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Request IR-01:

Refer to the Direct Installation Program, Executive Summary, Table 1, 2018 DSM Annual Progress Report (Table 1, Page 2 of 86). The Peak Demand Savings show a net savings of 1.441 MW, which is 15% less than what was targeted. Please provide an explanation to the less-than proposed Peak Demand Savings.

Response IR-01:

Within the 2018 DSM Annual Progress Report, regarding peak demand savings, it states on page 28:

[SBES] saw lower-than-expected net peak demand savings, as a result of adjustments made to tracked peak demand savings through the evaluation process; please refer to the 2018 Direct Installation Evaluation Report for further information.

The 2018 SBES evaluation report states on page 20:

The evaluated net peak demand savings were 29 percent lower than the tracked value. Overall, the gross peak demand savings were adjusted downwards as a result of the evaluation, with the Audit path savings being increased and the DIY path savings being reduced. The evaluated NTGR value being lower than the tracked value increased the variation between net evaluated and tracked peak demand savings.

Adjustments made via evaluation were primarily to hours of use assumptions.¹

¹ Direct Installation Program, 2018 DSM Evaluation: Efficiency Nova Scotia, Final Report, 15 March, 2019, at p. 13

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Request IR-02:

Please provide all memos, presentations and reports to management of EOne regarding the appropriate DSM plan activity and funding levels and /or that discuss the NSP testimony and alternative application.

Response IR-02:

There are no memos, presentations or reports in relation to the 2020-2022 DSM Plan that address the NS Power filed evidence, that were directed to EfficiencyOne's management – other than a presentation to the EfficiencyOne's Board of Directors that was prepared with the advice and assistance of legal counsel – solely for the purpose of receiving instructions with regard to the finalizing of the 2020-2022 DSM Plan Application.

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Request IR-03:

**Refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Evidence, Page 14, Line 12 –
22. Please provide first-year savings as percentage of total annual first-year savings by
technology type for each of the DSM program and sector proposed in the Preferred Plan
separately for 2020, 2021, and 2022.**

Response IR-03:

Please refer to Attachment 1 of this IR response, filed electronically.

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Request IR-04:

Please provide mathematical formula of total resource cost test used in the cost-effectiveness testing of 2020-2022 DSM Resource Plan.

Response IR-04:

The following response has been provided by Navigant Consulting:

The standard 2001 Standard California Cost Test Method is used for the TRC calculations in the 2020-2022 DSM Resource Plan. This is, **(Avoided Costs Benefits) / (Customer Costs + Utility Admin Costs + Negative Avoided Costs Benefits)**. Avoided costs streams considered in the Plan include electric energy, electric demand, water, and natural gas. Negative avoided costs, applied in the model as a cost, arise from increases in consumption due to the installation of an efficiency measure. Notably, this occurs as an increase in natural gas consumption due to electric commercial kitchen equipment switching to gas.

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Request IR-05:

Refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Appendix A, Page 10, Table 1,

a. Please comment on why TRC numbers of Efficient Product Rebates for Residential sector (1.1) and BNI sector (2.3) differ by more than 100%?

b. Please provide the % of incentives allocated in terms of total cost for Efficient Product Rebate programs of both Residential sector and BNI sector proposed in the Preferred Plan for 2020, 2021, and 2022.

c. If incentive level percentage provided above are different for Efficient Product Rebate programs of Residential and BNI sector, please comment on why E1 is proposing different incentive level in terms of total cost of the program?

Response IR-05:

a) The Residential Efficient Products and BNI Efficient Products programs comprise different program components and different measures. Residential Efficient Products includes the Instant Savings and Appliance Retirement program components; BNI Efficient Products includes only the Business Energy Rebates (BER) program. Four-foot linear replacement lamps, which have a high TRC (an average of 4.8), are a popular measure in BER and put upward pressure on the program average TRC. BER also includes demand reduction initiatives, which have a high TRC. The Instant Savings program does not provide incentives on four-foot linear replacements and does not have any demand reduction initiatives. Additionally, Instant Savings no longer offers incentives on LED A-lamps, which have traditionally had higher TRC results.

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b) Please refer to the table below.

	Incentive Cost (\$M)			Total Cost (\$M)			Incentive as percent of total cost		
	2020	2021	2022	2020	2021	2022	2020	2021	2022
Efficient Product Rebates	6.1	6.2	6.5	7.3	7.5	7.8	83%	83%	84%
Residential Efficient Products Rebates	2.3	2.2	2.2	3.7	3.5	3.3	62%	63%	66%

c) There are several key factors that differentiate these programs with respect to the percentage of total costs attributed to incentives:

Economies of scale

The BER program is able to operate at a much higher scale than the Residential Efficient Products program, which means its ratio of administrative costs to incentive costs is lower.

Program administration

The Instant Savings program is administered by a third-party delivery agent, whereas the BER program is administered internally. Delivery agent costs are a relatively higher portion of administrative costs for Instant Savings.

Marketing

The Instant Savings program component, which is open to the general population at participating retailers, has greater marketing costs than the BER program component.

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Request IR-06:

Refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Appendix A Attachment 1:

- a. Provide list of measures along with their key characteristics such as estimated energy and peak demand savings, total cost, proposed incentives, and customer cost included in the Preferred Plan that have TRC less than 1.**
- b. Please explain what it means, in terms of benefit-cost analysis, to include energy efficiency measures that have TRC of less than 1 in the proposed Preferred Plan.**
- c. Please discuss the reasons for including measures that have TRC less than 1 in the Preferred Plan.**

Response IR-06:

- a) Please refer to Attachment 1 of this IR response, filed electronically. The measures in this list all have a TRC of less than one in at least one year of the Plan; the specific years in which they have a TRC of less than one are highlighted in yellow.
- b) Measures with a TRC less than one put downward pressure on the overall TRC of the portfolio. However, it should be noted that the total utility benefits of the measures which do not pass TRC outweigh the utility costs by a factor of 2.2 i.e., the average PAC for the measures highlighted in Attachment 1 is 2.2. When all measures are considered and the portfolio is measured as a whole, the 2020-2022 Preferred Plan has a portfolio average TRC of 2.0.
- c) Measures with a TRC of less than one included in the 2020-2022 DSM Plan provide a strategic advantage by allowing EfficiencyOne to deliver a broad range of measures and

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1 address customer needs, which are not necessarily reflected in the TRC. Please see
2 Attachment 1 of this IR response (filed electronically) for detailed measure-level rationale
3 for inclusion of these measures. At a high-level, the rationale for inclusion is described
4 below.

Low income programming

5
6 Please refer to Attachment 1 of this IR response (filed electronically) which includes
7 measures in low-income-oriented programming (i.e., HomeWarming and First Nations).
8 Eight measures are contained in the Residential Efficient Products Installation program
9 component, which is open to all Nova Scotians, and another crucial avenue for
10 EfficiencyOne to provide support to low income Nova Scotians, especially those that rent
11 instead of own their homes.
12

Bundling, cross-promotion

13
14 Some measures can provide access to customers which may then lead to more in-depth and
15 comprehensive projects, e.g., a customer may participate in Instant Savings and purchase
16 a programmable thermostat, which may then lead to a more comprehensive project through
17 Home Energy Assessment. Offering a diverse set of measures is also important so that
18 customers can bundle them within a project based on their needs, increasing the total
19 savings associated with their project as a whole.
20

Lost opportunities

21
22 Obtaining deep, long lasting savings means pursuing a breadth of energy efficiency
23 opportunities when they arise. For example, when EfficiencyOne is in a participant's home
24 installing LED lamps, it has the opportunity to address multiple measures at that time,
25 negating the need for EfficiencyOne or the participant to revisit that measure at a later date.
26 This nuance is not something that is captured in the TRC test, i.e., the cost to revisit a home
27 and implement a measure at a later date. Another example is retiring an air conditioner
28 when retiring a refrigerator.
29

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In-store presence

In the Instant Savings program component, dehumidifiers and clothes washers provide a year-round in-store presence, i.e., outside of fall and spring campaign periods.

New, innovative, and specialized measures

For measures with low uptake, it is difficult to properly characterize the measure since EfficiencyOne only has a small sample of historical projects to extract information from. However, continuing to offer them allows EfficiencyOne to better assess potential for uptake and to better characterize their costs and benefits. Often, these are specialty measures which give EfficiencyOne an opportunity to address participants' individual needs, which can be varied. This is especially true in the Business, Non-profit and Institutional sector, which has specific measure needs based on industry type, e.g., agricultural, industrial kitchens, grocery, etc.

New technologies often reduce in cost over time, and by offering incentives to early adopters, EfficiencyOne encourages market transformation. For example, providing an incentive on a new product encourages distributors to stock them and service providers to offer their installation, increasing accessibility and accelerating cost reductions. Examples of emerging measures with low TRC include heat pump water heater technology and advanced lighting design.

Conservative TRC estimates

EfficiencyOne's approach to characterizing measures in Instant Savings was conservative for replace-on-burnout measures; EfficiencyOne used total retail cost instead of incremental costs since these were the most robust set of costs available. This decision decreases TRC since the customer cost is not reduced by the baseline technology cost.

Utility Benefits

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1 As mentioned in part a) of this IR response, the net impact of including the measures
2 highlighted in Attachment 1 of this IR response (filed electronically) is a positive return to
3 ratepayers as the utility benefits outweigh utility costs.

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Request IR-07:

Please refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Evidence, Page 13, Table 2, lines 13-15, which provides the mid-level DSM first year energy savings versus the Board approved values:

a. What are the mid-level DSM targets used to compute these values?

b. How were the mid-level DSM targets calculated? Please include all related documents and workpapers with formulae intact where applicable.

Response IR-07:

a) The level of DSM in the 2014 IRP Preferred Resource Plan is the mid-level from the Nova Scotia 2015-2040 Demand Side Management (DSM) Potential Study conducted by Navigant. The mid-level DSM annual first year energy savings presented in Table 2 of EfficiencyOne's Evidence, were taken from the Potential Study, provided as Attachment 1 to this IR response. An excerpt is provided below:

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1.4.2 Incremental Energy Savings and Costs of Achievable Potential Scenarios

Figure 3 presents a summary of the four Achievable Potential Scenarios in terms of “Incremental Energy Savings (GWh)” (Net-at-Generator) from energy efficiency programs, 2015 through 2040, along with “Incremental Program Administrator Cost (\$ millions)”.

Figure 3. Total All Sectors Achievable Potential Incremental Energy Savings and Costs – 2015 to 2040 (Net-at-Generator)

Total All Sectors Incremental Achievable Potential (Net-at-Generator)								
Scenario	Energy Savings (GWh)				Program Administrator Costs (\$ millions)			
	Base	Low	Mid	High	Base	Low	Mid	High
2015	137.8	107.7	164.0	174.9	\$50.7	\$46.5	\$56.1	\$76.3
2016	139.9	106.0	171.0	191.3	\$50.5	\$44.8	\$57.5	\$92.0
2017	141.7	104.0	177.7	205.5	\$50.0	\$42.9	\$59.0	\$104.6
2018	136.2	102.3	170.0	193.9	\$52.4	\$39.2	\$66.1	\$107.4
2019	134.8	100.0	167.4	186.9	\$57.0	\$37.6	\$76.4	\$112.8
2020	133.9	98.7	166.2	182.9	\$61.5	\$37.8	\$86.7	\$119.3
2021	130.1	98.1	162.2	177.7	\$56.9	\$38.5	\$81.7	\$106.9
2022	127.6	98.7	159.6	175.6	\$54.1	\$39.8	\$79.1	\$102.2
2023	126.6	99.5	158.8	176.9	\$51.5	\$39.7	\$76.3	\$99.0
2024	127.4	101.1	161.6	184.7	\$50.8	\$40.4	\$76.8	\$104.0
2025	130.1	103.2	167.4	196.0	\$50.6	\$40.8	\$78.5	\$110.9
2026	135.6	106.8	176.6	209.2	\$52.1	\$42.0	\$81.9	\$118.6
2027	143.5	111.8	187.5	217.7	\$54.8	\$43.7	\$85.7	\$121.1
2028	153.4	118.5	199.1	220.6	\$58.5	\$46.1	\$90.1	\$120.4
2029	163.3	126.5	207.8	216.5	\$60.7	\$47.0	\$92.0	\$114.5
2030	170.7	134.2	210.6	207.1	\$63.1	\$49.5	\$92.2	\$106.5
2031	173.5	139.5	206.8	195.4	\$62.6	\$50.8	\$87.4	\$94.6
2032	171.4	141.1	198.5	183.8	\$61.4	\$51.1	\$82.3	\$85.9
2033	166.0	139.2	188.4	173.7	\$59.3	\$50.4	\$76.8	\$65.8
2034	159.3	135.2	178.4	164.7	\$56.7	\$48.9	\$71.2	\$61.1
2035	153.0	130.5	169.5	157.0	\$47.7	\$47.2	\$57.9	\$56.6
2036	147.0	125.9	161.4	150.4	\$46.5	\$45.6	\$54.8	\$52.4
2037	141.5	121.6	154.2	145.1	\$45.4	\$44.0	\$52.0	\$49.6
2038	136.1	117.8	147.8	141.3	\$44.4	\$42.5	\$49.0	\$44.2
2039	131.6	114.3	142.6	137.5	\$43.5	\$41.3	\$46.5	\$43.4
2040	127.9	111.2	139.0	134.0	\$42.3	\$40.2	\$43.6	\$42.6

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- 1 b) Please refer to part a) of this IR response.

***Nova Scotia 2015-2040
Demand Side Management (DSM) Potential Study***

Presented to



January 7, 2014

Presented by

Todd Williams, Managing Director

One Adelaide Street East, Suite 3000

Toronto, ON M5C 2V9

647.288.5204, Todd.Williams@Navigant.com

Stu Slote, Associate Director (Project Manager)

802.526.5113, Stu.Slote@Navigant.com

Gary Cullen, Director (Potential Study Lead)

360.828.4008, Gary.Cullen@Navigant.com

Navigant

www.navigant.com



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1. Executive Summary

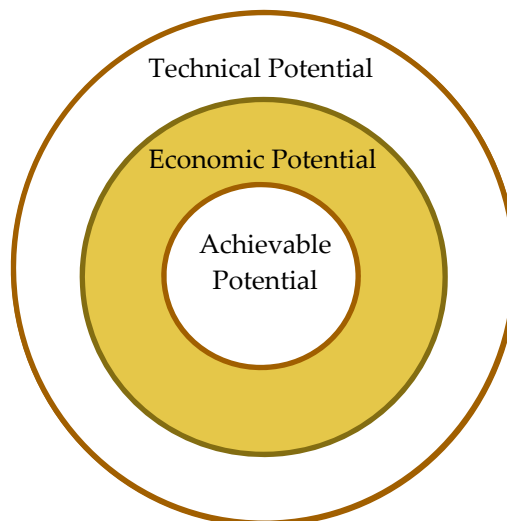
1.1 Study Objectives

The purpose of this study is to conduct a Demand Side Management (DSM) potential analysis of long-term electrical energy and system peak demand savings in Nova Scotia. On behalf of Efficiency Nova Scotia Corporation (ENSC), Navigant conducted a potential analysis of electrical energy efficiency over twenty-six years (2015 to 2040). The study addresses the Technical, Economic and Achievable Potential for Nova Scotia using Navigant's Energy Efficiency Resource Assessment Model (EERAM).

