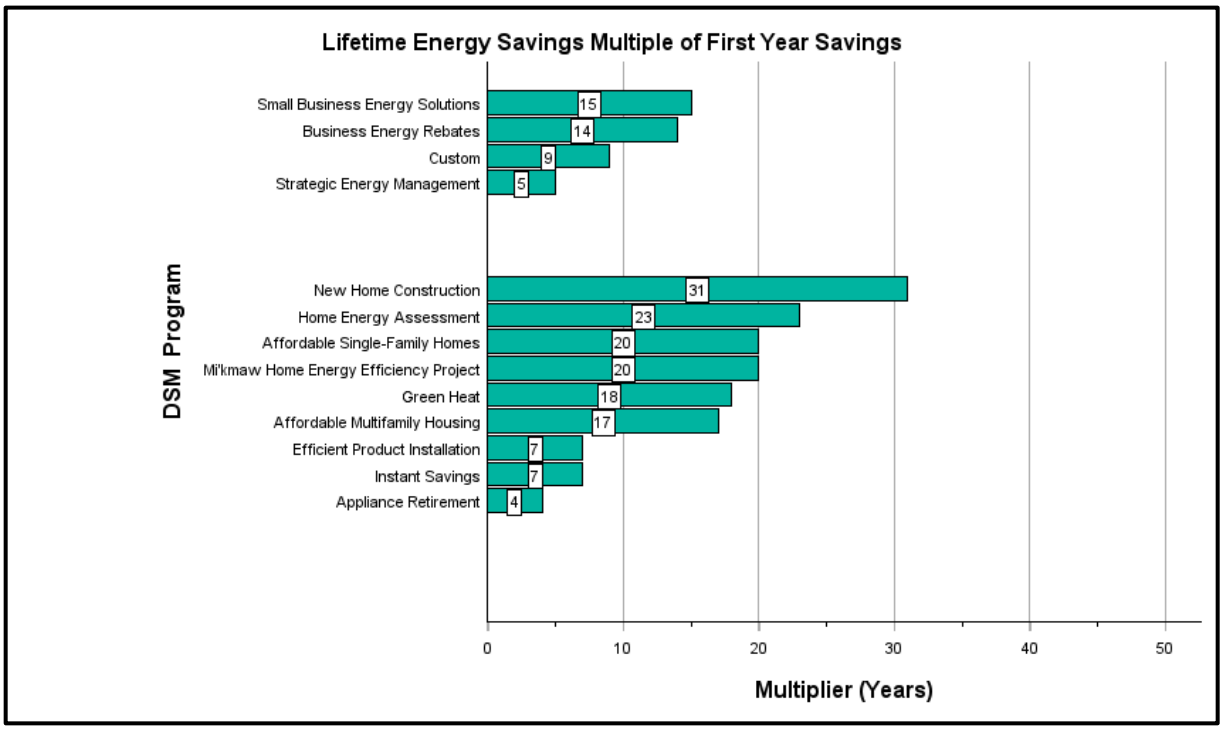

Figure 3: Rank Order for Evaluated Lifetime Energy Savings as a Multiple...

Sector Contributions

In Figure 4, net peak demand savings at the generator is split about 40% from BNI and about 60% from the Residential sector.

[14] Taken as a whole, the multiplier for Residential programs is seventeen, the multiplier for BNI programs is fourteen, and the multiplier for the overall portfolio is fifteen. The multiplier represents the average lifetime of savings for each program.

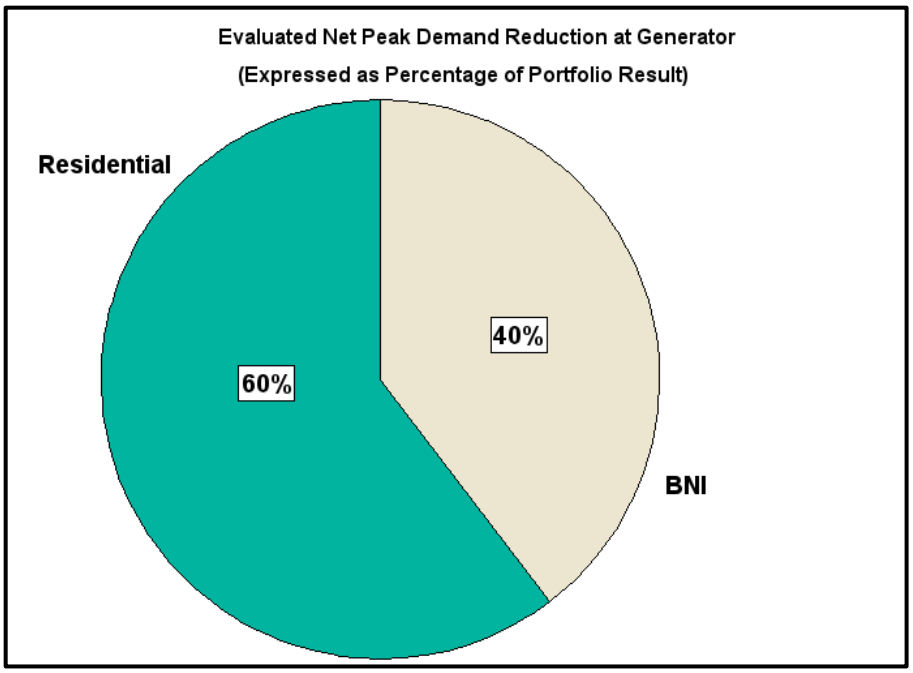

Figure 4: Percent Contribution to Net Demand Reduction at Generator by Sector.

In Figure 5, evaluated first-year net energy savings at the generator split approximately 50/50, with about 54% from BNI, and about 46% from the Residential sector. The 50/50 split also holds for the lifetime evaluated net energy savings although the distribution is reversed – 46% for BNI and 54% for the residential sector.

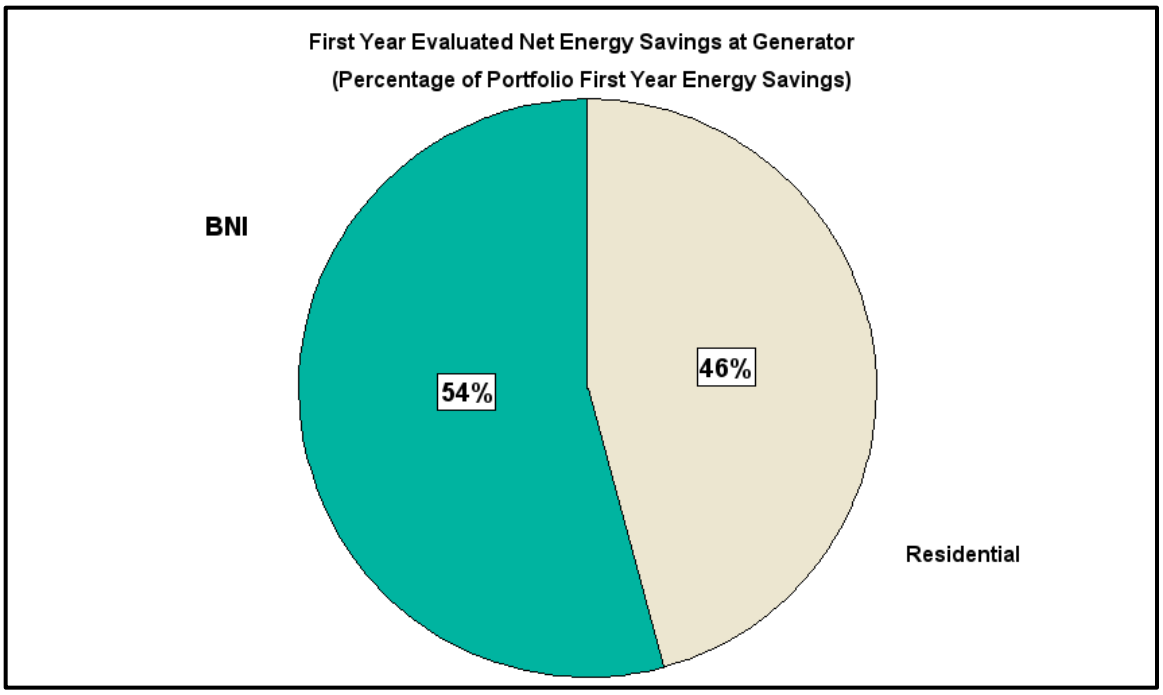

Figure 5: Percentage of First Year Evaluated Net Energy Savings at Generator.