This report is structured as follows:

- Section 1 Executive Summary
- Section 2 Energy Efficiency Potential Methodology
- Section 3 Efficiency Measure Characterization
- Section 4 Conclusion
- Appendix A Technical Potential
- Appendix B Economic Potential
- Appendix C Achievable Potential
- Appendix D Glossary of Terms
- Appendix E EERAM Economic Tests
- Appendix F 2012 Nova Scotia Baseline Study
- 1. Approach to Estimating Energy Efficiency Potential

Figure 1. Diagram of Types of Energy Efficiency Potential



As shown in Figure 1, there are three categories of energy efficiency potential:

2. **Technical Potential** – The theoretical maximum amount of energy use that could be displaced by the technology being evaluated, disregarding all non-engineering constraints.



3. **Economic Potential** – The subset of technical potential that is economically cost-effective. Estimates of economic potential do not address market barriers to implementation.
4. **Achievable Potential** – The potential that can realistically be achieved through implementation of cost-effective demand-side management programs, taking into account real-world barriers and assuming the most aggressive program and policy scenario possible.

Navigant undertook the energy efficiency potential study with the following key tasks (each of these tasks is summarized below):

- Develop baseline consumption profiles and initial building simulation model specifications.
- Characterize the energy efficiency measures.
- Conduct benefit-cost analysis of energy efficiency measures.
- Estimate energy efficiency potentials.

1.1.1 Develop Baseline Consumption Profiles & Initial Building Simulation Model Specifications

Navigant conducted this task by characterizing the Nova Scotia residential sector in terms of customer numbers, as well as age and size of the household/housing stock, and the business, nonprofit and institutional (BNI) sector in terms of BNI square footage. Residential, and Commercial and Industrial sector electricity sales data was used as a starting point to determine customer energy use in broad end-use categories, such as lighting, space heating and domestic hot water. This data was supplemented by data collected during an online panel survey of the Nova Scotia Residential sector and a phone survey of the BNI sector, as well as onsite assessments of both sectors conducted in the last quarter of 2012 and the first quarter of 2013. This information is used to estimate savings from energy efficiency investments. Navigant used representative data for each sector to develop characteristic whole building energy simulations, and inform inputs to the resource assessment model.

1.1.2 Characterize the Energy Efficiency Measures

Navigant developed representative DSM measures to be used as inputs to the ENSC DSM potential analysis. Navigant first reviewed the measure level details used as inputs to the approved 2013-2014 DSM Plan. As appropriate, Navigant revised measure assumptions, and received feedback from ENSC staff on measure relevance. Navigant characterized the energy efficiency measures as follows:

1. Estimate the baseline and new efficient measure energy consumption for each end-use (heating, lighting, domestic hot water, etc.) or unit energy consumption (UEC).
2. Estimate the incremental savings from each measure – improving from the baseline to the new technology.
3. Determine the incremental costs and lifetimes for each of the new technologies.
4. Determine cost effectiveness of measures.

In addition, the baselines consider that different classes of buildings have different penetrations of technologies, such as existing homes compared to new construction.

Navigant characterized each resource by estimating the following parameters for each measure:



- **Measure Replacement Methodology:** Each measure was defined as Retrofit/Early Retirement, Replace on Burnout (ROB), Dual Baseline, or New Construction, to guide baseline definitions and incremental cost calculations.
- **Measure Description:** Technical definitions of the baseline (code or existing) and energy-efficient technology were provided, detailing characteristics such as capacity, efficiency, size, and fuel type. Definitions of baseline technologies account for any anticipated changes to federal or provincial codes.
- **Savings Estimations:** The annual energy consumption (kWh) and demand (kW) for the baseline, code, and energy-efficient condition of each technology was defined and used to calculate annual savings. Effective useful life (EUL) for each measure was used to calculate lifetime energy and demand savings as well. For certain BNI early replacement measures, remaining useful life (RUL) was used to calculate the portion of savings before the measure would have reached the end of its EUL. Additionally, the effects of future changes to codes and standards were considered to develop a savings profile over time.
- **Seasonal Distribution of Savings:** Winter peak ratios were used to calculate avoided cost benefits for each measure.
- **Measure Costs:** Incremental and total measure costs were calculated based on the measure applicability and account for all material, labour, and operations and maintenance (O&M) costs associated with the baseline, code, and/or energy efficient technology.
- **Measure Densities:** The density of each measure was determined for the baseline and energy efficient conditions. Densities were defined as the number of each technology per home for residential, and per 1000 sq. ft. for the business, nonprofit and institutional (BNI) sector.

Navigant characterized each measure using a variety of sources and methodologies. Existing measure data for all technologies currently offered through ENSC's DSM programs were used as appropriate. Navigant reviewed all assumptions and supporting documentation to ensure measure parameters were up-to-date and reflected the current state of the technology.

Climate-Dependent Measures

For climate-dependent measures, Navigant used a combination of building simulation modeling using the eQuest model and engineering estimates to derive energy efficiency measure per unit savings. Building prototypes were developed based on the information gathered during the survey of Nova Scotia customer surveys and onsite assessments.

Climate-Independent Measures

For the climate-independent measures, Navigant utilized various resources, including data from Natural Resources Canada, the ENERGY STAR® Program, and manufacturer and national retailer data. Other measures were analyzed using engineering principles, such as steady-state heat loss, rated power, and hours of operation. Spreadsheet models were the primary tool used to develop the energy savings estimates for the climate-independent measures.



Measure Costs

Measure costs were based on the incremental equipment cost between the baseline and technologies for replacement on burnout and new applications. Retrofit measure costs included the full material cost of the energy-efficient measure and associated labour for removal of existing equipment and installation of the energy-efficient technology. Cost sources included existing ENSC data, online market research, area distributors, RS Means CostWorks®, etc.

In EERAM, measure technology costs are allowed to change over time and have technology cost vectors similar to the measure efficiency time vectors. Based on a US Department of Energy paper¹, technology costs come down over time at a rate that varies by technology. Within EERAM, the measures are mapped to a code that best matches the curves of technology cost reduction as identified in the DOE paper. This code matches the appropriate learning curve to the technology, with several technologies coded as having no change. Another variable estimates where the technology is on the learning curve in terms of maturity.

Measure Lifetimes

For measure lifetimes, a combination of resources was used, including manufacturer data, standard economic depreciation assumptions, NRCAN, the ENERGY STAR® Website, industry trade organizations, various Technical Reference Manual (TRM) reports, U.S. EPA, U.S. DOE, CBEEDAC, ACEEE, and various studies reviewed for this project. As with measure costs, where possible measure lifetimes were obtained from multiple sources and reconciled based on engineering judgment.

1.1.3 Conduct Benefit-Cost Analysis of Energy Efficiency Measures

The energy efficiency measures were evaluated with respect to each of the four main standard cost tests, with the total resource benefit-cost tests used to determine cost-effectiveness.

1. **Participant test:** measures are cost effective from this perspective if the reduced electric costs to the participating customer from the measure exceed the after-incentive cost of the measure to the customer.
2. **Program administrator cost (PAC) test:** measures are cost effective from this perspective if the sum of their avoided costs (costs avoided by the measure's energy and demand savings) and other benefits for the utility are greater than the program administrator's costs to support the measure, including administrative costs and customer incentives.
3. **Ratepayer impact measure (RIM) test:** measures are cost effective from this perspective if their avoided costs are greater than the sum of the program administrators' costs and the "lost revenues" caused by the measure.
4. **Total resource cost (TRC) test:** measures are cost effective from this perspective if the sum of their avoided costs and other benefits for participants or the utility are greater than the sum of the measure costs and the program administrator's administrative costs.

¹ U.S. Department of Energy (2011). Using the Experience Curve Approach for Appliance Price Forecasting. Supplemental draft paper to the DOE proposed rule in Docket No. EE-2008-BT-STD-0012.



1.1.4 Estimate Energy Efficiency Potentials

Navigant developed estimates of energy efficiency measure potentials in terms of Technical, Economic, and “Achievable” Potential. Note that the Energy Efficiency Achievable Potentials presented in this report are those that are realistic for Efficiency Nova Scotia Corporation to achieve through its implementation of cost-effective demand-side management programs and do not include savings associated with free-riders or savings from activities outside of DSM programs (such as energy savings resulting from codes and standards or efficiency initiatives of non-participants or electric utilities). Economic Potential was estimated using the TRC test as the economic screen applied to Technical Potential to determine cost-effectiveness. Alternatively, the EERAM tool allows for the PAC test to be used as the economic screen.

To estimate Achievable Potential, the EERAM model was used to estimate conversion rates from inefficient products to more efficient products for retrofit, replacement and dual baseline measures, as well as installation rates in new buildings for new construction markets. Navigant used a dual baseline approach to calculate technical potential where appropriate for early replacement measures. ENSC has adopted the dual baseline approach for certain measures. A dual baseline approach to calculating energy savings involves the following: in the year an energy-efficient measure is installed, if the replaced measure is still in working order, its remaining useful life (RUL) must be calculated based on its effective useful life (EUL) and the length of time it has been in use prior to replacement. Once calculated, energy savings are impacted in the following ways:

- “Enhanced” or full savings (the difference between existing energy consumption and the energy-efficient measure consumption) are calculated for the RUL period.
- Regular savings (the difference between the standard new baseline consumption and the energy-efficient measure consumption) are calculated for the rest of the measure life period.

A dual baseline approach for calculating costs involves the following:

- The full cost for the energy efficient equipment is calculated.
- The full cost for the standard practice baseline equipment that would have been purchased at the end of the RUL period is calculated.
- Final costs are the difference between the present value of the baseline costs and the energy-efficient costs at the time of early replacement of the existing technology.

1.2 *Energy Efficiency Technical Potential Results*

Figure 2 summarizes the Total Technical Potential results of the analysis conducted, 2015 through 2040 for the Residential, Commercial and Industrial sectors. The total (Gross at Generator) energy efficiency Technical Potential savings, including energy savings resulting from codes and standards, 2015 through 2040, is estimated to be approximately 7,820 GWh, about 56% of forecast sales without DSM, and approximately 1,556 MW, about 61% of peak winter demand. Appendix A presents the 2015 – 2040 Technical Potential with the breakdown of savings from DSM programs and savings from Codes and Standards.



Figure 2. Total All Sectors Energy Efficiency Technical Potential – 2015 to 2040 (Gross at Generator)

Total All Sectors Technical Potential (Gross at Generator)		
Year	Peak Demand Savings (MW)	Energy Savings (GWh)
2015	1,150	5,332
2016	1,168	5,434
2017	1,190	5,554
2018	1,208	5,654
2019	1,227	5,757
2020	1,246	5,859
2021	1,265	5,961
2022	1,284	6,047
2023	1,300	6,120
2024	1,391	6,719
2025	1,406	6,797
2026	1,418	6,866
2027	1,430	6,935
2028	1,440	6,999
2029	1,452	7,068
2030	1,463	7,133
2031	1,472	7,195
2032	1,481	7,257
2033	1,491	7,320
2034	1,500	7,388
2035	1,510	7,460
2036	1,520	7,533
2037	1,529	7,608
2038	1,538	7,676
2039	1,547	7,747
2040	1,556	7,820



1.3 *Energy Efficiency Economic Potential Results*

Appendix B presents the total Economic Potential results of the analysis, 2015 through 2040, across all sectors; Residential, Commercial and Industrial. The total (Gross at Generator) energy efficiency economic potential savings, including energy savings resulting from codes and standards, 2015 through 2040, is estimated to be approximately 6,354 GWh, about 46% of forecast sales without DSM, and approximately 1,334 MW, about 52% of peak winter demand.

The economic potential is a high percentage of the technical potential due to two factors. First, the analysis includes energy efficiency measures that a program administrator would consider including in a DSM portfolio, which tends to create a measure dataset that is already nearly economically feasible. Second, while the program portfolio overall passes the TRC test, the economic screen for individual measures is set to 0.75 to allow for a mix of measures to be included in programs that are cost effective.

1.4 *Energy Efficiency Achievable Potential Results*

The total Achievable Potential savings (Net at Generator) from energy efficiency programs, 2015 through 2040, are presented in Appendix C. Four scenarios of Achievable Potential have been developed and are labeled as Low, Base, Mid, and High and each are presented in terms "Total All Sectors" followed by a breakdown for each of the three sectors – Residential, Commercial and Industrial.

1.4.1 **Four Scenarios of Achievable Potential**

Four achievable potential scenarios were created. Each scenario is based on modifying the incentive level. Each measure has an estimated consumer payback elasticity based on calibration year estimates of measure installations and the incentive provided. Changes to the incentive level affects the consumer payback ratio and the resulting estimates of program participation based on measure consumer payback elasticity. Additionally, other factors affecting program participation as the incentive level changes include:

- Administrative costs are higher for lower incentives and conversely lower for higher incentives. Changes in administrative costs affect the consumer payback.
- Consumer awareness is higher when incentives are higher and conversely lower when incentives are lower than the base scenario. Consumer awareness affects the population of consumers who could participate in the program.
- Net-to-Gross ratio. This ratio becomes closer to 1.0 when there is a higher incentive and conversely lower when the incentive is lower than the base scenario.