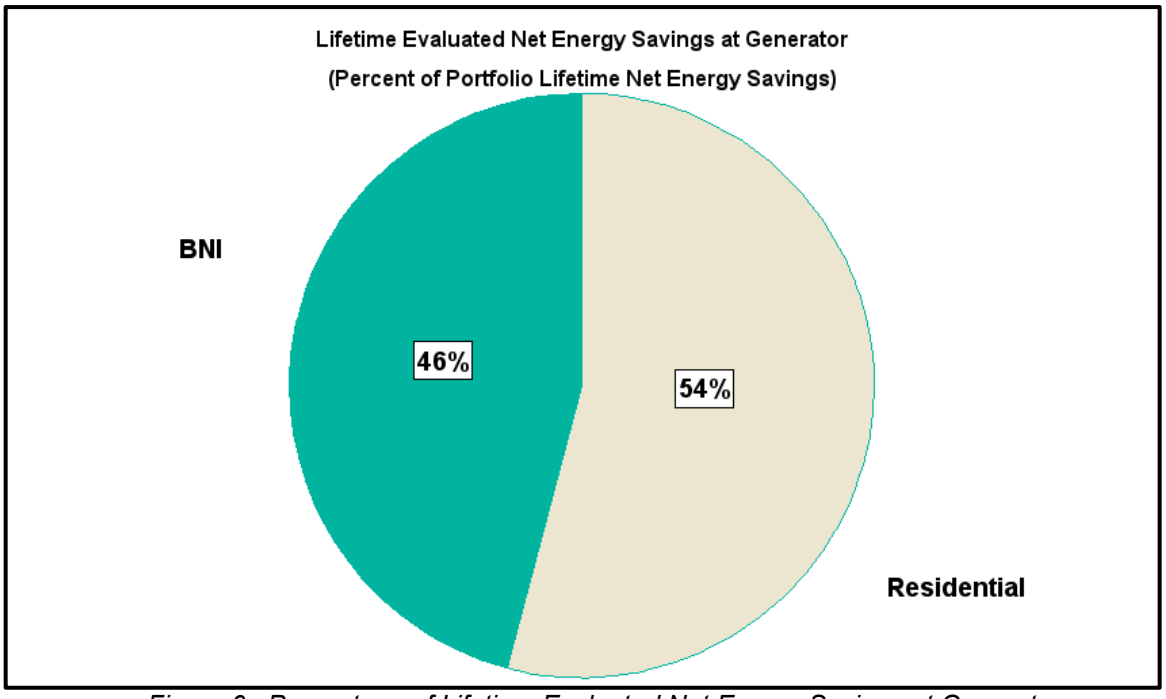

Figure 6: Percentage of Lifetime Evaluated Net Energy Savings at Generator.

V. Evaluation Effort for 2023 Programs

Econoler conducted fifteen impact evaluations (nine residential, of which two were comprehensive and seven were condensed; four BNI, of which three were comprehensive and one was condensed; and two demand response impact evaluations, one for residential and the other for BNI, both comprehensive evaluations (Table 3)).

Table 3: Planned Evaluations for 2023 Programs.

2023 Portfolio Evaluation Plan			
Program Components	**Impact**	**Process**	**Market**
Residential			
Appliance Retirement	Condensed		
Instant Savings	Comprehensive		
Home Energy Assessment	Comprehensive		
Green Heat	Condensed	X	X
Efficient Product Installation	Condensed		
Mi'kmaw Home Energy Efficiency Project	Condensed		
Affordable Multifamily Housing	Condensed		
Affordable Single-family Housing	Condensed		
New Home Construction	Condensed		
BNI			
Business Energy Rebates	Condensed		
Custom	Comprehensive	X (Retrofit)	
Strategic Energy Management	Comprehensive	X	
Small Business Energy Solutions	Comprehensive	X	
Demand Response Program			
Residential Demand Response	Comprehensive		
BNI Demand Response	Comprehensive		
Source: Econoler Table 1: 2023 Portfolio Evaluation Plan, P.3, Efficiency One 2023 DSM Programs Evaluation Reports, Final DSM Reports, March 28, 2024.			

A comprehensive impact evaluation is a full impact evaluation; a condensed evaluation includes new information but relies on information developed in one or more previous comprehensive evaluations. Econoler's goal is to conduct a comprehensive evaluation of each program every three years, with condensed evaluation between the full evaluations. However, mature programs may be assigned

full evaluations less frequently than every three years.[15]

VI. Savings Verification Approach

The savings verification review was conducted as follows:

- We focus on the "installed" annual energy savings and demand reductions. These are the annualized value of savings and demand reductions from the measures installed, regardless of what day of the year they were put into service. They do not represent the "realized" savings for the calendar year but are the savings that should be realized when each of the projects operates for a full year.

- Generally, we did not check the evaluator's mathematical calculations, but did carefully check the evaluator's presentation of method for each program analysis. We reviewed the interaction, free-ridership, spillover, and net-to-gross approaches.

- We conducted 39 site visit inspections for the 2023 review year at the time of filing of this report.

VII. General Findings

- Each program impact evaluation conducted by the Evaluator is both competent and sufficient. The structure and format of each impact evaluation is consistent. This helps to maintain a high standard of practice.

- Each evaluation has an Executive Summary. Each provides key definitions of terms and acronyms up-front. Each has a good table of contents. The evaluations have a methodological model diagram, followed by specification and discussion of methods employed. The citations to other studies are relevant. For each evaluation for which it applies there is an appendix containing clear delineation of calculations,

[15] See *Evaluation of DSM Programs, Overall Executive Summary, Efficiency One, Final Report*, March 28, 2023, P. 4 for a more complete set of considerations.

methods, and surveys.

- The Evaluator has appropriately developed savings-weighted measure life analysis for net energy savings at the generator for all program components reporting energy savings.

- Carbon emissions offsets are appropriately developed.

- The Evaluator has demonstrated command of the current evaluation guidelines, while taking independent responsibility for evaluation designs, choice of analytic methods and calculations.

- The Evaluator has conducted limited market evaluation.

VIII. General Recommendations

1. **Savings Verification Recommendation No. 1:** The Savings Verification study recommends acceptance of the 2023 evaluation results for energy savings and for demand-reduction for all programs with the understanding that the Evaluator will be conducting a full literature review for smart thermostats as part of the 2024 Measure Assessment Update in the next few months.

> **SVR-1**: The Savings Verification study recommends acceptance of the 2023 evaluated results for energy savings and peak demand reduction for all programs.

IX. Individual Program Review

There are fourteen individual programs. For Savings Verification, we focus on impact evaluation.

Table 4: List of Program Component Evaluations.

2023 Portfolio Program Components
Residential
1 Appliance Retirement
2 Instant Savings
3 Home Energy Assessment
4 Green Heat
5 Efficient Product Installation
6 Mi'kmaw Home Energy Efficiency Project
7 Affordable Multifamily Housing
8 Affordable Single-family Housing
9 New Home Construction
BNI
10 Business Energy Rebates
11 Custom
12 Strategic Energy Management
13 Small Business Energy Solutions
Demand Response Program
14 Demand Response

1. Appliance Retirement Program (ARet)

The Appliance Retirement program (ARet) provides a small incentive and service to pick-up older home appliances. It provides environmentally sound recycling of household refrigerators, freezers, room air conditioners, dehumidifiers and small refrigerators and freezers. Appliances are picked-up, carefully examined, and are

recycled by ARCA Canada Inc., which is the delivery agent for the program. Eligible appliances must be in working condition and must be ten years of age, or older. Participants must own the appliances that will be retired. The program also educates customers about the relatively high energy use of older appliances. A significant number of total participants receive appliance recycling services as the direct result of receiving new appliances through the Affordable Single-Family Homes (ASFH) and Mi'kmaw Home Energy Efficiency Project (MHEEP).

In 2023 the Evaluator performed a condensed impact evaluation of the program that entailed a review of the administrator tracking sheet data, a review of the unitary savings and an update of Net-to-Gross calculations. Free ridership was not assessed in 2023 (it was assessed in 2022 and used in the 2023 evaluation. The Appliance Retirement program shifted reporting mechanisms in 2023 to report all appliance retirements through either the Affordable Single-Family Homes (ASFH) or the Mi'kmaw Home Energy Efficiency Project (MHEEP). This reflects the continued integration of this program as a support to other programs that are targeting the replacement of older, inefficient appliances.

In 2023 the Appliance Retirement Program recycled 4,260 total appliances. Of these, ninety-three percent were either regular-sized refrigerators or freezers. These totals represented a 19% decline from 2022 levels and were the lowest reported levels since 2012. The energy savings target (2.024 GWh) for Appliance Retirement was not achieved by the program this year. The evaluated first-year net energy savings for 2023 is 1.698 GWh, or about 84% of target. The programs evaluated net demand reduction of 0.243 MW in 2023 was also smaller than program targets (0.28 MW), an achievement of about 87%.

The Appliance Retirement Program continues to have very high scores in customer service and satisfaction. The program also continues to have high rates of free ridership, which is expected for this program type. The sizable free ridership reduces the effective savings for ARet by just under 50%. The high free ridership rate is expected with the design of the program and the evaluation of this program's activities is in line with the Uniform Methods Project protocols for evaluation of these measures[16].

[16] Keeling, J.; Bruchs, D. (September 2017). Chapter 7: Refrigerator Recycling Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68563 (http://www.nrel.gov/docs/fy17osti/68563.pdf). This version supersedes the 2013 version of the protocol.

The Evaluator had no recommendations in 2023 for the ARet program. The ARet program continues to provide high environmental and community value propositions even as program savings and participation rates decline.

2. Instant Savings

Instant Savings is administered as an in-store discount program for energy-efficient products. The program is implemented through a delivery agent, Summerhill Group, Inc., and participating national and independent retailers throughout Nova Scotia. Since 2019 there is also online retailer participation. People encounter the program through marketing and promotional messages and/or when making purchases in stores or while searching for items on the Internet. Several types of stores are included in the program and the range of products is wide.

For 2023 the Evaluator performed a comprehensive impact evaluation that involved tracking sheet reviews, a participant online survey, retailer interviews, unitary savings calculations for the new measure added to the program offering (ENERGY STAR™ certified dishwashers) Previous LED lamps and fixtures unitary savings values were reviewed using the Uniform Methods Project protocol and updated for the 2023 DSM Evaluation.[17]

Free ridership was found to be increasing as would be expected as incentivized LED lighting measures are more widely adopted and are approaching market baseline. Since these lamps are now quite ubiquitous, they are scheduled to become baseline in 2025 with 2024 being the last year that program savings may be claimed for the majority of residential LED lighting technologies.[18] Despite the increase in sales from 2022 to 2023, there was a decrease in net energy and peak demand savings over the same period due to a lower NTGR established for LED lamps and fixtures in 2023. Net electrical energy savings (11.476 GWh) exceeded target (9.364 GWh). Peak demand savings (1.459 MW) exceeded the target of (0.980 MW). The Evaluator attributed these savings gains to increased sales of LED fixtures, dimmer

[17] Dimetrosky, S.; Parkinson, K.; Lieb, N. (2017). Chapter 6: Residential Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68562. (http://www.nrel.gov/docs/fy17osti/68562.pdf). This version supersedes the 2013 and 2015 versions of the protocol.