The four scenarios are:

- **Base Scenario:** incentive in the calibration year is set to what was offered in that calibration year.
- **Low Scenario:** incentive is set to ½ of the calibration year incentive.
- **Mid Scenario:** incentive is set to 1.5 times the calibration year incentive (up to a maximum of 100% of incremental cost)
- **High Scenario:** incentive is set to twice the calibration year incentive (up to a maximum of 100% of incremental cost)



1.4.2 Incremental Energy Savings and Costs of Achievable Potential Scenarios

Figure 3 presents a summary of the four Achievable Potential Scenarios in terms of “Incremental Energy Savings (GWh)” (Net-at-Generator) from energy efficiency programs, 2015 through 2040, along with “Incremental Program Administrator Cost (\$ millions)”.

Figure 3. Total All Sectors Achievable Potential Incremental Energy Savings and Costs – 2015 to 2040 (Net-at-Generator)

Total All Sectors Incremental Achievable Potential (Net-at-Generator)								
Scenario	Energy Savings (GWh)				Program Administrator Costs (\$ millions)			
	Base	Low	Mid	High	Base	Low	Mid	High
2015	137.8	107.7	164.0	174.9	\$50.7	\$46.5	\$56.1	\$76.3
2016	139.9	106.0	171.0	191.3	\$50.5	\$44.8	\$57.5	\$92.0
2017	141.7	104.0	177.7	205.5	\$50.0	\$42.9	\$59.0	\$104.6
2018	136.2	102.3	170.0	193.9	\$52.4	\$39.2	\$66.1	\$107.4
2019	134.8	100.0	167.4	186.9	\$57.0	\$37.6	\$76.4	\$112.8
2020	133.9	98.7	166.2	182.9	\$61.5	\$37.8	\$86.7	\$119.3
2021	130.1	98.1	162.2	177.7	\$56.9	\$38.5	\$81.7	\$106.9
2022	127.6	98.7	159.6	175.6	\$54.1	\$39.8	\$79.1	\$102.2
2023	126.6	99.5	158.8	176.9	\$51.5	\$39.7	\$76.3	\$99.0
2024	127.4	101.1	161.6	184.7	\$50.8	\$40.4	\$76.8	\$104.0
2025	130.1	103.2	167.4	196.0	\$50.6	\$40.8	\$78.5	\$110.9
2026	135.6	106.8	176.6	209.2	\$52.1	\$42.0	\$81.9	\$118.6
2027	143.5	111.8	187.5	217.7	\$54.8	\$43.7	\$85.7	\$121.1
2028	153.4	118.5	199.1	220.6	\$58.5	\$46.1	\$90.1	\$120.4
2029	163.3	126.5	207.8	216.5	\$60.7	\$47.0	\$92.0	\$114.5
2030	170.7	134.2	210.6	207.1	\$63.1	\$49.5	\$92.2	\$106.5
2031	173.5	139.5	206.8	195.4	\$62.6	\$50.8	\$87.4	\$94.6
2032	171.4	141.1	198.5	183.8	\$61.4	\$51.1	\$82.3	\$85.9
2033	166.0	139.2	188.4	173.7	\$59.3	\$50.4	\$76.8	\$65.8
2034	159.3	135.2	178.4	164.7	\$56.7	\$48.9	\$71.2	\$61.1
2035	153.0	130.5	169.5	157.0	\$47.7	\$47.2	\$57.9	\$56.6
2036	147.0	125.9	161.4	150.4	\$46.5	\$45.6	\$54.8	\$52.4
2037	141.5	121.6	154.2	145.1	\$45.4	\$44.0	\$52.0	\$49.6
2038	136.1	117.8	147.8	141.3	\$44.4	\$42.5	\$49.0	\$44.2
2039	131.6	114.3	142.6	137.5	\$43.5	\$41.3	\$46.5	\$43.4
2040	127.9	111.2	139.0	134.0	\$42.3	\$40.2	\$43.6	\$42.6



1.4.3 Cumulative Savings and Costs of Achievable Potential Scenarios

Figure 4 presents the “Cumulative Energy Savings (GWh)” (Net-at-Generator) from energy efficiency programs, 2015 through 2040, along with the “Cumulative Program Administrator Cost (\$ millions)” for each of the four Achievable Potential Scenarios. Cumulative savings take into account the overall savings occurring in a given year from both new participants and savings continuing to result from past participation with measures that are still in place. Cumulative savings do not always equal the sum of all prior year incremental values as some measures have relatively short measure lives and, as a result, their savings drop off over time.



Figure 4. Total All Sectors Achievable Potential Cumulative Energy Savings and Costs – 2015 to 2040 (Net-at-Generator)

Total All Sectors Cumulative Achievable Potential (Net-at-Generator)								
Scenario	Energy Savings (GWh)				Program Administrator Costs (\$ millions)			
	Base	Low	Mid	High	Base	Low	Mid	High
2015	137.8	107.7	164.0	174.9	\$50.7	\$46.5	\$56.1	\$76.3
2016	226.1	162.2	283.4	314.6	\$101.2	\$91.3	\$113.6	\$168.3
2017	360.8	259.1	454.2	513.1	\$151.2	\$134.3	\$172.6	\$272.9
2018	480.3	345.9	606.0	687.3	\$203.6	\$173.5	\$238.6	\$380.3
2019	597.4	431.1	752.5	849.1	\$260.6	\$211.1	\$315.0	\$493.1
2020	708.9	508.5	897.5	1,012.2	\$322.1	\$248.8	\$401.7	\$612.4
2021	817.1	582.0	1,038.8	1,170.2	\$379.0	\$287.3	\$483.4	\$719.3
2022	932.3	670.4	1,186.0	1,334.1	\$433.2	\$327.1	\$562.5	\$821.5
2023	1,040.9	754.2	1,325.9	1,492.3	\$484.7	\$366.8	\$638.7	\$920.5
2024	1,155.4	841.0	1,474.8	1,664.0	\$535.5	\$407.1	\$715.6	\$1,024.5
2025	1,257.1	922.0	1,603.8	1,820.5	\$586.1	\$447.9	\$794.1	\$1,135.4
2026	1,371.0	1,005.3	1,758.8	2,006.7	\$638.3	\$489.9	\$876.0	\$1,254.0
2027	1,509.5	1,111.5	1,940.7	2,217.3	\$693.0	\$533.5	\$961.7	\$1,375.1
2028	1,644.6	1,211.0	2,121.0	2,418.5	\$751.5	\$579.6	\$1,051.8	\$1,495.5
2029	1,797.6	1,326.9	2,318.3	2,624.4	\$812.2	\$626.6	\$1,143.9	\$1,609.9
2030	1,956.3	1,455.8	2,511.5	2,813.4	\$875.3	\$676.2	\$1,236.1	\$1,716.4
2031	2,112.9	1,579.0	2,700.6	2,991.8	\$937.9	\$726.9	\$1,323.5	\$1,811.0
2032	2,266.2	1,702.6	2,880.9	3,158.6	\$999.4	\$778.0	\$1,405.8	\$1,896.9
2033	2,415.4	1,822.7	3,055.0	3,320.5	\$1,058.7	\$828.4	\$1,482.6	\$1,962.8
2034	2,560.6	1,941.9	3,220.7	3,473.0	\$1,115.4	\$877.3	\$1,553.8	\$2,023.8
2035	2,699.4	2,057.0	3,376.3	3,614.3	\$1,163.1	\$924.5	\$1,611.7	\$2,080.4
2036	2,833.1	2,169.1	3,523.9	3,749.5	\$1,209.6	\$970.1	\$1,666.5	\$2,132.9
2037	2,955.0	2,271.4	3,657.9	3,874.4	\$1,254.9	\$1,014.1	\$1,718.5	\$2,182.5
2038	3,080.8	2,379.5	3,794.4	4,005.0	\$1,299.3	\$1,056.7	\$1,767.5	\$2,226.7
2039	3,197.5	2,479.8	3,921.4	4,128.6	\$1,342.8	\$1,098.0	\$1,814.1	\$2,270.1
2040	3,308.7	2,575.6	4,039.3	4,241.0	\$1,385.0	\$1,138.1	\$1,857.7	\$2,312.6

1.4.4 Unit Costs of Achievable Potential Scenarios

Figure 5 presents the Unit Costs for each of the Achievable Potential Scenarios expressed as the Cumulative Program Administrator Cost (\$ millions) divided by the Cumulative Energy Savings (GWh). Over the 2015– 2040 analysis period, the Base Scenario results in the lowest unit cost (\$0.419/kWh),



followed by the Low Scenario (\$0.442/kWh) and then the Mid Scenario (\$0.460/kWh). The High Scenario has the highest unit cost (\$0.545/kWh).

Figure 5. Total All Sectors Achievable Potential – 2015 to 2040 (Net-at-Generator) – Cost per kWh Savings – Base Scenario

Total All Sectors Achievable Potential (Net-at-Generator) – Cost per kWh Savings – Base Scenario								
Base Scenario			Low Scenario		Mid Scenario		High Scenario	
Program Administrator Costs (\$ million)	Cumulative Energy Savings (GWh)		Program Administrator Costs (\$ million)	Cumulative Energy Savings (GWh)	Program Administrator Costs (\$ million)	Cumulative Energy Savings (GWh)	Program Administrator Costs (\$ million)	Cumulative Energy Savings (GWh)
[a]	[b]		[a]	[b]	[a]	[b]	[a]	[b]
2015 to 2040								
\$1,385.0	3,308.7		\$1,138.1	2,575.6	\$1,857.7	4,039.3	\$2,312.6	4,241.0
Cost per kWh Savings = [a] / [b]								
\$0.419			\$0.442		\$0.460		\$0.545	



2. Energy Efficiency Potential Methodology

2.1 *Overview of the Energy Efficiency Resource Assessment Model (EERAM)*

The Energy Efficiency Resource Assessment Model (EERAM) is an energy efficiency potential model designed to estimate technical, economic, and achievable energy efficiency potential for a program administrator's service area. Developed by Navigant, the model forecasts energy savings and demand reduction potential within the residential, commercial, and industrial sectors over a forecast period of typically 20 – 25 years.

EERAM is an Excel spreadsheet model based on the integration of energy efficiency measure impacts and costs, customer characteristics, utility load forecasts, and utility avoided costs and rate schedules. Excel is used as the modeling platform to provide transparency to the estimation process. Using Excel also allows the model to be customized and to accommodate either detailed or more general model input data.

The model utilizes a bottom-up approach, using the starting points of study area building stocks and equipment saturation estimates, forecasts of building stock decay and new construction, energy efficiency technology data, past energy efficiency program accomplishments, and decision-maker variables that help drive the market scenarios.

For established energy efficiency measures, EERAM calculates achievable potential based on a decision maker adoption rate algorithm. This algorithm is primarily a measure by measure elasticity response to measure payback. However, a diffusion curve methodology is used for emerging technologies. Emerging technologies are considered to follow a Bass diffusion curve methodology rather than a measure payback methodology. The Bass diffusion model was developed by Frank Bass and describes the process of how new products are adopted as an interaction between users and potential users.

2.2 *EERAM Model Features*

The EERAM model incorporates a number of innovative features, including:

- Utilization and wherever possible, direct linkage to province-wide or program administrator specific deemed, per unit measure energy savings and cost databases.
- Utilization of program administrator-specific or, if not available, regionally-specific building characteristics information. These data often come from on-site or telephone-based building surveys of building and appliance stocks. The EERAM model is able to include as many different building segments and industrial classifications as there is data available.
- Utilization of decision-maker awareness of measures and if aware, the willingness to purchase the energy efficiency measure variables. These variables are utilized in the consumer choice algorithm. This data is most often collected at the same time as the building and appliance stock characteristics are gathered through a special decision maker survey.
- Utilization of historical program administrator-specific energy efficiency program achievements to calibrate model results.
- The ability to create forecasts utilizing either the historical achievement data for calibration or utilizing percent of sales by sector as the first year calibration method.



- The ability to quickly create scenarios based on different measure incentive levels. Other scenarios can also be developed using alternative input data, such as avoided costs, energy forecasts, building stock forecasts, and others that may be of interest to the program administrators.
- The ability to include a number of different avoided costs streams pegged to specific end-uses.
- Calculation of the basic economic tests (described later), but also calculates the Total Resource Cost (TRC) test for the base year and for each year in the forecast. The TRC value is used to screen what is included in the achievable potential estimates, and as technology costs and impacts change over time, so do the TRC values.
 - o The TRC screening value is a variable set by the user.
 - o For emerging technologies, the TRC screen is allowed to be lower, if desired by the user.
- In addition to the TRC values changing over time, the model incorporates time vectors for other key variables as well including:
 - o Technology cost
 - o Administrative cost
 - o Technology impact
 - o Consumer awareness and willingness
 - o Avoided costs
- Impacts of known codes and standards and the timing of those impacts are included in the EERAM modeling structure. These impacts are estimated at the measure level.
- The ability to include the interactive effects on other fuel usage (such as natural gas) when electric measures are implemented.
- Recognition that at the end of measure life, actions may take place that affect both cumulative potential and program participation.
 - o The model has a variable called measure re-engagement, which is a percentage estimate of those who continue with the same or more efficient version of the initially-implemented measure. The remainder is assumed to fall back to the baseline efficiency. The model adjusts cumulative potential to account for those who fall back to the baseline efficiency.
 - o The model has another variable called re-participants. This is an estimated percentage of the measure re-engagers who also again participate in the program administrator's program and receive an incentive. For these customers, their energy savings is assumed to continue, but is not counted as new incremental savings. Although there is no new incremental savings, there is a cost associated with maintaining these savings. The additional incentive and administrative costs are added to the program costs.
- Mutually-exclusive measures are placed into competition groups. Within the competition groups, the mutually-exclusive measures share the same base population but each measure uses its own unique decision-maker adoption rate algorithm to estimate year by year market potential. The base population is reduced each year by the sum of the mutually-exclusive measures participation.

2.3 Calculating Energy Efficiency Potential

The model partitions its evaluation of each measure into technical, economic and achievable potential. Each assessment includes building stock estimates, technology densities, and measure impacts, each using a different algorithm.



Technical potential is calculated using the product of a measure's savings per unit, the quantity of applicable units in each facility, and the number of facilities in a program administrator's area. The assessment includes measures that might not be cost-effective or have the backing of a strong consumer market. By disregarding these factors, the technical potential assessment provides an upper bound of efficiency potential regardless of cost or market penetration. For measures considered to replace inefficient measures on burnout (ROB), the quantity of applicable units per year is limited to the number that need to be replaced, which is determined by measure life. As time passes, this potential population grows until meeting the full measure life. For other, non-replace-on-burnout measures, the full populations of baseline units are considered available. No net-to-gross adjustments occur with technical potential.

Economic potential estimates the amount of technical potential that is cost-effective, as defined in this case by the results of the Total Resource Cost (TRC) test. The TRC test is a cost-benefit analysis of relevant energy efficiency measures, excluding market barriers, such as lack of consumer knowledge. Benefits are meant to include the avoided costs of generation, transmission and distribution investments, avoided fuel costs, and other benefits that may accrue to participants and/or to the utility. For purposes of this study, only avoided generation investments and fuel costs were considered. Costs are meant to – and for this study did – include incremental measure costs and program administration costs. The TRC screening value for emerging technologies can be set lower than other technologies if the user wishes it to be. Replacement on burnout measures are treated the same as with technical potential and there are no net-to-gross adjustments.

Achievable potential is the third of EERAM's energy efficiency algorithms, calculating the amount of economic energy efficiency potential that could be captured by program administrator programs over the forecast period. This calculation varies with the program's parameters, such as the program design or magnitude of incentives or rebates for customer installations.

2.4 Measure Types Addressed

EERAM recognizes seven measure types, including:

- **Replacement on Burnout (ROB):** An energy efficiency measure is installed after the existing equipment fails.
- **Early Retirement:** An energy efficiency measure normally regarded as ROB is installed before the effective life of the measure it is replacing is reached.
- **Retrofit:** An energy efficiency measure that can be implemented immediately. The lifetime of the base technology is not a factor as retrofit measures generally do not replace existing technologies, but rather improve the efficiency of existing technologies. The energy impact is therefore the amount of that improvement.
- **Dual Baseline:** A dual baseline measure uses a less efficient baseline in the first part of its measure life based on the remaining useful life (RUL), resulting in higher energy savings initially, with savings becoming lower at a point later in the measure life when the measure effective useful life (EUL) would have resulted in the measure reaching the end of its useful life. At the end of what would have been the end of the measure's EUL, measure costs also are adjusted.



- **Emerging Technology:** An energy efficiency measure is just entering or about to enter the marketplace. Achievable potential is calculated differently for emerging technologies and uses a Bass diffusion model rather than the traditional measure payback.
- **Behavioural Programs:** These are programs that are designed to influence consumer behaviour through the provision of training and/or information. As with emerging technologies, achievable potential is calculated using a Bass diffusion model rather than the traditional measure payback.
- **New Construction:** A measure or package of measures is installed at the time of construction.

2.5 *Financial Tests Calculated*

EERAM also calculates several financial tests², including:

- **Total Resource Cost (TRC):** This test includes all quantifiable costs and benefits of an energy efficiency measure that may accrue to participants or the utility. For example, a measure passing the TRC test is cost effective from this perspective if the sum of its avoided costs and other benefits accruing to participants or the utility are greater than the sum of the measure costs and the program administrator's administrative costs.
- **Program Administrator Cost Test (PAC):** This test measures the net costs of an energy efficiency program based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. For example, a measure passing the PAC test is cost effective from this perspective if the sum of the avoided costs (costs avoided by the measure's energy and demand savings) and other utility benefits are greater than the program administrator's costs to promote the measure, including incentives provided to customers.
- **Ratepayer Impact Measure Test (RIM):** This test measures what happens to a dwelling or business' electric bills or rates due to changes in utility revenue and operating costs caused by the program. For example, a measure passing the RIM test is cost effective from this perspective if its avoided costs are greater than the sum of the program administrator's costs and the "lost revenues" caused by the measure.
- **Participant Cost Test (PCT):** This test measures the quantifiable benefits and costs to the customer due to participation in the program. For example, a measure passing the PCT test is cost effective from this perspective if the reduced electric costs to the participating customer from the measure exceed the after-incentive cost of the measure to the customer.
- **Simple Customer Payback:** This measurement calculates the program payback by taking the measure cost less the incentive received and divides it by first year energy bill savings.
- **Levelized Measure Cost/kWh:** This measure multiplies the energy efficiency measure costs by the Capital Recovery Factor, and divides by the first year kWh savings.

Outputs from the model are designed to accomplish multiple objectives, including:

- Determining the total cost-effective energy savings available over the forecast period, both annually and cumulatively. This is determined for 100% of electric utility energy use in a service territory. These estimates are provided at the sector, program type, and end-use classification levels.

² Appendix E provides further details of each economic test.



- Providing guidance for the program administrator's energy efficiency goals at an aggregate level, as well as at the measure category level, where appropriate. As discussed, the EERAM calculations are calibrated to past program administrator achievement levels to ensure continuity with past program achievements.

2.6 *Approach to Multi-Life Benefits*

The EERAM model is built to recognize that the impacts of most DSM measures extend beyond the initial estimate of measure life. Taking this reality into account can affect benefit/cost ratios, such as the TRC, PCT, PAC, and RIM, by incorporating future expectations of avoided costs, as well as changes in measure costs and impacts, and cumulative energy and demand impact estimates. The estimation of multi-life benefits and costs begins with two variables:

- **Measure Re-Engagement.** A variable that estimates the share of measure installations that continue to provide efficiency benefits at least equal to the initial DSM measure installed. The complimentary share of installations not part of re-engagement is returned to the population totals of available stock for program participation.
- **Portion of Re-Engagement Receiving an Incentive (Re-Participation).** A variable that represents the percent of re-engagers that also re-participate in the DSM program, if it is still offered. This recognizes that from a program administrator's perspective, the program administrator will incur some amount of incentive and administrative cost from re-participants. With re-participants, the program administrator continues to maintain the original savings but does not accrue additional incremental savings.

Estimating measure re-engagement and re-participation is a two-step function used both to identify what share of initial participants continue saving energy by installing a new measure similar to the original measure and second, what portion of these re-engagers again partake in a DSM program. For example, if the re-engaging share is 85% (which is what the variable uses for the current default value), then 15% are thought of as returning to the baseline population. As this 15% are once again members of the baseline population, they can now participate in any program that affects this baseline.

There are no incremental savings accruing from this re-engaging population. However, cumulative savings must be adjusted in two ways. First, the 15% that go back to the baseline population needs to have their savings removed from cumulative savings. Second, for the 85%, adjustment to cumulative potential is dependent upon whether the savings are different from what was achieved at the time of the original participation. If unchanged, no changes to cumulative potential are made. If savings are different, then the cumulative potential is adjusted by this delta difference.

At the point in time of re-engagement, factors may exist that affect the estimate of continuing DSM measure saving and costs.

- A code or standard (C&S) may have come into effect since the initial point of participation. The effects of the C&S become an attribution issue. Since C&S are mandatory, savings affected by C&S are attributed to the C&S. The share of savings may be 100% or may be a share lower than 100%. If 100%, then no further savings or costs are attributed to the DSM program measure. If the attribution is less than 100%, then the attribution share still applicable to the program administrator is accounted for.



- A measure's estimated energy savings may increase or decrease in the future. For example, LED lighting is still improving in efficacy and, as it does, savings per measure increase. In contrast, appliance recycling programs, such as refrigerator recycling, are expected to have lower savings per unit over time as the population of refrigerators becomes a more recent (more efficient) vintage each passing year.
- A measure's estimated cost may increase or decrease in the future. For example, LEDs and other, newer technologies are expected to decline in cost as these become more popular in the marketplace. The declining cost of CFLs over the past decade is an example of such an effect.

Any changes in energy savings at the point of re-engagement are calculated. These changes in energy savings are applied to the Cumulative Potential and do not affect the Achievable Incremental Potential.

Avoided costs of energy, capacity, and any externality that is quantified are all calculated per measure unit. The impacts are separated into "first life" avoided costs and "beyond first life" avoided costs. The "first life" values are the present value of avoided costs using measure life, the discount rate, and the utility's avoided cost stream. The "beyond first life" estimate of avoided cost is calculated only for the population of "re-engagers". For this population, the present value of future avoided costs beyond the first life³ is calculated starting at this future point in time. This calculation uses any revised future estimate of measure impact, along with measure life, the discount rate, and the avoided cost stream appropriate for that time frame.

In a similar manner, future costs for incremental technology, incentives, and administrative costs are calculated. Each of these three costs are for re-engagers only, with estimates of future incentive and administrative costs for the portion of re-engagers that are re-participants in the DSM program. For each of these costs, the appropriate future technology, incentive, and administrative costs are utilized in the present value calculation.

2.7 Codes and Standards Modified Baseline Effects on Cumulative Potential

The effects of codes and standards within the EERAM model are viewed as an attribution issue between what is credited to codes and standards and what is credited to the DSM program. The "Code Based Impact Change" identifies the specific codes and standards expected to affect measure savings over the forecast period. The effects to measure savings are in the form of time vectors where a specific code or standard is associated with the measures it is expected to affect. The measure effect is in the form of a percent change in savings starting at the point when the code or standard goes into force. As an example, if a specific code or standard effectively reduces savings by 50% starting in the year 2015, the DSM measure's first year incremental measure impact would be 100% of the estimated measure impact up to the year 2015. Starting in 2015 and thereafter, the program administrator's share of the measure savings is reduced by 50% with the other 50% being attributed to the code or standard.

Treating the savings achieved by the DSM program after a code or standard goes into force is done in two parts. First addressed, at the moment the code or standard goes into force, is whether there are any adjustments to the first measure lifetime savings, costs, and benefits. The EERAM model treats these already existing program achievements, benefits, and costs as unchanged (maintained) over the remaining first life of the measure.

³ Several lifetimes may be calculated, depending on the measure's estimated life and the length of the forecast period.



However, at the time of re-engagement, adjustments do occur. For those measures assumed to re-engage after the first lifetime is complete, the measure impacts, benefits, and costs are calculated based on the code or standard adjusted savings level. It is assumed that attribution of the savings transfers to the code or standard at this point forward. To accommodate this, the Cumulative Potential is adjusted downward to reflect the lowered savings resulting from the impact of the code or standard at the time of re-engagement. Additionally, post first lifetime benefits and costs are calculated to reflect the lower savings.

2.8 Dual Baseline Measures

Certain DSM measures are candidates for an early replacement program that utilize a dual baseline. A dual baseline measure uses a less efficient baseline in the first part of its measure life, resulting in higher energy savings initially, with savings becoming lower at a point later in the measure life. Measure costs also are adjusted. Such measures include those with long measure lifetimes that have recent C&S impacts affecting their baseline efficiency at the time of measure burnout and replacement (ROB). Examples of these measures include early replacements of long-lived appliances, such as T-12 lighting fixtures. The existing baseline stock is generally significantly less efficient than the C&S baseline technology.

It is in the program administrator's interest to replace existing stock as quickly as possible, which it does through early replacement programs. Navigant will use an example of a fluorescent light fixture efficiency measure with a 20 year measure life in an early replacement program. The first part of the measure life covers the remaining life of the measure being replaced (T12 light fixtures), which in this example is 5 years or 25 percent. Using existing stock as the efficiency baseline, the measure has a savings of 100 kWh/year per unit for the first 15 years when replaced one-for-one with a high performance T8 (HPT8) fluorescent fixture. The standard practice baseline (a standard T8 fixture) provides savings of 15 kWh/year per unit when replaced with a HPT8 fixture. This 15 kWh/year savings value is applied to years 16 through 20 of the measure life, the 25 percent mentioned above.

The incremental first year measure impacts calculated in the Market Incremental Potential utilizes the 100 kWh/unit annual savings estimate. However, the cumulative savings must be adjusted after the first fifteen years to reflect the lower savings for the remaining 15 years (years 16 to 20). This estimate of lowered savings is used in the Cumulative Potential to adjust the cumulative savings downward.

Another modeling element affected by dual baseline measures is avoided costs over the first measure life and subsequent periods of re-engagement. During the first measure life, the calculation of avoided costs are split between the first 15 years and the last 5 years and then added together. At the point of re-engagement, it is appropriate to utilize only the standard practice baseline energy savings as represented by the last 5 years of the first measure life. These standard practice baseline energy savings affect the entire 20 years of the efficient measure life.

The final modeling element affected is incremental measure cost. With the initial lifetime, the incremental measure cost includes any labour costs along with full measure costs. However, at the point of re-engagement, only incremental measure costs are incurred.

2.9 Transitioning to Market Transformation

EERAM recognizes that a program administrator-sponsored DSM program measure reaches a point where it can be considered part of a transformed market. This market transformation point is estimated



when a certain saturation point is reached. This saturation point is an input variable expressed as a saturation percentage. The model also assumes that when market transformation is reached, market penetration increases. The reason for increasing market penetration is because under Market Transformation, the entire market place is affected and not just a population affected by a DSM program.

At the point when market transformation is reached, it is assumed that the measure is no longer receiving an incentive or incurring any additional program administration costs. However, the program still claims the benefits of the measure's avoided costs. Adjustments to the incentives and costs after the Market Transformation Point (MTP) when market transformation is reached are calculated. The results of the calculations are used to adjust the administrative and incentive costs.

Market penetration is increased (with corresponding energy savings), and incentive and administrative costs are removed after the point of Market Transformation. This results in market potential increasing from the Market Transformation year forward (limited by available base population). However, within the benefit/cost tests, the program administrator's benefits (in terms of avoided costs) are limited to the portion of the future estimated measure impacts if no market transformation is assumed to occur. The cost portions of the benefit/cost tests improve because of the assumption of no further administrative or incentive costs being incurred.

2.10 Appliance Recycling

Appliance recycling measures need special treatment because of the unique characteristics of the base population. Unlike other base technologies, the used appliance stock available for recycling is constantly being refreshed with new populations of appliances. Due to past improvements to appliance efficiencies (primarily codes and standards), the constantly refreshing population of available appliances for recycling is more efficient (and thus saves less energy) from year to year. Available populations of appliances for recycling do not change significantly from year to year, but the time vector of savings per unit does decline.

2.11 Behaviour Based Energy Savings Potential

Savings potential from behaviour-based initiatives was included in the EERAM model. For the purposes of this study, Navigant defines behaviour-based initiatives as those providing information about energy use and efficiency actions, rather than financial incentives, equipment, or services. These initiatives use a variety of implementation strategies including mass media marketing, community-based social marketing, competitions, training, and feedback.⁴

Outcomes from behaviour-based initiatives that result in energy savings can be broadly characterized as equipment-based and usage-based:

- **Equipment-based behaviour** – Savings from the purchase and installation of higher efficiency equipment, relative to baseline conditions.⁵ Examples of equipment-based behaviour include the replacement of lights with higher efficiency lights, purchasing Energy Star®-qualified appliances, and purchasing premium efficiency motors. In the EERAM Model, these savings are modeled at

⁴ *Evaluation of Consumer Behavioural Research*, Navigant (Summit Blue Consulting) for the Northwest Energy Efficiency Alliance, April 6, 2010, Page 4.