[18] According to Efficiency Nova Scotia, LED will become the baseline for residential LED lamps for Efficiency Nova Scotia in 2025 for point of purchase rebated programs like Instant Savings. For direct install programs (like EPI, SBES) where the existing measure is tracked, E1 would be able to claim one year of savings. Also, the LED baseline in 2025 doesn't apply to BNI sector.

switches and outdoor motion sensors and the inclusion of dishwashers to the program portfolio of measures.

The continued addition of new and innovative products to the Instant Savings portfolio of measures will be necessary as market transformation occurs and LED lamps are removed from the portfolio through shifting baselines. It should be noted that LED lamp baselines are not shifting as rapidly in other markets and this should be considered as a demonstration of the continuous impacts of this program, culminating over many years.

3. Home Energy Assessment (HEA)

Home Energy Assessment (HEA) is a component of the Existing Residential Program suite of offerings. This program encourages homeowners to increase the efficiency and comfort of their homes by providing rebates for qualified energy efficiency products and retrofits. HEA provides rebates for a wide range of equipment and building envelope activities. To measure performance, the program incorporates "test-in/test-out" ("D" and "E") residential audits which include blower door testing. Delivery agent energy advisors conduct these assessments. Based on the results of the "E" assessment, a final EnerGuide rating and subsequent savings are developed. Rebates are provided by type of measure installed. In 2023, HEA continued to co-deliver the Canada Greener Homes Grant which enabled participants to adopt heat pump equipment through the HEA program. Due to the focus of electricity savings and HVAC related efficiency gains, the HEA program is primarily focused on homes that use electricity as their primary heat source.

For 2023 the Evaluator completed a comprehensive impact evaluation of HEA. This evaluation included a participant survey (n=100), audits of program tracking documentation, calculation assessments for energy savings associated with solar photovoltaic (PV) and avoided GHG emission calculations. A continuing issue with program operations is the failure of homeowners to complete the post-retrofit "E" assessments within the required program timeline. *The Evaluator continues to recommend that unconverted D assessments be surveyed in future evaluations to better define spillover savings from this program activity. In 2023 the Evaluator found that, of 4,085 HEA program participants, 1,441 (35%) did not complete the exit assessment and that of these participants 54% had completed at least one efficiency measure installation activity as a result of program operations.*

HEA program participation increased from 2,783 homes in 2022 to 4,085 in 2023, a year-over-year increase of 47%. Energy savings per participant in 2023 increased

from 4.755 MWh to 7.486 MWh, an increase of 57%. Both changes likely resulted from the adoption of the Canada Greener Homes (CGH) Grant into the HEA program for 2023. The addition of new participants is largely due to HEA now being able to serve the needs of homes that do not use electricity as primary heat, which results in greatly reduced electrical savings per participant in this category. However, the increased savings per participant *overall* is also due to these additional grant monies, which supported the installation of Photovoltaic (PV) systems.

The net evaluated energy and peak demand savings determined by the Evaluator were higher than the results tracked by Efficiency Nova Scotia. This is due to increases in the Net to Gross Ratios for energy efficient upgrades and solar PV measures determined as part of the 2023 evaluation.

Weather normalized billing analysis, using a five-year regression analysis was conducted by the Evaluator to provide a 'true-up' of savings associated with the program as found and separate from the HOT2000 savings model used as a guideline for participant savings assessments. *The billing analysis provided inconclusive results by showing net negative savings (increased demand) in some cases associated with heat pump adoptions.* This is contrary to expectations and contrary to program delivery experiences in other service territories with the exception of rare cases where interactive impacts with retrofit placement of 'smart' thermostats can produce significant MSHP inefficiencies due to incorrect setback settings. Observed differences between treatment and control groups also indicate the potential for some behavior changes that may be the direct result of program delivery, though selection bias and motivation factors between groups may be a factor and indicate that reanalysis using a much larger sample size may be necessary. These and other factors yield conflicting results that make the end results of the billing analysis inconclusive, though they do tend to support the long-term observation that the HOT2000 model may overestimate savings for HVAC treatments. *Further activities should be taken to ensure that these program savings are real and to determine whether or not behavior changes associated with program delivery are resulting in significantly reduced energy savings from those expected by the delivery agent.*[19]

[19] In fieldwork, our Savings Verification site visits found situations in which heat pumps were operated by homeowners with the expectation that they would have the responsiveness of natural gas furnaces, propane, or oil heat. Cases of negative savings occur when households are not experienced with the manner of operation of heat pumps. We suspect that the negative savings following installation of heat pumps as detected and reported by the Evaluator are real and that program delivery which includes installation of heat pumps requires the addition of a carefully developed education component to be delivered in the home as a program focus.The Evaluator should visit homes with negative heat pump

As part of the 2022-2023 SolarHomes evaluation, the Evaluator conducted a calibration study of tracked PV system savings that utilized the results from SolarHomes participants, a 2-year study performed between 2021-2023. This analysis resulted in a nearly negligible (0.9%) increase in savings above tracked values for these systems. For the 2023 evaluation of Solar PV unitary savings in HEA, the Evaluator used the established calibration value of 0.9%. A very conservative application of system degradation based on a 2012 NREL study determined an exceedingly short system effective useful life (EUL) of 22.5 years. This application was applied with a linear trend much more aggressive than the observed degradation rate characteristics of PV systems. This tracks exponentially, then levels off at about 55% system capacity after 30+ years. The NREL study also cited breakouts for hot and cold weather climates and determined that *system degradation occurred at much slower rates for colder weather climates.* Typically, for investor-owned utility systems, recommended PV system EULs are 30-35 years[20]. These systems are generally installed in moderate to hot weather climates. Different cost-benefit priorities for homeowners influence perceptions of real effective life and often extend perceived 'useful' life of the system. *A reasonable adjustment could be made based on these studies and observations that would increase HEA rooftop residential PV system EULs by 50% above current values used by the Evaluator.*

SVR-2: Reanalyze Solar PV system EUL for colder climate zones and adjust according to most recent applicable studies for mounting and building types.

The inclusion of resiliency measures in the Canadian Greener Homes initiative provides additional opportunity for the inclusion of Thermal Energy Storage (TES) systems to be paired with rooftop solar. When combined with rooftop solar, this measure can provide additional Winter peak demand reductions as well as provide significant health and safety benefits. While offered through the Green Heat program, consideration should be made to include these measures within an ensemble of other energy storage and residential demand response program offerings that are above those provided through the Green Heat program (that are specifically marketed to HEA participants that are installing rooftop solar through Canadian Greener Homes).

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savings and talk with people experiencing negative savings from heat pumps, preferably not by phone and not with a survey but through unhurried discussion, to surface causes and develop solutions.

[20] Wiser, R., et al., "Benchmarking UtilityScale PV Operational Expenses and Project Lifetimes," LBL, June 2020. [Online]. Available: https://etapublications.lbl.gov/sites/default/files/solar_life_and_opex_report.pdf

4. Green Heat

Green Heat is a component of Efficiency Nova Scotia's Existing Residential program, providing financial incentives for heating systems installations that use fuel from renewable resources, specifically installations for high-efficiency heat pumps, biomass heating systems, solar space and water heating systems and demand reduction measures. Equipment purchased through Green Heat can replace or supplement existing heating equipment. Incentives are available for central heating systems and for supplementing electric heat with an area heater.

Green Heat rebated incentives for each system are:

- Heat Pumps: Ductless Mini-split Heat Pumps, Centrally Ducted Air-source Heat Pumps, Air to Water Heat Pumps, Ground-source Heat Pumps.
- Biomass: Wood/Pellet Stoves, Fireplace Inserts, Wood/Pellet Boilers, Centrally Ducted Forced Air Furnaces
- Solar: Solar Thermal Air Heating, Solar Domestic Hot Water (DHW)
- Demand Reduction: Electric Thermal Storage, Three-element Water Heaters and DHW Heater Timers

Since July 2018, Green Heat has offered non-electrically heated homes Mini-spit heat pump (MSHP) incentives under the federal government's Low Carbon Economy Fund (LCEF) through the Province of Nova Scotia. Nova Scotia Power offers on-bill financing for customers purchasing a heat pump system, and together with Efficiency Nova Scotia cross promotes the on-billing option.

The Evaluator reported that Green Heat's installations continued to decrease in 2023 by 11% compared to 2022 which decreased by 45% over 2021. The Evaluator found that the decrease in Green Heat installations was due to customers choosing to enroll the Home Energy Assessment (HEA) program which was combined with the Canada Greener Homes Grant (CGH), launched May 2021. This alternative pathway provided substantially larger grants, resulting in a 22% drop in Green Heat Mini-split Heat (MSHP) installations in order to access the higher CGH federal incentives.

Nova Scota homeowners that enroll in HEA receive CGH grants up to $5,000 to install energy efficiency retrofits including MSHPs. Note that homeowners cannot receive financial incentives from both Green Heat and HEA/CGH. As a result, the Evaluator reports that HEA installed more MSHPs in 2022 and 2023 than Green Heat and concludes that the increase in HEA MSHP installations is a direct result of the availability of the CGH grants.