⁵ This could be either the early retirement of older equipment or the installation of high-efficiency equipment at the natural time of installation or replacement.



the equipment level as contributions to the percentages of the population that are aware of the measure and that are willing to adopt this measure. Equipment-based behaviour can be sub-categorized as:

- Non-incented equipment-based behaviour – The purchase of higher efficiency equipment for which no incentives are provided.
 - Incented equipment-based behaviour– The purchase of higher efficiency equipment for which incentives are provided. Also known as channeling.
- **Usage-based behaviour** – Savings from changes in usage and maintenance of existing equipment. Examples of usage-based behaviour include turning off lights, unplugging electronics and chargers, programming thermostats, and improving the efficiency of equipment through modified maintenance practices. In the EERAM model, these savings are modeled as an equipment-independent module with savings unassociated with equipment improvement.

The behaviour measure savings used within EERAM reflect estimates of usage-based and non-incented based behaviour. The incentivized equipment-based behaviour is assumed to be addressed by the program administrator's other incentive-based DSM programs. The measure life is assumed to be one year, reflecting the need to continually reinforce the behaviour program's message to conserve and use energy efficiently.



3. Efficiency Measure Characterization

A significant component underlying Navigant's estimate of energy efficiency and peak demand reduction potential is the set of residential and business, non-profit and institutional (BNI) measure characterizations. These measure characterizations were developed by Navigant both to act as a base component of the potential analysis, as well as key inputs to the ENSC Technical Reference Manual (TRM).

This section of the report provides an overview of the process undertaken by Navigant to develop the measure characterizations. Additional detail regarding the measures themselves, the sources used, and the underlying measure assumptions is available in the Excel measure characterization spreadsheets provided to ENSC by Navigant.

The main efficiency measure attributes estimated as part of the measure characterization exercise were:

1. Base technology and efficient measure levels of annual consumption of all relevant resources.
2. The effective useful life (EUL) of the base technology and efficient measure.
3. The labour and materials cost of the base technology and efficient measure.
4. The net-to-gross ratio of the efficient measure (in a given program).
5. The density in the province of the base and efficient technology.⁶

This section of the report is divided into the following sub-sections:

- **Measure Selection and Inclusion:** This sub-section contains a brief description of the manner in which measures were chosen for characterization.
- **Base and Efficient Consumption, EUL and Incremental Measure Cost:** This sub-section describes the approach undertaken by Navigant to estimate these measure characteristics.
- **Loadshapes:** This sub-section describes how the hourly savings profiles were derived and applied for various end-uses.
- **Net-To-Gross:** This sub-section briefly describes how net-to-gross values were ascribed to each measure.
- **Measure Densities:** This sub-section describes the general approach to estimating a technology's density if the density was not drawn directly from the baseline report.

3.1 Measure Selection and Inclusion

Measures for inclusion in the ENSC TRM and EERAM potential model were chosen by ENSC and provided in a list to Navigant, with the measures broken down by program. In some cases measures originally requested by ENSC were not characterized because:

⁶ Densities for BNI technologies were informed by the findings of the Navigant 2012 Baseline Study, and from phone surveys conducted by Corporate Research Associates (CRA) on behalf of ENSC (and *not* as part of the process of measure characterization, as were many of those for residential technologies.) In some cases for residential technologies, publically-available statistical information (from NRCAN or Statistics Canada) was found by Navigant to be applicable and was used as a secondary source to supplement the baseline study results where appropriate.



- It was determined that the technology was insufficiently developed to be included as part of an ENSC program (for example: LED linear fluorescent high bay fixtures).
- Savings (beyond the assumed baseline technology) were insufficiently high relative to the savings of other efficiency measures in the same program to justify characterizing the measure (for example: pre-rinse spray valves).
- These would no longer be offered as part of an ENSC program (for example: all residential natural gas fuel-switching measures).
- These would be handled under a different umbrella, such as Codes and Standards (for example: LED traffic signals).

Prescriptive measures were characterized for the following ENSC residential programs:

- Efficient Products (Appliance Retirement)
- Efficient Products (Direct Install)
- Efficient Products (Instant Savings)
- New Construction (Performance Plus)
- Existing Homes (Green Heating)
- Existing Homes (Solar Program)⁷
- Home Energy Assessment
- Multi-Unit Residential Building (MURB) Program (individual suite measures)

Prescriptive measures were characterized for the following ENSC BNI programs:

- Business Energy Solutions
- Business Energy Rebates (for: commercial kitchens, commercial laundry, commercial refrigeration, motors and variable speed drives, compressed air equipment, central heating and cooling, commercial lighting and agriculture)
- Multi-Unit Residential Building (MURB) Program (common areas)

3.2 Base and Efficient Consumption, Effective Useful Life, and Incremental Measure Cost

The overall approach for estimating base and efficient consumption (of electricity and other resources), effective useful life (EUL), and incremental measure cost was governed by a set of sources of information that were consulted in a descending order determined by:

- How locally relevant the source was (e.g., a Nova Scotia-specific source is better than an Ontario source, but an Ontario source is better than a California source, etc.)
- Vintage of the information (how recent)
- How closely the parameters of the measure characterized in the source matched those of the measure to be characterized by ENSC (e.g., same wattage or flow rate? same size? same type of application?)
- The transparency and reproducibility of the source's method for calculating consumption and savings.

⁷ Note that despite the name, new construction installing solar measures receives its incentives from the "Existing Homes" program.



Selecting the most appropriate source for each component of the measure characterization at times required some compromise – in some cases the most locally-specific source was a number of years older than a source that focused on a jurisdiction considerably distant from Nova Scotia. Thus, in some instances, the choice of source may have been a matter of Navigant’s professional judgment.

For residential measures, the two most frequently-cited sources were Econoler’s “Evaluation of 2011 DSM Programs” document and the Ontario Power Authority’s “2011 Prescriptive Measures and Assumptions”⁸.

Other documents frequently used as sources for the characterization measure savings, measure life and measure cost include:

- Ontario Power Authority, *2011 Quasi-Prescriptive Measures and Assumptions* (March 2011)⁹
- Illinois Energy Efficiency Stakeholder Advisory Group, *State of Illinois Energy Efficiency Technical Reference Manual* (June 2012)¹⁰
- Ontario Energy Board, *Measures and Assumptions for Demand Side Management* (April 2009)¹¹
- Natural Resource Canada (NRCAN)’s *Comprehensive Energy Use Database*.¹²
- US Environmental Protection Agency, Energy Star® website (measure calculators)¹³
- National Grid, *Rhode Island Technical Reference Manual for Estimating Savings from Energy Efficiency Measures* (2012)¹⁴
- Efficiency Vermont, *Technical Reference User Manual No. 2010-67A* (December 2010)
- Massachusetts Electric and Gas Energy Efficiency Program, *Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures* (October 2010)¹⁵

In addition to the documents cited above, Navigant used a plethora of online savings calculators (such as those published by the Food Service Technology Center¹⁶ and CEATI¹⁷), measure-specific studies and measure installation case studies to estimate base and efficient consumption. Full citations for all measures may be found in the measure characterization spreadsheets provided to ENSC by Navigant.

⁸ <http://www.powerauthority.on.ca/evaluation-measurement-and-verification/measures-assumptions-lists>

⁹

<http://www.powerauthority.on.ca/sites/default/files/2011%20Quasi%20Prescriptive%20Release%20Version%201%20%28December%202010%29.pdf>

¹⁰

http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CDIQFjAA&url=http%3A%2F%2Filsa.org%2Fyahoo_site_admin%2Fassets%2Fdocs%2Fillinois_Statewide_TRM_Effective_060112_Final_Technical_Version_082012_Clean.267210945.docx&ei=wn9tUbGCK_PB4AONzoGgCA&usg=AFQjCNFhuELMLWeTPtH9VYxhLrUemepvQw&sig2=003ELUpQVTpGbahbK92vyQ&bvm=bv.45175338,d.dmg

¹¹ http://www.ontarioenergyboard.ca/OEB/_Documents/EB-2008-0346/Navigant_Appendix_C_substantiation_sheet_20090429.pdf

¹² http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_egen_ca.cfm

¹³ https://www.energystar.gov/index.cfm?c=home_improvement.hm_improvement_index&s=m

¹⁴ http://www.nationalgridus.com/non_html/er/ri/Rhode%20Island%20TRM_PY2013_final.pdf

¹⁵ http://www.ma-eeac.org/docs/MA%20TRM_2011%20PLAN%20VERSION.PDF

¹⁶ <http://www.fishnick.com/>

¹⁷ <http://www.ceati.com/>



In Navigant's experience, frequently, the least reliable secondary-source measure characterization estimates are those pertaining to measure cost. This is due to the fact that a rapidly-developing marketplace in energy-efficient technologies and more widespread adoption of these technologies tends to drive prices down over time. Therefore, Navigant's approach to estimating cost was typically to turn to primary sources, including online retailers (amazon.ca, homedepot.ca, bulbtown.ca, etc.) and local contractors and installers, particularly for newer technologies. For more established measures with known labour and material costs, research from existing TRMs was used to characterize measure costs and incremental costs.

3.3 Loadshapes

The potential study relied on annual end use loadshapes to develop results, allocating savings potential across the different sectors (residential, commercial, and industrial.) Loadshapes were derived by Navigant from a variety of primary and secondary sources, including whole building energy modeling performed by Navigant based on data from the Navigant 2012 baseline study, and secondary research such as Pacific Gas & Electric (PG&E) Climate Zone 2/16. This section describes what loadshapes are and how they were developed for a variety of end uses to support the Nova Scotia potential study and Technical Reference Manual (TRM).

3.3.1 Loadshapes Overview

A loadshape is an hour by hour description of how a particular technology type, such as HVAC heating equipment or Interior Lighting, uses energy, every hour from January 1 through December 31 (with 24 hours over 365 days for a total of 8,760 hours annually.) Energy savings loadshapes provide annual consumption patterns for energy consuming equipment such as light fixtures and air conditioners. Electrical energy savings for energy efficiency measures related to these end uses will follow these same consumption loadshapes, since an efficient measure generates savings when the equipment is operating.

Loadshapes for Potential Studies

Loadshapes address impacts on system capacity by assuming that savings for a given end use match consumption patterns. Loadshapes are used to allocate a proportion of the annual savings to each hour of the day for each end use. While the overall Nova Scotia avoided cost calculation is currently not time-differentiated, correct end use loadshapes positively impact the total savings potential by accurately characterizing variable-driven measures such as weather sensitive measures. This reduces uncertainty in the overall estimation of program potential. The loadshapes can also be utilized during day-to-day program implementation as part of the ENSC Technical Reference Manual (TRM), providing an accurate means of estimating measure-level demand savings during peak hours.

Loadshapes for TRMs

Loadshapes used for TRMs are normalized to an annual maximum value for each end use, such as HVAC or lighting. Where the hourly fraction is 1.00, the hourly usage is at the annual maximum kW per whole building energy modeling (eQuest). Where the hourly fraction, or average fraction across several hours, is less than one, the end use is, on average, operating at part load. This allows the user of the TRM to estimate relative average energy savings based on equipment usage during certain time windows, such as the winter peak, for energy conservation measures.



3.3.2 Characteristic Loadshapes for Nova Scotia

The loadshapes used to generate the Nova Scotia potential study results were as follows (NS indicates the end use was modeled for Nova Scotia specific weather conditions):

Residential Loadshapes

- Refrigeration
- Clothes Washer
- Miscellaneous Loads
- Domestic Hot Water (NS)
- Interior Lighting (NS)
- HVAC (NS)

Commercial Loadshapes

- HVAC (NS)
- Refrigeration (NS)
- Laundry
- Miscellaneous Loads
- Domestic Hot Water (NS)
- Interior Lighting (NS)
- Agricultural
- Process/Industrial

The next section outlines how region specific loadshapes are developed using whole building energy modeling.

3.3.3 Whole Building Modeling of EE Loadshapes for the Potential Study

Nova Scotia-specific loadshapes were developed using whole building energy modeling with eQuest modeling software, particularly important for weather dependent measures, such as HVAC. For both residential and BNI buildings, specific data were input into the modeling software including the following:

- Building and equipment data from the 2012 Nova Scotia baseline study
- Typical daily schedules for Nova Scotia
- U.S. National Renewable Energy Laboratory (NREL) typical meteorological year (TMY) data

The resulting region-specific outputs of the model were then disaggregated into the different end use categories, and normalized so that the total usage for each end use sums to 1.00. These normalized loadshapes were associated with certain measures in EERAM, such as HVAC and Lighting measures, such that the total aggregated savings reflects region-specific variables, such as weather, daylight, and local system usage.

3.4 Net-to-Gross

Net-to-gross (NTG) values are specific to a unique combination of measure and delivery program, not just specific to a given measure (as are savings and EUL.) NTG values used in the measure



characterizations were drawn exclusively from the Econoler “Evaluation of 2011 DSM Programs” document or estimated as some combination of values across different programs in that document.

3.5 *Measure Densities*

Measure or technology density is a requirement for the estimation of energy efficiency and demand reduction potential. “Density” in this case refers to the prevalence of the technology in question throughout the province. For example, the base technology density for the “Outdoor Motion Sensor” residential measure would be the average number of outdoor light bulbs installed per single-family home in Nova Scotia not connected to a motion sensor. The efficient technology density would be the average number of outdoor light bulbs installed per single-family home in Nova Scotia *that are also connected to a motion sensor*.

BNi measure densities were estimated using the data obtained from the BNi sector baseline survey, and phone surveys conducted by Corporate Research Associates (CRA) on behalf of ENSC. In the case of the residential sector just under half of the densities used were derived from the residential sector baseline survey. Densities not derived from the baseline study were derived by Navigant staff during the measure characterization process using a variety of different sources. The most common sources for information for the estimation of residential measure densities include:

- Natural Resource Canada (NRCAN)’s *Comprehensive Energy Use Database*¹⁸
- NRCAN’s *Survey of Household Energy Use* (2007)¹⁹
- Efficiency Nova Scotia’s *2011 Socket Study* (December 2011)²⁰

A variety of other tables obtained from Statistics Canada and a variety of provincial authorities were also used to determine measure densities.

¹⁸ http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/trends_egen_ca.cfm

¹⁹ <http://oee.nrcan.gc.ca/publications/statistics/sheu-summary07/sheu.cfm>

²⁰ <http://efficiencyns.ca/images/uploads/ENSC%202013-2015%20DSM%20Plan%20Part%20II.pdf>



4. Conclusion

Navigant used the EERAM model to estimate the Nova Scotia long-term (2015-2040) electrical energy efficiency potential. The results for Technical and Economic Potential are provided for context and include both savings from DSM programs as well as savings outside of DSM programs, such as Codes and Standards. The Achievable Potential results include savings from DSM programs only and are presented in four scenarios of varying incentive amounts; Low, Base, Mid, and High.

The results of this potential study can be used to develop energy efficiency investment strategies, and define specific objectives to meet provincial energy efficiency goals. The yearly results of the Achievable Potential scenarios are presented in terms of energy and demand savings along with their associated costs for the Residential, Commercial, and Industrial sectors and therefore may be used within the utility's Integrated Resource Planning (IRP) process.

As Navigant's EERAM tool accounts for code-mandated efficiency effects, and is based on existing market characterization via the baseline study and other research conducted by Navigant and others, the results of this study are robust to baseline uncertainties and foreseeable market transformations.



Appendix A. Technical Potential

Figure 6 presents the 2015 – 2040 Technical Potential with the breakdown of savings from DSM programs and savings from Codes and Standards.

Figure 6. Total All Sectors Energy Efficiency Technical Potential – 2015 to 2040 (Gross at Generator)

Total All Sectors Technical Potential (Gross at Generator)						
Peak Demand Savings (MW)				Energy Savings (GWh)		
Year	Programs	Codes & Standards	Total	Programs	Codes & Standards	Total
2015	1,141	9	1,150	5,277	55	5,332
2016	1,152	16	1,168	5,343	91	5,434
2017	1,167	23	1,190	5,426	128	5,554
2018	1,177	31	1,208	5,486	168	5,654
2019	1,189	39	1,227	5,548	209	5,757
2020	1,199	47	1,246	5,607	252	5,859
2021	1,210	56	1,265	5,665	295	5,961
2022	1,219	64	1,284	5,710	337	6,047
2023	1,227	72	1,300	5,747	374	6,120
2024	1,310	81	1,391	6,301	417	6,719
2025	1,318	87	1,406	6,342	455	6,797
2026	1,327	91	1,418	6,384	482	6,866
2027	1,335	95	1,430	6,426	509	6,935
2028	1,342	98	1,440	6,465	534	6,999
2029	1,351	102	1,452	6,510	559	7,068
2030	1,358	105	1,463	6,551	582	7,133
2031	1,366	107	1,472	6,593	602	7,195
2032	1,373	109	1,481	6,635	622	7,257
2033	1,380	111	1,491	6,677	642	7,320
2034	1,388	113	1,500	6,721	667	7,388
2035	1,395	115	1,510	6,766	694	7,460
2036	1,403	117	1,520	6,812	721	7,533
2037	1,410	119	1,529	6,859	749	7,608
2038	1,417	122	1,538	6,900	776	7,676
2039	1,423	124	1,547	6,944	803	7,747
2040	1,430	126	1,556	6,990	831	7,820



Appendix B. Economic Potential

Figure 7 presents the total Economic Potential results of the analysis, 2015 through 2040, across all sectors; Residential, Commercial and Industrial.

Figure 7. Total All Sectors Energy Efficiency Economic Potential – 2015 to 2040 (Gross at Generator)

Total All Sectors Economic Potential (Gross at Generator)		
Year	Peak Demand Savings (MW)	Energy Savings (GWh)
2015	990	4,662
2016	999	4,719
2017	1,014	4,796
2018	1,024	4,852
2019	1,035	4,909
2020	1,046	4,970
2021	1,114	5,253
2022	1,137	5,348
2023	1,187	5,546
2024	1,197	5,592
2025	1,204	5,629
2026	1,212	5,668
2027	1,220	5,707
2028	1,227	5,743
2029	1,235	5,786
2030	1,242	5,824
2031	1,249	5,863
2032	1,280	6,024
2033	1,287	6,063
2034	1,294	6,104
2035	1,301	6,145
2036	1,308	6,188
2037	1,315	6,232
2038	1,322	6,270
2039	1,328	6,311
2040	1,334	6,354



Appendix C. Achievable Potential

For the Base Scenario, Figure 8 presents the Total All Sectors Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 8. Total All Sectors Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Base Scenario

Total All Sectors Achievable Potential (Net-at-Generator) – Base Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	29.8	29.8	137.8	137.8	\$50.7	\$50.7
2016	30.9	50.4	139.9	226.1	\$50.5	\$101.2
2017	31.6	77.3	141.7	360.8	\$50.0	\$151.2
2018	29.9	102.9	136.2	480.3	\$52.4	\$203.6
2019	28.9	127.5	134.8	597.4	\$57.0	\$260.6
2020	28.1	150.0	133.9	708.9	\$61.5	\$322.1
2021	27.3	172.4	130.1	817.1	\$56.9	\$379.0
2022	26.9	195.6	127.6	932.3	\$54.1	\$433.2
2023	26.7	217.8	126.6	1,040.9	\$51.5	\$484.7
2024	27.0	241.1	127.4	1,155.4	\$50.8	\$535.5
2025	27.6	261.2	130.1	1,257.1	\$50.6	\$586.1
2026	28.8	284.1	135.6	1,371.0	\$52.1	\$638.3
2027	30.6	313.2	143.5	1,509.5	\$54.8	\$693.0
2028	32.8	341.5	153.4	1,644.6	\$58.5	\$751.5
2029	34.9	373.7	163.3	1,797.6	\$60.7	\$812.2
2030	36.6	407.1	170.7	1,956.3	\$63.1	\$875.3
2031	37.2	439.8	173.5	2,112.9	\$62.6	\$937.9
2032	36.6	471.6	171.4	2,266.2	\$61.4	\$999.4
2033	35.4	502.6	166.0	2,415.4	\$59.3	\$1,058.7
2034	33.8	532.7	159.3	2,560.6	\$56.7	\$1,115.4
2035	32.3	561.2	153.0	2,699.4	\$47.7	\$1,163.1
2036	30.8	588.6	147.0	2,833.1	\$46.5	\$1,209.6
2037	29.6	612.3	141.5	2,955.0	\$45.4	\$1,254.9
2038	28.4	638.6	136.1	3,080.8	\$44.4	\$1,299.3
2039	27.4	662.2	131.6	3,197.5	\$43.5	\$1,342.8
2040	26.6	684.5	127.9	3,308.7	\$42.3	\$1,385.0



For the Low Scenario, Figure 9 presents the Total All Sectors Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 9. Total All Sectors Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Low Scenario

Total All Sectors Achievable Potential (Net-at-Generator) – Low Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	23.9	23.9	107.7	107.7	\$46.5	\$46.5
2016	24.3	38.9	106.0	162.2	\$44.8	\$91.3
2017	24.2	57.8	104.0	259.1	\$42.9	\$134.3
2018	23.7	77.5	102.3	345.9	\$39.2	\$173.5
2019	23.0	97.0	100.0	431.1	\$37.6	\$211.1
2020	22.5	114.9	98.7	508.5	\$37.8	\$248.8
2021	22.1	131.7	98.1	582.0	\$38.5	\$287.3
2022	21.9	149.6	98.7	670.4	\$39.8	\$327.1
2023	21.9	166.7	99.5	754.2	\$39.7	\$366.8
2024	22.0	184.6	101.1	841.0	\$40.4	\$407.1
2025	22.4	200.8	103.2	922.0	\$40.8	\$447.9
2026	23.1	217.6	106.8	1,005.3	\$42.0	\$489.9
2027	24.2	240.2	111.8	1,111.5	\$43.7	\$533.5
2028	25.7	261.2	118.5	1,211.0	\$46.1	\$579.6
2029	27.4	285.8	126.5	1,326.9	\$47.0	\$626.6
2030	29.0	313.3	134.2	1,455.8	\$49.5	\$676.2
2031	30.1	339.1	139.5	1,579.0	\$50.8	\$726.9
2032	30.3	364.7	141.1	1,702.6	\$51.1	\$778.0
2033	29.7	389.5	139.2	1,822.7	\$50.4	\$828.4
2034	28.7	413.9	135.2	1,941.9	\$48.9	\$877.3
2035	27.4	437.2	130.5	2,057.0	\$47.2	\$924.5
2036	26.3	459.9	125.9	2,169.1	\$45.6	\$970.1
2037	25.2	479.2	121.6	2,271.4	\$44.0	\$1,014.1
2038	24.2	501.4	117.8	2,379.5	\$42.5	\$1,056.7
2039	23.4	521.2	114.3	2,479.8	\$41.3	\$1,098.0
2040	22.7	539.8	111.2	2,575.6	\$40.2	\$1,138.1



For the Mid Scenario, Figure 10 presents the Total All Sectors Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 10. Total All Sectors Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Mid Scenario

Total All Sectors Achievable Potential (Net-at-Generator) – Mid Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	35.4	35.4	164.0	164.0	\$56.1	\$56.1
2016	37.9	62.6	171.0	283.4	\$57.5	\$113.6
2017	39.8	98.1	177.7	454.2	\$59.0	\$172.6
2018	37.9	131.4	170.0	606.0	\$66.1	\$238.6
2019	37.0	163.3	167.4	752.5	\$76.4	\$315.0
2020	36.6	194.5	166.2	897.5	\$86.7	\$401.7
2021	36.1	225.8	162.2	1,038.8	\$81.7	\$483.4
2022	35.7	258.1	159.6	1,186.0	\$79.1	\$562.5
2023	35.6	289.1	158.8	1,325.9	\$76.3	\$638.7
2024	36.1	321.6	161.6	1,474.8	\$76.8	\$715.6
2025	37.3	349.7	167.4	1,603.8	\$78.5	\$794.1
2026	39.3	383.0	176.6	1,758.8	\$81.9	\$876.0
2027	41.7	423.1	187.5	1,940.7	\$85.7	\$961.7
2028	44.4	462.9	199.1	2,121.0	\$90.1	\$1,051.8
2029	46.2	506.5	207.8	2,318.3	\$92.0	\$1,143.9
2030	46.7	548.6	210.6	2,511.5	\$92.2	\$1,236.1
2031	45.5	589.5	206.8	2,700.6	\$87.4	\$1,323.5
2032	43.2	627.8	198.5	2,880.9	\$82.3	\$1,405.8
2033	40.5	664.5	188.4	3,055.0	\$76.8	\$1,482.6
2034	37.8	699.1	178.4	3,220.7	\$71.2	\$1,553.8
2035	35.4	730.8	169.5	3,376.3	\$57.9	\$1,611.7
2036	33.2	760.6	161.4	3,523.9	\$54.8	\$1,666.5
2037	31.3	785.9	154.2	3,657.9	\$52.0	\$1,718.5
2038	29.7	813.1	147.8	3,794.4	\$49.0	\$1,767.5
2039	28.3	837.4	142.6	3,921.4	\$46.5	\$1,814.1
2040	27.3	858.6	139.0	4,039.3	\$43.6	\$1,857.7



For the High Scenario, Figure 11 presents the Total All Sectors Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 11. Total All Sectors Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – High Scenario

Total All Sectors Achievable Potential (Net-at-Generator) – High Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	39.6	39.6	174.9	174.9	\$76.3	\$76.3
2016	45.5	74.3	191.3	314.6	\$92.0	\$168.3
2017	49.9	120.1	205.5	513.1	\$104.6	\$272.9
2018	46.3	161.4	193.9	687.3	\$107.4	\$380.3
2019	43.2	198.4	186.9	849.1	\$112.8	\$493.1
2020	41.0	234.5	182.9	1,012.2	\$119.3	\$612.4
2021	39.6	269.6	177.7	1,170.2	\$106.9	\$719.3
2022	39.0	305.3	175.6	1,334.1	\$102.2	\$821.5
2023	39.2	340.0	176.9	1,492.3	\$99.0	\$920.5
2024	40.7	377.2	184.7	1,664.0	\$104.0	\$1,024.5
2025	43.1	410.8	196.0	1,820.5	\$110.9	\$1,135.4
2026	45.8	450.3	209.2	2,006.7	\$118.6	\$1,254.0
2027	47.8	496.1	217.7	2,217.3	\$121.1	\$1,375.1
2028	48.3	539.7	220.6	2,418.5	\$120.4	\$1,495.5
2029	47.1	584.1	216.5	2,624.4	\$114.5	\$1,609.9
2030	44.5	623.9	207.1	2,813.4	\$106.5	\$1,716.4
2031	41.4	661.0	195.4	2,991.8	\$94.6	\$1,811.0
2032	38.4	694.9	183.8	3,158.6	\$85.9	\$1,896.9
2033	35.7	727.5	173.7	3,320.5	\$65.8	\$1,962.8
2034	33.3	757.8	164.7	3,473.0	\$61.1	\$2,023.8
2035	31.3	784.6	157.0	3,614.3	\$56.6	\$2,080.4
2036	29.7	810.3	150.4	3,749.5	\$52.4	\$2,132.9
2037	28.5	832.8	145.1	3,874.4	\$49.6	\$2,182.5
2038	27.5	857.9	141.3	4,005.0	\$44.2	\$2,226.7
2039	26.6	881.0	137.5	4,128.6	\$43.4	\$2,270.1
2040	25.9	900.7	134.0	4,241.0	\$42.6	\$2,312.6



For the Base Scenario, Figure 12 presents the Residential Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 12. Residential Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Base Scenario