In 2023 Green Heat measures installed totaled 1,783, the lowest level of measures installed since 2016, which resulted in the lowest savings level since 2017 when the Evaluator reported savings at 5.026 GWh in gross energy savings and 5.114 MW in gross peak demand savings compared to 2023 reported savings of 5.561 GWh in gross energy savings and 4.668 MW in gross peak demand savings.

The Evaluator attributed the decrease in savings to the lower number of measures installed, including MSHPs which represented 61% of gross energy savings in 2023.

The Evaluator conducted a condensed impact, process, and market evaluation. The main evaluation objectives were:

- Collect information on participant and partner perspectives.
- Calculate gross and net electrical first year and lifetime energy saving and peak demand savings.
- Calculate avoided GHG emissions.
- Analyze the market evolution of MSHPs.

The Evaluator's Green Heat evaluation approach included:

- Collecting survey information from participants.
- Conducting interviews with contractors and distributors.
- Tracking audit sheets.
- Calculating gross electrical energy and peak demand savings.
- Determining free-ridership level for MHSPs, biomass and ETS measures.
- Calculating first year and lifetime net electrical energy and peak demand savings.
- Calculating GHG emissions in CO2 eq reduction.
- Conducting market evolution since 2021 and characterization study.

The Evaluator found that Green Heat:

- Achieved net electrical energy savings of 2.918 GWh, and 2.561 MW in net peak demand savings, although savings are less than planned net electrical energy savings of 3.629 GWh and net peak demand savings of 2.920 MW.

- Evaluated gross energy and peak demand savings were identical EOne's gross tracked savings therefore there no change made to gross energy and peak demand savings parameters and calculations.

- Participation levels totaled 1,783 measures installed in 2023 compared to 2022 levels of 2005, a 11% decrease and the lowest level since 2016.

- Interviews conducted by the Evaluator with contractors found that:

1. Two out of ten participants were aware of both Green Heat and HEA/CGH grant.

2. Customers chose HEA/CGH over Green Heat because incentive levels are higher than Green Heat's incentives.

3. A market exists for a Green Heat component for customers who need one MSHP, a simple program application that does not require a home energy assessment and provides rebates quickly.

4. Contractors play a significant role in recommending, promoting, and informing participants about Green Heat, in addition to assisting in completing application forms including photographing and uploading photos of the correct equipment information.

5. Customers who are aware of the two programs are confused about the differences between Green Heat and HEA/CGH grant.

- Evaluators' surveys indicated that participants are satisfied with the overall program regarding equipment eligible for rebate and equipment installations but less satisfied with the rebate amount.

- Seventy-six percent (76%) of biomass and 61% of MSHP participants are satisfied overall with the Green Heat program; 38% of biomass and 26% of MSHP participants are less satisfied with the rebate amount; 63% of biomass and 53% of MSHP participants are satisfied with the Green Heat website and 60% of biomass and 56% of MSHP participants are satisfied with communication with Efficiency Nova Scotia.

- The Evaluator reports that the contractor overall program satisfaction averages out to 6.6 on a ten-point scale, due to dissatisfaction with: low incentives, communication with ENS, lack of marketing materials, difficulty navigating the ENS portal, and equipment list updated regularly…

- Free-ridership levels reported by the Evaluator increased in 2023 over 2021. For MSHP the level was 48% compared to 39% in 2021; for biomass customers the level was 47%, compared to 41% in 2021.

- The Evaluator reports that MSHP market is in a sustained growth phase and that:
    - The Nova Scotia Power forecast indicates 40% of Nova Scotia households use heat pumps in 2023.

- Distributors report increased sales in 2021 to 2023 and anticipate continued increases in sales in 2024 stating that as the market matures, investments will move from new heat pump installations to heat pump repairs and system replacement.

- The Evaluator offered four recommendations to Efficiency Nova Scotia for consideration:
    1. Increase Green Heat marketing materials availability to contractors and participants.
    2. Ensure that Green Heat's website is user-friendly, understandable, and easy to navigate.
    3. Investigate how communications can be enhanced between contractors and participants.
    4. Offer increased incentives to low and moderate-income households including incentives for heat pump replacements, noting that this population has less income to purchase heat pumps.

5. Residential Efficient Product Installation (EPI)

In 2023 the Evaluator conducted a condensed impact evaluation for the Efficient Product Installation (EPI) program, a component of EOne's Residential DSM Program. EPI provides free direct installation of energy-efficient products to homeowners and renters, provided through contractors.

Listed below are EPI's 2023 eligible products offered for free direct installation of energy-efficient products for electrical and non-electrical savings:[21]

- LED lamps (A-type, reflectors, and chandeliers)
- LED nightlights
- Faucet Aerators
- Low-Flow Showerheads
- Thermostatic Shower Valves
- Pipe Insulation
- Hot Water Tank Wraps
- Smart Thermostats (For Non-Electrically Heated Homes)

[21] According to the Efficiency Nova Scotia Evaluation Manager, air sealing kits are no longer offered.

- Smart Thermostats (For Mini-Split Heat Pumps (MSHPs)
- Smart Thermostats (For electric baseboards)
- Retractable Clotheslines
- Foam Gaskets
- Door Sweeps
- Window Air Sealing
- Door Weather Stripping
- Window Film Kits

From April to June 2023 EPI offered smart thermostats for electric baseboards as a pilot measure to accommodate demand for domestic hot water heater load controllers offered through the Efficiency Nova Scotia's Residential Demand Response program. EPI installed 97 smart thermostats for electric baseboards, before the installation of controllers was halted, due to withdrawal by the delivery agent. The decision of the installer not to continue also paused the installation of smart thermostats for electric baseboards[22].

EPI's two funding sources include: 1) electricity ratepayer funds used for upgrades that reduce electricity consumption and 2) Government of Nova Scotia and the federal government's Low Carbon Economy Fund funds used for upgrades that reduce the use of other fuels.

This evaluation reports results for electricity ratepayer portion of EPI only.

The Evaluator reported a 16% increase in EPI participation levels in 2023 totaling 9,763 compared to 8,394 participants in 2022. The total number of efficient products installed in 2023 was 153,775, an 18% increase compared to 2022 that totaled 130,361 efficient products, representing an average of 15.8 products installed per household, comparable to installations per household in 2022 which totaled 15.5. The Evaluator found that the average savings per participant decreased by 3.4% in 2023.

Gross energy savings and peak demand savings in 2023 were higher than 2022 savings due to the higher participation level. Gross energy savings totaled 9.481

[22] The partner decided not to continue installing smart thermostats and controllers past the trial period (June 2023) due to competition for its limited electricians and the lower revenue potential of these upgrades compared to heat pumps. Efficiency Nova Scotia reported that they will continue to explore the inclusion of these, and other electrician installed measures, using other contractors. (EOne 2023 DSM Annual Progress Report p. 22)

GWh in 2023, a 12% increase compared to 8.438 GWh in 2022. Gross peak demand savings totaled 0.942 MW in 2023 a 6% increase compared to 0.889 MW in 2022.

The Evaluator's 2023 condensed impact evaluation main objectives were to:

- calculate gross and net EPI results, specifically first-year and lifetime electrical energy savings,
- calculate peak demand savings,
- calculate avoided GHG emissions.

To determine the gross and net electrical energy and peak demand savings and avoided annual GHG emissions the condensed impact evaluation approach included:

- audit of tracking sheet,
- unitary savings review,
- calculations using evaluation results, 2021 NTGR results and
- avoided GHG emission reduction calculations.

The Evaluator updated the effective useful life (EUL) values and the 2020-2023 DSM Measure Assessment to account for the smart thermostats for electric baseboards.

The Evaluator highlighted the following 2023 EPI impacts:

- achieved the highest energy savings since 2019 before the COVID-19 pandemic,
- achieved 9.357 GWh in net electrical energy savings, exceeding planned savings target of 8.268 GWh,
- achieved 0.920 MW in net peak demand savings at the generator, an increase over planned savings of 0.760 MW,
- enrolled 9,763 program participants, a 16% increase in 2023 with a similar gross savings per participant to 2022 resulting in a 12% increase in energy savings and 6% increase in peak demand savings compared to 2022,
- installed 118,018 LED lamps generating 4.400 GWh in gross energy savings, representing 77% of EPI products and 46% of gross energy savings,
- installed 4,452 smart thermostats for electric baseboards representing 26% of gross energy savings.

The Evaluator provides no new recommendations for this program.

6. Mi'kmaw Home Energy Efficiency Program

MHEEP provides energy efficiency upgrades to band-owned homes in the thirteen (13) Mi'kmaw communities in Nova Scotia, at no cost to the participant or the communities. Energy efficiency upgrades are installed in collaboration with EOne, community housing managers and delivery agents:

- Community housing managers (HMs) identify and enroll participants. HMs review and approve recommended upgrades prior to installation.

- Two delivery agents (DA) hired by EOne:
    1. conduct pre-retrofit assessments (D assessments), post-retrofit (E assessment),
    2. identify, recommend, and submit upgrades for review and approval by EOne and HMs,
    3. hire and manage Mi'kmaw-preferred contractors.

The EnerGuide audit (test-in, test-out) is used to conduct home energy assessments resulting in each home receiving an EnerGuide rating.

MHEEP provides the following measures:

- Building Envelope upgrades
- Space Heating Equipment
- Programmable Thermostats
- Smart Thermostats with Electric Resistance Baseline
- Smart Thermostats with Heat Pump Baseline
- Drain Water Heat Recovery Systems
- Heat Pump Water Heaters and Electric Resistance Baseline
- Heat Pump Water Heaters with Heat Pump Baseline
- Appliance Replacement: Refrigerators, Freezers and Dehumidifiers and Clothes Dryers

Project funding for MHEEP is from two sources 1) electricity ratepayers DSM funding for standard upgrades that reduce electricity consumption and 2) Province of Nova Scotia funding for upgrades and reduce non-electrical fuel consumption and a portion of upgrades that reduce electricity consumption.