Residential Sector Achievable Potential (Net-at-Generator) – Base Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	16.4	16.4	64.1	64.1	\$25.3	\$25.3
2016	18.0	30.3	68.3	116.4	\$25.6	\$50.9
2017	18.7	45.1	69.7	170.7	\$25.2	\$76.1
2018	16.6	57.6	62.4	217.5	\$27.4	\$103.6
2019	16.1	69.6	63.4	264.3	\$33.1	\$136.7
2020	15.7	81.5	64.4	314.7	\$38.2	\$174.9
2021	15.3	92.8	61.9	361.0	\$34.3	\$209.2
2022	15.0	103.6	60.1	405.6	\$31.7	\$240.9
2023	14.9	114.4	59.0	448.8	\$29.1	\$270.0
2024	14.9	124.9	58.6	491.7	\$28.3	\$298.3
2025	15.1	136.0	58.8	533.8	\$27.5	\$325.9
2026	15.6	147.9	60.1	580.6	\$28.2	\$354.1
2027	16.3	160.1	62.3	627.3	\$29.5	\$383.6
2028	17.3	173.8	65.3	679.8	\$31.5	\$415.1
2029	18.2	188.1	68.1	732.8	\$32.9	\$448.0
2030	18.9	203.0	70.0	787.8	\$34.1	\$482.0
2031	19.1	218.2	70.3	843.4	\$34.0	\$516.0
2032	18.7	232.8	69.0	897.2	\$33.1	\$549.1
2033	18.1	247.0	66.5	948.7	\$31.8	\$580.9
2034	17.3	260.3	63.6	997.3	\$30.3	\$611.2
2035	16.5	272.5	61.1	1,042.4	\$22.3	\$633.5
2036	15.8	284.4	58.6	1,085.8	\$22.0	\$655.5
2037	15.1	293.2	56.3	1,121.0	\$21.6	\$677.1
2038	14.5	305.2	53.7	1,162.9	\$21.3	\$698.4
2039	14.0	315.1	51.5	1,198.8	\$21.1	\$719.5
2040	13.5	324.2	49.6	1,231.2	\$20.9	\$740.4



For the Low Scenario, Figure 13 presents the Residential Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 13. Residential Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Low Scenario

Residential Sector Achievable Potential (Net-at-Generator) – Low Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	14.0	14.0	49.9	49.9	\$21.6	\$21.6
2016	15.1	25.0	51.7	85.6	\$21.1	\$42.7
2017	15.3	36.4	51.0	121.2	\$19.8	\$62.5
2018	13.9	46.3	45.3	150.9	\$14.6	\$77.1
2019	13.4	55.7	43.9	178.2	\$13.9	\$91.0
2020	13.0	64.8	43.5	207.8	\$14.4	\$105.4
2021	12.7	73.5	43.2	235.4	\$15.3	\$120.7
2022	12.6	81.9	44.1	264.4	\$16.8	\$137.5
2023	12.5	90.9	44.7	297.7	\$16.6	\$154.2
2024	12.6	98.8	45.4	326.1	\$17.3	\$171.5
2025	12.6	107.6	45.7	355.4	\$17.2	\$188.7
2026	12.8	116.6	46.3	387.4	\$17.6	\$206.3
2027	13.2	125.6	47.4	418.8	\$18.1	\$224.4
2028	13.8	135.7	49.0	454.2	\$18.9	\$243.3
2029	14.5	146.2	51.0	490.0	\$19.5	\$262.8
2030	15.2	157.5	52.9	528.1	\$20.3	\$283.1
2031	15.6	169.2	54.0	567.3	\$20.8	\$303.8
2032	15.5	180.5	53.7	605.8	\$20.8	\$324.6
2033	15.0	191.6	52.3	643.0	\$20.3	\$345.0
2034	14.3	202.0	50.2	678.2	\$19.6	\$364.6
2035	13.6	211.2	47.8	710.1	\$18.8	\$383.3
2036	12.8	220.1	45.6	740.7	\$17.9	\$401.3
2037	12.2	226.1	43.6	763.3	\$17.1	\$418.3
2038	11.7	235.2	41.7	793.7	\$16.3	\$434.6
2039	11.2	242.4	40.0	818.6	\$15.7	\$450.3
2040	10.7	248.9	38.5	840.9	\$15.1	\$465.5



For the Mid Scenario, Figure 14 presents the Residential Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 14. Residential Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Mid Scenario

Residential Sector Achievable Potential (Net-at-Generator) – Mid Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	18.6	18.6	71.9	71.9	\$26.5	\$26.5
2016	21.0	35.5	78.3	134.1	\$27.6	\$54.0
2017	22.4	54.0	81.7	200.4	\$28.6	\$82.6
2018	20.6	70.5	73.8	258.6	\$36.3	\$119.0
2019	20.7	87.0	75.7	317.7	\$48.2	\$167.2
2020	20.9	104.1	77.8	381.5	\$59.4	\$226.5
2021	20.9	121.0	76.0	442.0	\$55.5	\$282.0
2022	20.8	137.6	74.5	501.0	\$53.2	\$335.2
2023	20.7	154.1	73.5	557.3	\$50.4	\$385.6
2024	20.9	170.7	74.3	615.9	\$50.6	\$436.2
2025	21.4	188.0	76.0	675.1	\$51.4	\$487.6
2026	22.2	206.6	78.7	741.0	\$53.6	\$541.1
2027	23.3	225.7	81.7	807.0	\$55.6	\$596.7
2028	24.4	246.5	84.9	879.2	\$58.0	\$654.7
2029	25.1	267.7	87.0	950.8	\$59.2	\$713.8
2030	25.0	288.7	86.8	1,022.6	\$58.8	\$772.6
2031	24.1	309.0	84.1	1,091.9	\$55.5	\$828.1
2032	22.6	327.5	79.7	1,156.6	\$51.6	\$879.7
2033	20.9	344.5	74.7	1,216.3	\$47.3	\$927.0
2034	19.3	359.8	69.7	1,270.7	\$43.0	\$970.0
2035	17.7	373.1	65.3	1,319.8	\$30.8	\$1,000.8
2036	16.3	385.4	61.3	1,365.8	\$28.7	\$1,029.5
2037	15.1	394.2	57.7	1,402.3	\$26.7	\$1,056.2
2038	14.0	405.6	54.1	1,444.5	\$25.0	\$1,081.2
2039	13.1	414.5	51.1	1,479.7	\$23.6	\$1,104.8
2040	12.4	420.7	48.8	1,507.0	\$22.4	\$1,127.2



For the High Scenario, Figure 15 presents the Residential Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 15. Residential Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – High Scenario

Residential Sector Achievable Potential (Net-at-Generator) – High Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	22.0	22.0	78.8	78.8	\$42.1	\$42.1
2016	27.2	45.1	90.9	153.7	\$56.2	\$98.3
2017	30.4	71.5	98.2	236.5	\$67.5	\$165.8
2018	27.2	94.6	87.7	308.7	\$71.5	\$237.3
2019	25.4	115.8	86.2	378.3	\$78.7	\$316.1
2020	24.0	136.0	85.6	449.9	\$86.1	\$402.2
2021	23.0	155.0	82.4	516.8	\$75.1	\$477.4
2022	22.5	173.3	80.6	582.0	\$70.6	\$548.0
2023	22.4	191.6	80.3	645.0	\$67.2	\$615.2
2024	23.2	210.3	83.7	713.1	\$71.2	\$686.3
2025	24.4	230.7	88.4	784.7	\$76.3	\$762.7
2026	25.7	252.7	93.5	865.2	\$82.3	\$845.0
2027	26.4	275.0	95.2	944.6	\$83.2	\$928.2
2028	26.4	297.9	94.6	1,026.7	\$81.7	\$1,010.0
2029	25.3	319.3	91.2	1,102.4	\$76.8	\$1,086.7
2030	23.6	338.9	85.8	1,173.1	\$70.0	\$1,156.7
2031	21.6	356.6	79.5	1,237.8	\$61.3	\$1,218.0
2032	19.6	372.1	73.4	1,296.2	\$54.1	\$1,272.1
2033	17.8	386.0	68.3	1,349.5	\$35.4	\$1,307.5
2034	16.3	398.2	63.6	1,397.4	\$31.9	\$1,339.4
2035	14.9	408.1	59.4	1,439.0	\$29.2	\$1,368.6
2036	13.8	417.5	55.3	1,478.0	\$27.0	\$1,395.6
2037	12.9	424.2	52.1	1,509.1	\$25.6	\$1,421.2
2038	12.4	433.8	49.9	1,547.1	\$21.5	\$1,442.7
2039	12.0	442.0	48.4	1,580.4	\$21.0	\$1,463.8
2040	11.7	447.6	47.3	1,606.5	\$20.5	\$1,484.3



For the Base Scenario, Figure 16 presents the Commercial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 16. Commercial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Base Scenario

Commercial Sector Achievable Potential (Net-at-Generator) – Base Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	9.0	9.0	48.4	48.4	\$14.0	\$14.0
2016	8.6	13.0	47.0	69.0	\$13.6	\$27.6
2017	8.6	21.1	47.6	123.0	\$13.3	\$40.9
2018	8.8	29.8	47.8	170.0	\$13.3	\$54.2
2019	8.4	38.0	46.0	215.1	\$12.5	\$66.7
2020	8.1	45.0	44.6	254.2	\$12.1	\$78.8
2021	7.9	52.3	43.6	293.6	\$11.6	\$90.3
2022	7.8	60.3	43.1	338.6	\$11.4	\$101.8
2023	7.7	67.6	43.0	380.0	\$11.4	\$113.1
2024	7.8	76.0	43.8	425.8	\$11.5	\$124.6
2025	8.1	81.6	45.4	462.2	\$11.8	\$136.4
2026	8.6	88.4	48.1	503.5	\$12.4	\$148.8
2027	9.3	99.6	51.8	563.2	\$13.3	\$162.0
2028	10.1	109.1	56.4	616.3	\$14.4	\$176.5
2029	10.9	120.9	61.1	681.0	\$15.1	\$191.6
2030	11.5	133.1	64.6	747.9	\$16.0	\$207.6
2031	11.7	144.4	65.9	812.0	\$15.7	\$223.4
2032	11.5	155.3	64.9	874.6	\$15.3	\$238.7
2033	11.1	166.0	62.4	935.7	\$14.7	\$253.4
2034	10.5	176.7	59.3	995.7	\$13.8	\$267.1
2035	9.9	187.0	56.3	1,053.3	\$12.9	\$280.1
2036	9.3	196.7	53.5	1,108.2	\$12.2	\$292.3
2037	8.9	205.9	51.0	1,160.5	\$11.6	\$303.9
2038	8.5	214.7	48.9	1,210.5	\$11.1	\$315.0
2039	8.1	223.0	47.1	1,258.3	\$10.6	\$325.5
2040	7.9	231.0	45.9	1,304.7	\$9.7	\$335.2



For the Low Scenario, Figure 17 presents the Commercial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 17. Commercial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Low Scenario

Commercial Sector Achievable Potential (Net-at-Generator) – Low Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	6.5	6.5	36.9	36.9	\$13.1	\$13.1
2016	5.9	8.4	34.4	44.9	\$12.1	\$25.3
2017	5.7	13.2	33.6	84.9	\$11.6	\$36.9
2018	6.3	19.6	35.8	120.7	\$12.4	\$49.3
2019	6.2	26.1	35.2	157.3	\$11.9	\$61.2
2020	6.1	31.7	34.5	187.5	\$11.6	\$72.9
2021	6.1	36.7	34.3	215.1	\$11.5	\$84.4
2022	6.0	42.9	34.0	252.9	\$11.4	\$95.8
2023	6.0	47.9	34.0	283.3	\$11.4	\$107.1
2024	6.1	54.5	34.5	319.7	\$11.3	\$118.5
2025	6.2	58.8	35.6	350.0	\$11.6	\$130.1
2026	6.5	63.5	37.4	380.1	\$12.1	\$142.2
2027	7.0	72.4	39.9	427.9	\$12.9	\$155.1
2028	7.5	79.3	43.1	467.5	\$14.0	\$169.0
2029	8.2	88.4	46.9	518.0	\$14.4	\$183.4
2030	8.8	99.0	50.5	576.0	\$15.5	\$198.9
2031	9.2	108.0	53.0	627.9	\$16.0	\$214.8
2032	9.3	116.9	53.8	679.8	\$16.0	\$230.8
2033	9.2	125.2	53.0	729.8	\$15.7	\$246.5
2034	8.9	133.9	51.3	780.3	\$15.0	\$261.5
2035	8.5	142.5	49.2	829.9	\$14.3	\$275.8
2036	8.1	150.9	47.2	878.0	\$13.6	\$289.5
2037	7.8	159.0	45.4	924.6	\$13.0	\$302.5
2038	7.5	166.8	43.8	969.7	\$12.5	\$315.0
2039	7.2	174.3	42.3	1,013.0	\$12.0	\$327.0
2040	7.0	181.5	41.1	1,054.8	\$11.5	\$338.5



For the Mid Scenario, Figure 18 presents the Commercial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 18. Commercial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Mid Scenario

Commercial Sector Achievable Potential (Net-at-Generator) – Mid Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	11.2	11.2	60.5	60.5	\$17.1	\$17.1
2016	11.2	17.6	61.0	95.1	\$17.3	\$34.4
2017	11.7	29.0	63.8	165.2	\$17.3	\$51.7
2018	11.5	40.2	62.3	225.8	\$16.7	\$68.4
2019	10.8	50.1	59.1	281.6	\$15.6	\$84.0
2020	10.2	59.4	56.8	333.8	\$14.9	\$99.0
2021	9.9	68.8	55.2	385.4	\$14.2	\$113.1
2022	9.7	78.9	54.4	441.3	\$13.9	\$127.0
2023	9.7	88.3	54.4	494.4	\$13.9	\$140.9
2024	9.9	98.8	55.7	552.1	\$14.1	\$155.1
2025	10.3	105.5	58.4	596.2	\$14.8	\$169.8
2026	11.1	114.7	62.6	651.9	\$15.5	\$185.4
2027	12.0	128.7	67.9	727.2	\$16.8	\$202.1
2028	13.0	141.0	73.4	797.1	\$18.2	\$220.3
2029	13.8	155.7	77.7	878.4	\$18.8	\$239.1
2030	14.0	169.3	79.3	955.7	\$19.1	\$258.2
2031	13.8	182.5	78.0	1,031.5	\$18.0	\$276.2
2032	13.2	195.1	74.8	1,103.7	\$17.1	\$293.3
2033	12.4	207.7	70.9	1,175.2	\$16.1	\$309.4
2034	11.7	219.9	67.0	1,244.1	\$15.0	\$324.4
2035	11.0	231.4	63.4	1,309.3	\$14.1	\$338.5
2036	10.4	242.2	60.2	1,370.9	\$13.3	\$351.8
2037	9.9	252.4	57.5	1,429.4	\$12.6	\$364.4
2038	9.5	262.1	55.5	1,485.6	\$11.6	\$376.0
2039	9.2	271.4	53.9	1,540.0	\$10.9	\$386.9
2040	9.0	280.5	53.2	1,593.6	\$9.3	\$396.3



For the High Scenario, Figure 19 presents the Commercial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 19. Commercial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – High Scenario