Initiated as the First Nations Home Energy Efficiency Pilot in 2018, the Evaluator reported that MHEEP participation in 2023 increased by 38% over 2022 with 162 Mi'kmaw participants in 2023, compared to 117 in 2022Completed home retrofit projects achieved 3.559 MWh gross energy savings per participant, resulting in a

10% increase in average savings per participant over 2022.

The Evaluator reported increases in gross energy and peak energy savings in 2023 over 2022 savings. MHEEP gross energy savings in 2023 were 0.577 GWh compared to 0.380 GWh in 2022 and gross peak demand savings in 2023 were 0.373 compared to 0.194 in 2022.

In 2023 the Evaluator conducted a condensed impact evaluation stating the main objectives were to:

- calculate gross and net MHEEP results, specifically first-year and lifetime electrical energy savings,
- calculate peak demand savings,
- calculate avoided GHG emissions.

To determine the gross and net electrical energy and peak demand savings and avoided annual GHG emissions the condensed impact evaluation approach included:

- audit of tracking sheet,
- unitary savings review,
- calculations using evaluation results, NTGR ratio of 1, and

avoided GHG emission reduction calculations.

The Evaluator's 2023 MHEEP key evaluation findings:

- achieved 0.577 GWh in net electrical energy savings, a decrease from targeted net electrical energy savings of 0.608 GWh,
- achieved 0.373 MW in net peak demand savings at the generator, an increase from targeted net peak demand savings of 0.300 MW,
- achieved 38% increase in Mi'kmaw participation in 2023 compared to 2022,
- increased average savings per participant by 10% in 2023,
- achieved 0.577 GWh gross energy savings in 2023 compared to 0.380 GWh in 2022, a 52% increase in gross energy savings,
- achieved gross peak demand savings in 2023 was 0.373 compared to 0.194 in 2023, a 92% increase in peak demand savings,
- evaluated net energy and peak demand savings defined by the Evaluator were about the same net savings tracked by EOne.

The Evaluator provides no new recommendations for this program.

The methods and calculations performed by the Evaluator are in scope and appropriate to this program type.

7. Affordable Multifamily Housing (AMH)

The Affordable Multifamily Housing (AMH) program provides affordable-housing owners and nonprofit organizations, including rehabilitation and transition housing, with incentives for building-wide energy retrofit projects that reduce consumption of electrical and non-electrical energy consumption. The program uses the same delivery model as Small Business Energy Solutions, with similar measures. Unless project owners follow a prescriptive path by installing specific measures, projects are audited by one of five AMH approved energy auditors, at the beginning of the participation process, like the Small Business Energy Solutions Audit path.

Since April 2021, AMH project has received funding from electric ratepayers for electricity demand and energy reduction activities and from the Province of Nova Scotia for measures that reduce non-electrical fuel consumption. In addition, Nova Scotia's Green Fund continues to provide funds that increase incentive amounts up to 80% of project costs for electrical energy and demand reduction and up to 100% for these measures that are applied to transition housing and shelters. Incentive limits for per unit and per room (multi-family and affordable room housing) were increased in 2023 by 15% with an overall total building cap of $300,000.

Launched as a pilot in 2018, AMH continues to increase the number of projects resulting in 61% more projects in 2023 than 2022. This increase follows a 113% increase in 2022 over 2021 numbers. The Evaluator reported that program participation increased from 49 prescriptive and comprehensive projects in 2022 to 79 projects in 2023.

In 2023 the Evaluator conducted a condensed impact evaluation of AMH to determine gross and net AMH savings, peak demand reductions and avoided GHG emissions. Calculations methods developed during the 2022 AMH evaluation were used for this determination. The specific focus of this analysis was given to prescriptive MSHPs with a small (n=34) billing analysis to determine full-load hours was performed and a bench review given that determined consistency with a prior (2017) larger billing analysis.

Evaluated net savings exceeded program targets in 2023 with 1.46 GWh in net energy savings and 0.741 MW in net peak demand savings. These values represent an increase from corresponding 2022 values by 59% and 66% respectively. The Evaluator provided no specific recommendations in 2023 for the Affordable Multi-family Housing program.

8. Affordable Single-Family Homes (ASFH)

The Affordable Single-Family Housing (ASFH) program was launched in 2023 and provides health and safety (moisture control) and energy efficiency retrofits (building envelope, appliances, and heat pump HVAC) at no cost for income-qualified homes. Under the “HomeWarming” brand, this program serves both electric and non-electrically heated homes.

Qualified participants are either self-referred or referred by Housing Nova Scotia. Income is verified by one of six delivery agent energy advisers. A pre-post audit is performed, and home energy assessment report produced to recommend treatments and provide inputs to the EnerGuide savings report upon project completion and to determine measure total savings.

In 2023 the evaluator provided a condensed evaluation of the ASFH program. This evaluation included tracking sheet audits with savings and avoided GHG calculation reviews. NTGR was not analyzed for this program due to its treatment group receiving a zero free-ridership value (NTGR=1).

Since ASFH participants also qualify for the Efficient Product Installation (EPI) suite of low-cost no-cost measures, these treatments are referred immediately through internal channels and the homes are treated by EPI prior to treatment by the ASFH program.

The Affordable Single-Family Homes program treated 242 participants in its first year of operations. Evaluated net energy savings were 1.444 GWh and evaluated peak demand savings were 0.627 MW. These values were significantly below projected program targets by 59% and 30% respectively. These shortfalls are likely due to new program operations and the lack of program guidance for target setting. The evaluator provided no recommendations for the 2023 ASFH program.

9. New Residential Program

The New Residential Program has a single program component that is called the New Home Construction (NHC) program. This program provides incentives to builders and homeowners to construct new homes above the current energy efficiency building codes.

The program steps are:

- The participant registers with the program within 30 days of obtaining a building permit and pays a $99 assessment fee.
- An Energy Adviser (EA) reviews the building plans and inputs values from these plans into the HOT2000 simulation software. This generates a building report with expected incentives for above-code construction.
- The participant has 12 months after program registration to complete the home and receive the final energy audit to verify the energy efficiency level of the new home.
- The final report is received by Efficiency Nova Scotia and a rebate check is sent to the participant.

The program provides a structured set of incentive levels. For single-family detached homes, the incentive levels are $2,000 for 40% better than code (Tier 1), $5,000 for 65% better than code (Tier 2) and $7,000 for 75% better than code (Tier 3). For multi-unit homes, the incentive levels are $1,000 for 30% better than code (Tier 1), $2,000 for 65% better than code (Tier 2) or $3,000 for 75% better than code (Tier 3). Tier 3 homes in both tracks can be certified as Net Zero Ready, Net Zero or Passive House.[23] Certified Tier 3 homes receive an additional $2,000 from the Province of Nova Scotia as part of the Advanced New Homes pilot program. Only electrically heated households are eligible for participation in this program.

For 2023, the Evaluator conducted a condensed evaluation. Free-ridership and spillover effects were adopted from previous years' evaluations with a spillover value of 14% taken from 2022 and free-ridership values calculated based on values from the 2019 evaluation.

For NHC, participants' gross energy savings were calculated by determining the difference between the to-code and the as-built modelled energy consumption values. Since the primary calculation tool for this program type is a simulation using HOT2000 that has been shown to overestimate savings for HVAC measures, initial results were corrected using an adjustment factor, called an overestimation ratio (OR), that is dependent on the type of heating system installed. The ORs used in 2022 were borrowed from the 2018 HEA evaluation.

For 2023, the program achieved 5.281 GWh net energy savings and 1.909 MW net peak demand savings at the generator. This exceeded the net savings target (3.146 GWh) and the net demand reduction target (1.060 MW). These increased savings above targets are significant and correspond to a 68% increase in net energy savings

[23] The Province of Nova Scotia contributes $2000 to the Tier 3 incentives that qualify for net-zero, net-zero ready or Passive House certified construction.

and an 80% increase for net demand reduction. It is unclear why program targets were exceeded by such a large amount as program participation, savings per participant and the ratio of tier level homes all appear similar to prior years' operations. Total program savings were consistent with prior program year operations, though participation rates declined slightly from 2022. The Evaluator provided no recommendations for the New Home Construction program.

10. BNI Efficient Products Rebates (BER)

This program serves the business, non-profit and institutional sector (BNI sector). The Efficient Product Rebates program operates the Business Energy Rebates (BER) program. This program has two components, Instant Rebates at point-of-sale and rebates provided through mail-in application. The point-of-sale rebates are provided via electrical product distributors throughout Nova Scotia. The application rebates require the submittal of an application for rebate submitted to Efficiency Nova Scotia with proof of purchase.

The product categories that qualify for rebates are LED linear lamps, LED linear fixtures, LED outdoor fixtures, occupancy/motion sensors, circulator pumps, LED directional and architectural fixtures, HVAC, motors, and booster pumps. To be included, a measure must meet minimum efficiency/efficacy values for its category as well as industry standards (such as Energy Star® performance levels or standards of the Design Lights Consortium and the National Electrical Manufacturers Association).

Point-of-sale rebates increased by 19% in 2023 over 2022 levels with 240,886 individual measures receiving incentive. Incentivized measures were led by an increase in linear LED lamps by 25% and followed by in-place LED fixtures by 14%. A slight increase in point-of-sale rebates for outdoor LED fixtures and occupancy sensors was balanced by slight reductions in rebates for circulator pumps and LED architectural fixtures.

Applications for rebates were received for 227 individual projects that were generated by 169 unique business participants. Of all applications received, 94% were attributed to lighting projects with the majority of the remainder attributed to HVAC measures and motors. Counts of total project applications received and total number of unique participants declined in 2023 from 2022 levels by 19% and 21% respectively. While lighting was attributed to 94% of applications, tracked savings for 2023 showed only 64% of total program portfolio savings attributable to lighting with 24% attributed to HVAC measures and 10% attributed to high-efficiency motors/controllers.

For the 2023 program year the Evaluator conducted a condensed impact evaluation that consisted of a tracking sheet review and effective useful life (EUL) update. Net savings were determined using 2021 NTGR values and a calculation of avoided emissions using methodologies developed in prior years' evaluations.

A condensed evaluation of BER was conducted in 2023 using the 2021 Application Rebates NTGR results and the 2022 Instant Rebates NTGR results. Adjustment ratios from 2022 project review results were using in 2023 except for lighting which used values from the 2021 evaluation, Net evaluated savings were found to be extremely close to those values tracked by Efficiency Nova Scotia and reflect the recent adjustments made to the tracking sheet following last year's comprehensive impact evaluation. Total combined evaluated savings at the generator for instant and application rebates were found to exceed 2023 program targets by 29% and 13% respectively. The Evaluator made no new recommendations for the BER program.

Recent site surveys for this type of program in California have found a small portion of participants (who received application rebates for linear LED fixtures in periods three to five years prior) developed a significant issue with these products.[24] The issue involves a unique set of circumstances where a large number of identical fixtures were installed, usually for a larger office space application, and after a number of years fixture failure would occur in one or two units, representing 5% early failure rates. While this failure rate can be expected as within a normal range for manufacturing operations in some cases, an issue arises if these fixtures have been discontinued or the manufacturer is no longer operating. In this case the building manager has two options: either re-lamp the entire space with new identical fixtures or install replacement fixtures that are different in appearance and lighting quality. This experience has prompted some program managers to recommend the purchase of identical spare LED fixtures for large jobs that can be stored and used in the event of early fixture failure. We suggest that some kind of recommendation be made to this effect on the application documentation and through training of program delivery agents, to ensure that full awareness of this potential issue is provided to BER application participants.

SVR-3: Provide guidelines within LED fixture rebate applications that participants purchase additional replacement fixtures in the event that failure occurs in a small number of units after warranty expiration.

[24] California site surveys developed in 2023.

11. BNI Custom Incentives Program (Custom)

For 2023, the BNI Custom Incentives Program consists of two components, Custom and Strategic Energy Management (SEM). The Custom program is comprised of four components: Retrofit, New Construction, Pay-for-Performance and Building Optimization.

The Retrofit component of the Custom program helps with technical and financial support for scoping and feasibility studies and then helps implement efficiency improvements using site-specific and needs-appropriate options. In 2022 rooftop solar was added to the measures for commercial retrofit projects and this measure contributed to substantial (13% of total tracked Retrofit portfolio) savings in 2023. 107 Retrofit projects were included in the Retrofit project portfolio in 2023. Of these projects, fourteen were started but not completed and 31 had been initiated in prior program years and completed in 2023. In addition to solar PV systems, retrofit program measures included refrigeration, air compression, air compression leak detection, efficient motors, HVAC, and process equipment. Some building envelope measures were also included but provided only limited (2%) tracked savings.

The Pay-for-Performance program, added to the portfolio in 2022 after a successful pilot concluded in 2021, pays incentives for low-cost measures based on Winter avoided contribution to peak demand. New Construction provides incentives for new buildings, additions to buildings and major renovation of existing buildings. Building Optimization provides a recommissioning process and supports implementation of low-cost/no-cost efficiency improvements. Efficiency Nova Scotia reports 22 new participants in 2023 for the Pay-for-Performance program but, due to multi-year savings progression, no savings for these participants are expected to be reported until 2024 or 2025. In Q4 2023 incentives for Pay-for-Performance participants were increased by 50% to pair those offered by the Custom Retrofit program.

The New Construction component of the Custom program provides technical assistance and financial incentives to assist BNI participants to construct new buildings with energy efficient savings that are above the current building code. Increases in finance costs and labor shortages for new construction activities have reduced participation rates somewhat in 2023. New Construction had 15 completed projects in 2023 (down from 19 in 2022) with the majority (80%) of these building new multi-unit residential living spaces.

The Building Optimization component of the Custom program completed 5 single-year projects and had one multi-year project. This program component provides technical assistance to increase building energy consumption performance, both for

peak demand savings and for overall energy reduction activities.

For 2023 the Evaluator performed a comprehensive impact evaluation of the Retrofit, Building Optimization and New Construction components of the Custom program that included free-ridership and spillover assessments. The 2021 NTGR results for Building Optimization were applied in the 2023 Evaluation. The comprehensive evaluation consisted primarily of developing a new adjustment ratio for Retrofit Solar PV savings calculations, desk reviews of tracked savings for New Construction and Compressed air leak audits and a Retrofit participant satisfaction, performance, and motivation survey. An additional focus on program process was made in the evaluation in the form of a phone interview of two program delivery agents, called "Business Development Managers", to help reveal current program delivery challenges and develop recommendations that will address these potential challenges.

Net evaluated savings were developed subsequent to the updated values of free ridership for Regular Retrofit and Solar PV and New Construction Program participants. No additional study of free ridership for compressed air leak audit participants was performed in 2023 and so 2021 NTGR values were used. Relatively high levels of free-ridership were found for the two program components studied and, in the case of Solar PV measure applications, the free-ridership levels were excessive (38%). In addition, the Evaluator noted that fully half of participants surveyed would have installed the exact same measures had no incentive been offered (for Regular Retrofit program measures).

Further questions were also used to determine the extent to which participant decisions about whether to have products installed or not had been influenced by previous participation in an Efficiency Nova Scotia program component or ENS efforts to raise awareness about energy efficiency.[25] When participant answers indicate 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 ENS activities on participant decisions. It should be noted that the survey count (n=13 of 54 projects completed in 2023) did meet ENS's confidence levels required for definitive results (Margin of Error of 6.3%).

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[25] The results presented by Econoler show that the initial FR question asked to participants indicates they would have implemented the exact same EE projects without the incentive, but further questions asked to the participants bring the FR result down. The appendix to this report shows the FR algorithm which considers other Efficiency Nova Scotia influences that bring the FR level down based on the responses to these additional questions. As the Evaluator notes, measuring FR through influence and intention questions is best practice and most used format.

Net evaluated savings for the Retrofit program were extremely close to those tracked by Efficiency Nova Scotia (98%) and net evaluated peak demand savings were slightly less than those tracked, but well within expected ranges (90%).

Evaluation of the New Construction component of the Custom program found that enhanced engineering review of tracked measure savings produced good results, that program participant satisfaction was high and that free-ridership levels remain high. Free ridership for BNI New Construction programs is always generally higher than non-new construction programs since incentive values are relatively inconsequential when compared with total building construction costs. In this regard, the continuing program works as a market transformation activity, especially for multi-unit housing construction, as it works to gradually shift preferences of potential buyers and increases motivation for builders to produce higher-efficiency buildings. Recent declines in participation rates for New Construction program delivery warrants a process evaluation to determine what activities and assumptions within delivery of the program are more effective and which may be changed or otherwise adapted to environmental changes to increase participation rates. In addition, the New Construction program delivery operation appears to be highly, and disproportionately active within the Halifax Regional Municipality area. This delivery bias may yield significant lost potential province-wide savings and should be more clearly understood.

SVR-4: Contract for an extensive New Construction program process evaluation with a specific focus on recent declines in participation rates and potential geographic delivery biases. This evaluation should also contain a detailed assessment of logic model assumptions as they relate to program design and delivery within a changing economic environment.

The overall net evaluated program savings for the Custom portfolio tracked exceptionally well with expected net savings at 21.746 GWh (97% of tracked) and 3.053 MW (91% of tracked).

12. BNI Strategic Energy Management (SEM)

Strategic Energy Management (SEM) is an approach for integrating energy management into business practice – so that a focus on continually advancing energy-efficiency becomes an integral aspect of workplace awareness and cooperative activity. This kind of approach has previously been used to uplift awareness and attention to quality assurance and in workplace safety campaigns. Generically, SEM focuses on changes in daily operations (with management support)

that engage staff in energy efficiency thought, alertness, and activities as they perform cooperative work. In a specific project it may be that only certain categories of workers are designated by management to be involved, such as engineers. The origin of Canadian and US SEM programs is attributed to the Japanese Kaizen (continuous improvement) programs which assume that every process can be cooperatively improved and that with management support, intentional self-discipline, corporate- discipline, and awareness, improvements can continue over time, indefinitely.[26] In more recent program iterations, facility management methods of cultivating continuous system-wide efficiency gains have spread under the SEM guidelines from the traditional manufacturing and industrial process environments and now encompasses other large-scale facilities such as hospitals and universities. This is now being performed through contracted professional “efficiency managers” who provide technical assistance and expertise for the development of new facility efficiency retrofits.

In 2023 the Energy Management Information System (EMIS) program was absorbed as a subprogram within SEM and now functions as an additional measure that may be adopted by the SEM program.

In 2023 the SEM program continued to produce increases in total participants (9 total) and achieved savings, though this increase can be attributed to a single participant that gained 54% of all SEM program savings. The result of this large single participant savings pushed the average participant gross savings slightly above 2022 values, when it would have otherwise declined significantly. The overwhelming majority of measure-level savings for SEM can be attributed to either compressed air leak repairs (70%) or the installation of control automations (25%).

For 2023, the Evaluator conducted a comprehensive impact and process evaluation of SEM. The impact evaluation entailed interviews with program delivery agents, called “Business Development Managers”, service providers and participant decision makers. In addition, a program logic model review was conducted with updates to the tracking sheet, on-site and phone interviews for project review and the development of updated NTGR values. No metering study was conducted for any of the 2023 SEM projects and no attempt was made by the program administer to adopt 2023 verification reviewer recommendations to incorporate systematic pre-post metering studies, or to even consider such studies, as a requirement for project initiation in

[26] See https://www.investopedia.com/terms/k/kaizen.asp.

SEM program operations.[27] Administrator states in program reports options for determination of savings for SEM were either 'energy modeling' or 'engineering calculations.' In addition, a document cited by the Evaluator that exemplifies minimum program requirements for successful SEM program operations that was developed by the Consortium for Energy Efficiency[28] found that the implementation of robust measurement and data collection activities of energy consumption and use, even to the point of implementing permanent submetering of targeted processes, be utilized to facilitate the necessary analysis, internal evaluation and effective external communication of program savings.[29]

SVR-5: SEM program administrators must strengthen reporting to show incorporation of Pre/Post metering or some comparable form of submetering or EMIS system reporting as a robust form of energy data collection to validate savings verifications in future SEM program cycles.

Six of Nine total participants produced savings in the 2023 SEM program cycle. Net evaluated savings were determined using the updated calculations, desk and on-site interview results and the application of updated NTGR values of spillover and free ridership resulting from this year's evaluation activities. In addition, some additional savings from spillover effects due to prior program year operations were observed anecdotally, but since their savings were not incented and the amount of net savings were not evaluated, they could not be added to program operations during this evaluation cycle. The Evaluator notes, anecdotally, that these observations indicate a long-term response to prior program year operations.

SVR-6: An in-depth participant survey of all prior SEM and Custom Retrofit program participants should be conducted to better quantify past program participation persistent spillover savings.

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[27] However, Econoler did perform interviews with the Service Providers to discuss any barriers they may face with implementing SEM protocols and compliance of the SEM participation process with CEE SEM Minimum Elements. Table 34 in the Custom report highlights the responses from participants on if all minimum elements are completed or in place. Most participants have adopted almost all SEM minimum Elements, with the energy policy being the element that most have less of a priority on as it doesn't result in direct savings.

[28] Consortium for Energy Efficiency, "CEE^{SM} Strategic Energy Management Minimum Elements", 2014 (Available at https://cee1.my.site.com/s/resources?id=a0V2R00000sUQcE)

[29] The Efficiency Nova Scotia Evaluation Manager notes that SEM does have pre and post measurements for all projects. Recommendation SVR-5 is for the Evaluator to clearly show incorporation of pre and post measurements in the evaluation writeups.

Evaluated net energy savings and net peak demand for the SEM program exceeded 2023 program targets with 3.381 GWh of savings and 0.366 MW of peak demand. These values exceeded program targets by 13% and 7% respectively.

The SEM process evaluation followed an evaluator recommendation from 2022 to explore potential program logic model constraints in delivery and to gain clarity in program/facility decision maker interactions and perceptions of SEM. As a result of this process evaluation, the Evaluator recommended that the program begin to track other program interactions with SEM participants who initiate capital projects through BER or Custom Retrofit programs. In addition, a lack of program effectiveness and project value was determined in the participant/decision maker interviews of program perceptions. An additional set of recommendations were made to communicate SEM program value directly and indirectly to both participants and non-participants.

13. BNI Small Business Energy Solutions Program (SBES)

The BNI Direct Installation Program has a single program component, Small Business Energy Solutions (SBES). SBES is available to businesses that use less than 350,000 kWh annually. There are two paths within the program, the audit path, and the do-it-yourself (DIY) path. For 2023 there was also a Commercial Direct Installation pilot that was initiated in 2021 and remains in the pilot program stage. Most participants (83%) were on the DIY path, a similar percentage of total participants as in 2022. There were 467 projects across the audit path, DIY path, and CDI pilot, a 27% decrease in participation levels from 2022 and a number slightly lower than the 2021 counts. Of the total program count, only fifteen projects were developed through the Audit path (3.2%). Evaluated net energy savings was 7.451 GWh and evaluated net demand reduction at peak was 1.491 MW. Net energy program savings achieved only 63% of program targets for 2023 and 72% of peak demand reductions. Program targets for SBES were lowered via a mid-year adjustment.[30]

Businesses that desire and qualify for the audit path are offered a free energy audit. Those that do not qualify may pay for an energy audit. Participants that follow the DIY path are not provided energy audits since participants have already identified measures they want to implement. DIY customers are provided quotes and invoice guidelines, product worksheets and a referral to the Efficiency Preferred Partner (EPP) Network. Participants can select measures or choose to employ a contractor

[30] Efficiency Nova Scotia reports mid-course adjusted targets in the evaluation reports. The Annual Progress Report presents both the original targets and the mid-course adjustments, with explanation.

to help with the decision on which measures to install. After 2020 program participant rates had dropped considerably from earlier program cycles, Efficiency One increased program incentives and this appears to have considerable effect on participation rates for both 2021 and 2022 program years, though 2023 counts declined unexpectedly.

The evaluation approach consisted of a comprehensive impact evaluation for the SBES program with a condensed impact evaluation applied to the Commercial Direct Install (CDI) pilot program. The impact evaluation was paired with a process evaluation that reviewed customer and delivery agent experiences, satisfaction levels and explored barriers to improved program performance. For the impact evaluation, the Evaluator conducted a tracking sheet audit, reviewed peak demand savings for heat pumps, conducted site visits and performed desk reviews. A participant survey was conducted with site visits to update NTGR values for free-ridership and spillover. The Evaluator also completed avoided GHG emission reduction calculations.

The participant awareness survey performed for the process evaluation indicates a program shift away from the use of Efficiency Nova Scotia account representatives who promote SBES and toward relying on prior experience/awareness of Efficiency Nova Scotia and the use of email or electronic newsletters to promote program awareness among potential participants. The trend for declining awareness from account managers or representatives dropped from 22% in 2019 to only 2% of surveyed participants in 2023. Overall, program awareness in participants derived from personal interactions (friends or colleagues, contractor or consultant/vendor, and account representatives) dropped from 84% positive response rates in 2019 to 48% in 2023. This indicates a major shift in promotional strategies away from personal relationships and toward electronic or internet outreach. It also indicates a reliance on prior program operations to generate program engagement as a form of spillover with program awareness from prior program experience rising from 8% in 2019 to 20% of all participants surveyed in 2023.

SVR-7: Shifts in program delivery and promotion away from account manager interactions and the subsequent decline in Audit-path project numbers are negatively impacting program performance and should be reversed. Additional focus should also be placed toward canvasing potential SBES audit-path participants through the employment of regional contractors with assigned territories and performance-based reimbursements for business audit recruitment activities (application and participation).

Program participant and contractor satisfaction survey results were consistent with

prior program years with a single notable exception. When asked about awareness of on-bill financing and the current real value of measure incentives, participants scored significantly higher in the 2023 survey as compared to other program process evaluations in prior years. The Evaluator notes that special attention should be made to inform potential participants of financing options and that these two changes in response rates indicate the possibility of recent economic pressures placed on small business owners in the province in recent years. This may warrant a major shift in both program design and program promotional activities if this trend continues.

The Evaluator made two recommendations for SBES. One recommendation is to consider improvements in oversight of the Customer Information System (CIS) automated tracking sheet data entry, where blank entries could reduce tracking sheet accuracy. The second recommendation involves improved follow-up to registered program participants who are approaching their project expiration date to prevent drop-out or lost savings from installed measures.

Previous evaluations of similar programs in other service territories have attempted to investigate non-participant spillover, as well as 'partial participant' spillover (defined as a program participant who had received an energy audit within 4 years). Due to the common financial constraints on small business owners, it is natural for some business owners to delay needed efficiency investments beyond the 120-day program completion window for DIY installations. It is also possible that additional efficiency investments, usually in non-lighting upgrades, may be incurred in the absence of other program incentives (for example, point of sale rebates). A 2020 process evaluation of NYSEG's direct-install program found that 43% of non-participants conducted similar upgrades to their facility.[31]

Small business owners of Nova Scotia are a small, tight-knit community with shared experiences and natural alignments. It is expected that there would be some non-participant spillover produced by an effective direct-install program that has delivered significant savings over previous years' operations. A process evaluation should be conducted to capture this potential non-participant activity but should, at a minimum, follow up with partial-participants and participants from prior program cycles.[32] This

[31] Energy & Resource Solutions, "*Small Business Direct Install Program Process & Net-to-Gross Evaluation Draft Report prepared for NYSEG/RG&E"*, October 2, 2020 https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B7C7408AE-835B-4EEF-BBB2-5650390C75F5%7D.

[32] According to the Efficiency Nova Scotia Evaluation Manager, Econoler did perform an interview with ten dropped out participants in SBES in 2023. Eight of the ten indicted they *did* plan to complete the program (approval was given at least 8 months prior). One indicated they did not move forward with any EE measures, and one *did* move forward but didn't submit paperwork.

non-participant evaluation should be conducted using a survey method approach as informed by the Uniform Methods Protocols for net-to-gross evaluations[33] as this effort may also inform other programs that may need to update their portfolio of incentivized measures. It should be noted that this recommendation originates from the 2022 program year review and, though a process evaluation for SBES was performed this year, no effort was made to explore non-participant spillover, though anecdotally there are indications that prior program interaction and program referrals from friends and colleagues continue to be a strong enrollment tool.

SVR-8: A non-participant and partial-participant spillover survey should be conducted. This activity should also inform rebate programs of additional measures that may be included in future program offerings.

14. Demand Response

In Q1 2023 Efficiency Nova Scotia integrated two pilot demand response (DR) programs that had been operating since 2021 into a single DR program offering. The DR program has two components, (1) Residential and (2) Business, Non-Profit and Institutional (BNI).

The residential DR program offers incentives to homeowners who allow direct control of their water heaters to voluntarily reduce peak demand consumption during peak demand events. The BNI component of the DR program operates through peak demand aggregation and voluntary curtailment during peak demand events. Evaluated demand response savings for the Residential program were 0.058 MW total available DR capacity with 0.023 MW new DR capacity enrolled in 2023.

Residential enrollments for the first year of program operations in 2023 doubled previous pilot enrollments and continues to provide savings from this sector. Metering analysis by the Evaluator indicates some connectivity issues with controller equipment that somewhat reduced evaluated peak demand savings but should be considered normal to the implementation streamlining and ramp-up process of a newly initiated program.

[33] Dimetrosky, S.; Parkinson, K.; Lieb, N. (2017). Chapter 21: Estimating Net Savings – Common Practices, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68578. (http://www.nrel.gov/docs/fy17osti/68578.pdf). This version supersedes the 2013 and 2015 versions of the protocol.

BNI engagements showed high levels of response and enrollment rates. A small proportion of participants opted to not curtail during peak demand events due to site activity production demands and adjustments have been made by the program administrator to somewhat over-enroll participant populations for the 2023-2024 period to compensate. This indicates that a prescribed target and not-to-exceed levels of demand response have been set, likely to fit within a program budgetary constraint. Evaluated demand response savings for the BNI program were 2.365 MW total available DR capacity with 2.365 MW new DR capacity enrolled in 2023. These values were below first-year program targets.

X. Recommendations from Fieldwork

In multiple site visits for Program Year 2023 it was discovered that some confusion between similarly named programs and program delivery functions had occurred. Specifically, in regard to the Green Heat program and Canada Greener Homes Grant (CGH Grant). In some cases, we encountered customers who had missed out on the federal CGH Grant due to a measure delivery deadline of which they were unaware of and thought that the Green Heat program had completed.

The overwhelming majority of fieldwork visits presented excellent workmanship and positive statements of program value from participants. Very few issues were found that indicated poor workmanship or lower than expected savings.

In a few audited locations there were some issues that appear to be representative of a pattern of changing program delivery behavior. In general, these issues suggest a general perception of reduced program/customer interactions and the development of direct social relationships through interpersonal interactions. The lack of strong program/customer interactions then leads to miscommunications and lost delivery opportunities.

Although, most of the problems reported by customers are minor (for example, a subcontractor was assigned to install a jacket on a water heater but did not have one along and did not schedule a return visit to correct the issue). There does appear to be a systemic problem with customer perceptions of how heat pump systems will operate. Since the maximum heat rates of heat pumps are significantly lower than that of other heating sources (resistance heat, fossil fuel heat) the normal operational profiles of heat pumps differ greatly from the previously installed system. When these operational differences are not sufficiently communicated to the participant, expectations of operational equivalency can be very high. This then leads to attempts to operate the installed heat pump in a manner similar to the replaced gas or coal

furnace. *Since a heat pump performance cannot respond in real time like equipment that works with more dense forms of energy, this misperception can lead to frustration and to a pattern of constant setpoint resetting which can raise energy bills.*

This lack of product coaching has been observed both in institutional installations (a church with a vibrant community service focus and nightly meetings in which people keep changing the heat pump settings) and in homes (specifically with the HomeWarming program that replaces fossil fuel heat sources).

SVR-9: Specific focus must be made to ensure that heat pump treated participants are made fully aware of differences in operational characteristics and recommended system management. Additional focus should be made to identify special-need customers, specifically, homes and businesses that are occupied by senior citizens who do not have previous experience with heat pump equipment. In these cases it may be necessary to develop a home visit protocol to chat with these customers *in an unhurried way* about how to best use their new heat pump and to manage further expectations of measure performance. It may be particularly important to have a conversation in person, and not be under time pressure to move on to the next thing in order to have real communication and support for the household. These home visits cannot be conducted adequately by a call center or as an additional requirement placed on the installation contractor and are best conducted by Efficiency Nova Scotia personnel.

A separate, but related concern is that there may be a tendency for lack of control of crews (for Home Warming) that may have begun during Covid, because presence of Efficiency Nova Scotia staff may be less in the field. Efficiency Nova Scotia needs to develop closer presence and tighter quality control of field operations. This means spending more time building personal relationships with the contractors who do the work in outlying communities (away from the HRM where problems do not appear to be as prevalent). Using automated or electric systems, box checking, call center scripts, and the lack of physical presence are likely contributors to this problem.

SVR-10: Have two or more teams that put more direct time on the job in the field, particularly in making rounds in the areas outside of the HRM. Reduce communication requirements through electronic systems and increase direct communication through the development of social relations with other participants in the service delivery networks. Create a stronger Efficiency Nova Scotia team presence in the areas away from HRM to strengthen accountability of crews to contractors and crews and contractors to Efficiency Nova Scotia's quality of service objectives.

XI. Summary of Recommendations

General Recommendations

SVR-1: The Savings Verification study recommends acceptance of the 2023 evaluated results for energy savings and peak demand reduction for all programs.

Program Specific Recommendations

1. Home Energy Assessment (HEA)

SVR-2: Reanalyze PV system EUL for colder climate zones and adjust according to most recent applicable studies for mounting and building types.

2. BNI Efficient Product Rebates (BER)

SVR-3: Provide guidelines within LED fixture rebate applications that participants purchase additional replacement fixtures in the event that failure occurs in a small number of units after warranty expiration.

3. BNI Custom Incentives Program (Custom)

SVR-4: Contract for an extensive New Construction program process evaluation with a specific focus on recent declines in participation rates and potential geographic delivery biases. This evaluation should also contain a detailed assessment of logic model assumptions as they relate to program design and delivery within a changing economic environment.

4. BNI Strategic Energy Management (SEM)

SVR-5: SEM program administrators must incorporate Pre/Post metering or some comparable form of submetering or EMIS system reporting as a robust form of energy data collection to validate savings verifications in future SEM program cycles.

SVR-6: An in-depth participant survey of all prior SEM and Custom Retrofit program participants should be conducted to better quantify past program participation persistent spillover savings.

5. Small Business Energy Solutions (SBES)

SVR-7: Shifts in program delivery and promotion away from account manager interactions and the subsequent decline in Audit-path project numbers are negatively impacting program performance and should be reversed. Additional focus should also be placed toward canvasing potential SBES audit-path participants through the employment of regional contractors with assigned territories and performance-based reimbursements for business audit recruitment activities (application and participation).

SVR-8: A non-participant and partial-participant spillover survey should be conducted. This activity should also inform rebate programs of additional measures that may be included in future program offerings.

General Recommendations

SVR-9: Specific focus must be made to ensure that heat pump treated participants are made fully aware of differences in operational characteristics and recommended system management. Additional focus should be made to identify special-need customers, specifically, homes and businesses that are occupied by senior citizens who do not have strong experience with heat pump equipment. In these cases it may be necessary to develop a home visits protocol to chat with these customers in an unhurried way about how to best use their new heat pump and to manage further expectations of measure performance. It may be particularly important to have a conversation in person, and not be under time pressure to move on to the next thing in order to have real communication and support for the household. These home visits cannot be conducted adequately by a call center or as an additional requirement placed on the installation contractor and are best conducted by Efficiency Nova Scotia personnel.

SVR-10: Have two or more teams that put more direct time on the job in the field, particularly in making rounds in the areas outside of the HRM. Reduce communication requirements through electronic systems and increase direct communication through the development of social relations with other participants in the service delivery networks. Create a stronger Efficiency Nova Scotia team presence in the areas away from HRM to strengthen accountability of crews to contractors and crews and contractors to Efficiency Nova Scotia's quality of service objectives.

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XIII. Appendix: Questions to ask of DSM Evaluations

(1) Is the evaluator free of conflicts of interests?

(2) Does the independent evaluator have control over methods and measurement approaches?

(3) Is the evaluation oriented to the goal of truth in measurement?

(4) Is the evaluation open, well documented, and transparent?

(5) If the evaluator uses a Technical Resource Manual, are values and calculation methods critically reviewed?

(6) Are appropriate evaluation guidelines or protocols cited and used?

(7) Is impact evaluation supported by process and market evaluation?

(8) Is market evolution critically developed and well reported?

(9) Does the evaluator engage with program administration and program technical staff in the design of the evaluation?

(10) Does the evaluation make use of literature reviews and/or consultation with experts, where appropriate?

(11) Are problems identified by the evaluator during fieldwork reported to program managers on a timely basis?

(12) Does the evaluator follow up to check implementation of recommendations in the next program cycle and include follow-up in the next evaluation report?

(13) In a complex evaluation, does the evaluator include a list of abbreviations and definitions?

(14) In a complex evaluation, is method and measurement approach explained?

(15) For surveys, are the survey questions presented in an appendix to the evaluation?

(16) Is statistical confidence and statistical precision reported for surveys or interview sets?

(17) For programs that require on-site visits, are there enough on-site visits?

(18) Are there careful project file reviews?

(19) Are there critical unitary savings reviews?

(20) Is analysis of metered energy data conducted correctly and used when it is relevant?

(21) Is there critical review of simulation models when simulation models are used in a program and/or for evaluation?

(22) When metering is done, are potential problems with the accuracy and/or precision of metered results explored and reported?

(23) Is effective useful life (EUL) well estimated?

(24) Are avoided GHG emissions calculations conducted correctly?

(25) Is the method of calculation of free-ridership and spillover carefully reported and clarified?

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