Commercial Sector Achievable Potential (Net-at-Generator) – High Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	11.8	11.8	63.2	63.2	\$20.5	\$20.5
2016	12.3	19.1	66.3	103.0	\$21.5	\$42.0
2017	13.2	32.2	71.6	181.0	\$22.2	\$64.3
2018	12.7	44.3	69.2	247.5	\$21.2	\$85.5
2019	11.8	54.5	65.4	306.4	\$20.0	\$105.5
2020	11.2	64.9	63.1	365.9	\$19.4	\$124.9
2021	10.9	75.6	61.6	424.8	\$18.4	\$143.3
2022	10.8	86.9	61.4	488.3	\$18.2	\$161.5
2023	11.0	97.6	62.4	549.5	\$18.4	\$179.9
2024	11.4	109.7	65.2	616.5	\$19.1	\$199.0
2025	12.2	118.1	69.6	671.2	\$20.3	\$219.3
2026	13.2	129.2	75.0	738.5	\$21.4	\$240.7
2027	13.9	144.9	79.3	824.3	\$22.4	\$263.2
2028	14.3	158.4	81.4	901.6	\$23.0	\$286.1
2029	14.1	173.5	80.5	985.6	\$22.2	\$308.4
2030	13.5	186.4	77.2	1,060.3	\$21.2	\$329.6
2031	12.7	198.7	73.0	1,131.4	\$19.0	\$348.6
2032	11.9	210.2	68.7	1,198.3	\$17.8	\$366.4
2033	11.2	222.1	64.9	1,265.9	\$16.7	\$383.1
2034	10.6	233.4	61.5	1,330.1	\$15.6	\$398.7
2035	10.1	244.0	58.9	1,390.7	\$14.2	\$412.8
2036	9.7	254.1	56.9	1,448.8	\$12.6	\$425.4
2037	9.5	263.8	55.4	1,505.1	\$11.3	\$436.8
2038	9.2	273.2	54.4	1,560.6	\$10.2	\$446.9
2039	8.9	282.3	52.9	1,614.4	\$9.9	\$456.9
2040	8.5	290.7	51.3	1,665.4	\$9.8	\$466.6



For the Base Scenario, Figure 20 presents the Industrial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 20. Industrial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Base Scenario

Industrial Sector Achievable Potential (Net-at-Generator) – Base Scenario						
Peak Demand Savings (MW)			Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
Year	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	4.4	4.4	25.3	25.3	\$6.2	\$6.2
2016	4.3	7.1	24.6	40.8	\$6.1	\$12.3
2017	4.2	11.1	24.4	67.2	\$6.0	\$18.2
2018	4.5	15.6	26.1	92.9	\$6.2	\$24.4
2019	4.3	19.9	25.4	118.0	\$5.9	\$30.3
2020	4.2	23.5	24.9	140.0	\$5.7	\$36.0
2021	4.2	27.4	24.6	162.5	\$5.5	\$41.6
2022	4.1	31.7	24.5	188.1	\$5.5	\$47.1
2023	4.1	35.7	24.5	212.1	\$5.5	\$52.6
2024	4.2	40.1	25.0	237.9	\$5.6	\$58.1
2025	4.4	43.7	26.0	261.2	\$5.8	\$63.9
2026	4.6	47.8	27.5	286.9	\$6.1	\$70.0
2027	5.0	53.5	29.3	319.0	\$6.5	\$76.5
2028	5.4	58.5	31.7	348.4	\$7.0	\$83.5
2029	5.8	64.7	34.1	383.8	\$7.1	\$90.7
2030	6.2	71.0	36.2	420.6	\$7.6	\$98.2
2031	6.4	77.3	37.4	457.4	\$7.4	\$105.7
2032	6.4	83.5	37.6	494.4	\$7.4	\$113.1
2033	6.2	89.6	37.1	531.0	\$7.3	\$120.4
2034	6.1	95.7	36.4	567.6	\$7.2	\$127.6
2035	5.9	101.7	35.6	603.7	\$7.0	\$134.6
2036	5.7	107.5	34.9	639.0	\$6.8	\$141.4
2037	5.6	113.2	34.2	673.6	\$6.6	\$148.0
2038	5.4	118.7	33.6	707.3	\$6.5	\$154.5
2039	5.3	124.1	33.0	740.4	\$6.3	\$160.8
2040	5.2	129.3	32.4	772.8	\$6.2	\$167.0



For the Low Scenario, Figure 21 presents the Industrial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 21. Industrial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Low Scenario

Industrial Sector Achievable Potential (Net-at-Generator) – Low Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	3.4	3.4	20.9	20.9	\$6.6	\$6.6
2016	3.3	5.5	19.9	31.7	\$6.3	\$12.9
2017	3.2	8.2	19.3	53.1	\$6.1	\$19.0
2018	3.5	11.7	21.2	74.3	\$6.6	\$25.6
2019	3.4	15.2	20.9	95.6	\$6.3	\$31.9
2020	3.4	18.4	20.8	113.2	\$6.2	\$38.2
2021	3.4	21.5	20.7	131.5	\$6.1	\$44.3
2022	3.4	24.7	20.6	153.1	\$6.1	\$50.4
2023	3.4	27.9	20.7	173.2	\$6.1	\$56.6
2024	3.4	31.3	21.2	195.1	\$6.2	\$62.8
2025	3.6	34.4	21.9	216.7	\$6.4	\$69.2
2026	3.8	37.6	23.1	237.7	\$6.8	\$76.0
2027	4.0	42.2	24.5	264.9	\$7.2	\$83.1
2028	4.3	46.2	26.4	289.2	\$7.7	\$90.9
2029	4.7	51.2	28.5	318.9	\$7.7	\$98.5
2030	5.1	56.8	30.8	351.8	\$8.3	\$106.8
2031	5.4	62.0	32.6	383.9	\$8.5	\$115.4
2032	5.5	67.4	33.6	416.9	\$8.8	\$124.2
2033	5.5	72.6	33.9	449.8	\$8.9	\$133.0
2034	5.5	78.1	33.8	483.4	\$8.8	\$141.8
2035	5.4	83.5	33.5	517.0	\$8.7	\$150.5
2036	5.3	88.9	33.1	550.4	\$8.5	\$159.0
2037	5.2	94.2	32.7	583.4	\$8.4	\$167.4
2038	5.1	99.4	32.3	616.1	\$8.3	\$175.6
2039	5.0	104.5	31.9	648.3	\$8.1	\$183.8
2040	5.0	109.5	31.5	679.9	\$8.0	\$191.8



For the Mid Scenario, Figure 22 presents the Industrial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 22. Industrial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – Mid Scenario

Industrial Sector Achievable Potential (Net-at-Generator) – Mid Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	5.6	5.6	31.7	31.7	\$7.3	\$7.3
2016	5.6	9.4	31.7	54.3	\$7.4	\$14.8
2017	5.7	15.1	32.3	88.7	\$7.5	\$22.3
2018	5.9	20.8	33.9	121.6	\$7.5	\$29.8
2019	5.6	26.1	32.6	153.2	\$7.1	\$36.9
2020	5.4	31.0	31.7	182.2	\$6.9	\$43.8
2021	5.3	36.0	31.1	211.5	\$6.5	\$50.4
2022	5.2	41.5	30.8	243.6	\$6.5	\$56.8
2023	5.2	46.6	30.9	274.2	\$6.5	\$63.3
2024	5.3	52.2	31.7	306.8	\$6.6	\$69.9
2025	5.6	56.2	33.1	332.5	\$6.9	\$76.8
2026	6.0	61.7	35.3	366.0	\$7.3	\$84.1
2027	6.5	68.8	37.9	406.5	\$7.9	\$92.0
2028	7.0	75.4	40.8	444.6	\$8.5	\$100.5
2029	7.4	83.1	43.1	489.1	\$8.6	\$109.1
2030	7.6	90.5	44.5	533.2	\$8.9	\$117.9
2031	7.6	98.0	44.7	577.2	\$8.3	\$126.2
2032	7.4	105.2	44.0	620.6	\$8.2	\$134.4
2033	7.2	112.4	42.9	663.5	\$7.9	\$142.3
2034	6.9	119.5	41.8	705.9	\$7.7	\$150.0
2035	6.7	126.3	40.7	747.2	\$7.5	\$157.5
2036	6.5	132.9	39.8	787.2	\$7.3	\$164.8
2037	6.3	139.3	38.9	826.2	\$7.1	\$172.0
2038	6.1	145.4	38.2	864.2	\$7.0	\$178.9
2039	6.1	151.5	37.6	901.7	\$6.5	\$185.4
2040	5.9	157.4	37.0	938.7	\$6.4	\$191.8



For the High Scenario, Figure 23 presents the Industrial Sector Incremental and Cumulative (Net-at-Generator) Achievable Potential in terms of Peak Demand Savings (MW) and Energy Savings (GWh) from energy efficiency programs, 2015 through 2040, along with Program Administrator Cost (\$ millions).

Figure 23. Industrial Sector Energy Efficiency Achievable Potential – 2015 to 2040 (Net-at-Generator) – High Scenario

Industrial Sector Achievable Potential (Net-at-Generator) – High Scenario						
Year	Peak Demand Savings (MW)		Energy Savings (GWh)		Program Administrator Costs (\$ millions)	
	Incremental	Cumulative	Incremental	Cumulative	Incremental	Cumulative
2015	5.8	5.8	32.9	32.9	\$8.5	\$8.5
2016	6.1	10.1	34.1	57.8	\$9.0	\$17.5
2017	6.4	16.4	35.7	95.6	\$9.3	\$26.9
2018	6.5	22.5	37.0	131.1	\$9.1	\$36.0
2019	6.1	28.1	35.3	164.4	\$8.6	\$44.6
2020	5.8	33.5	34.2	196.4	\$8.3	\$52.9
2021	5.7	39.1	33.7	228.6	\$7.8	\$60.7
2022	5.7	45.1	33.7	263.8	\$7.8	\$68.5
2023	5.8	50.9	34.2	297.8	\$7.9	\$76.5
2024	6.1	57.2	35.7	334.4	\$8.3	\$84.7
2025	6.5	62.0	38.0	364.6	\$8.8	\$93.5
2026	7.0	68.3	40.8	403.1	\$9.3	\$102.9
2027	7.4	76.2	43.1	448.4	\$9.9	\$112.7
2028	7.6	83.4	44.6	490.2	\$10.2	\$123.0
2029	7.6	91.3	44.8	536.4	\$10.0	\$132.9
2030	7.4	98.6	44.1	580.0	\$9.8	\$142.7
2031	7.2	105.7	42.9	622.6	\$8.8	\$151.5
2032	6.9	112.6	41.7	664.0	\$8.5	\$160.0
2033	6.7	119.4	40.5	705.2	\$8.3	\$168.3
2034	6.5	126.1	39.5	745.5	\$8.0	\$176.3
2035	6.3	132.5	38.7	784.5	\$7.8	\$184.1
2036	6.2	138.7	38.1	822.7	\$7.3	\$191.4
2037	6.1	144.8	37.6	860.2	\$7.1	\$198.5
2038	6.0	150.8	37.0	897.3	\$7.0	\$205.6
2039	5.8	156.7	36.2	933.8	\$6.9	\$212.5
2040	5.6	162.3	35.4	969.1	\$6.8	\$219.3



Appendix D. Glossary of Terms

Achievable Potential: the amount of energy use that efficiency through DSM programs can realistically be expected to displace assuming the most aggressive program scenario possible (such as providing end-users with payments for the entire incremental cost of more efficient equipment). This is often referred to as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.

Cost-effectiveness: a measure of the applicable economic effects resulting from the implementation of an energy efficiency measure. If the benefits outweigh the cost, the measure is said to be cost-effective.

Cumulative Annual: refers to the overall savings occurring in a given year from both new participants and savings continuing to result from past participation with measures that are still in place. Cumulative annual does not always equal the sum of all prior year incremental values as some measures have relatively short measure lives and, as a result, their savings drop off over time.

Dual Baseline: A dual baseline approach uses a less efficient baseline in the first part of its measure life based on the remaining useful life (RUL), resulting in higher energy savings initially, with savings becoming lower at a point later in the measure life when the measure effective useful life (EUL) would have resulted in the measure reaching the end of its useful life. At the end of what would have been the end of the measure's EUL, Measure costs also are adjusted.

Early Replacement: refers to an energy efficiency measure normally regarded as ROB is installed before the effective life of the measure it is replacing is reached.

Economic Potential: the subset of the technical potential screen that is economically cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential screens are theoretical numbers that assume immediate implementation of efficiency measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation of efficiency. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (such as marketing, analysis, administration) that would be necessary to capture them.

Effective Useful Life (EUL): the number of years (or hours) that the new energy efficient equipment is expected to function based on the assumed or average general life of the measure. Useful life is also commonly referred to as "measure life."

Emerging Technology: An energy efficiency measure just entering or about to enter the marketplace.

End-use: a category of equipment or service that consumes energy (e.g., lighting, refrigeration, heating, process heat).

Energy Efficiency: using less energy to provide the same or an improved level of service to the energy consumer in an economically efficient way. Sometimes "conservation" is used as a synonym, but that



term is usually taken to mean using less of a resource even if this results in a lower service level (e.g., setting a thermostat lower or reducing lighting levels). This distinction recognizes that energy efficiency includes using less energy at any time, including at times of peak demand through demand response and peak shaving efforts.

Free Rider: participants in an energy efficiency program who would have adopted an energy efficiency technology or improvement in the absence of a program or financial incentive.

Incremental: savings or costs in a given year associated only with new installations happening in that year.

Market Characterization: refers to evaluations focused on program-induced market effects when the program being evaluated has a goal of making longer-term lasting changes in the way a market operates. These evaluations examine changes within a market that are caused, at least in part, by the energy efficiency programs attempting to change that market.

Measure: any action taken to increase efficiency, whether through changes in equipment, control strategies, or behaviour. Examples are higher-efficiency central air conditioners, occupancy sensor control of lighting, and retro-commissioning. In some cases, bundles of technologies or practices may be modeled as single measures. For example, an ENERGY STAR® home package may be treated as a single measure.

Megawatt (MW): a unit of electrical output, equal to one million watts or one thousand kilowatts. It is typically used to refer to the output of a power plant.

Megawatt-hour (MWh): one thousand kilowatt-hours, or one million watt-hours. One MWh is equal to the use of 1,000,000 watts of power in one hour.

New Construction: A measure or package of measures is installed at the time of construction.

Net-to-gross (NTG) Ratio: a factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts

Portfolio: either a collection of similar programs addressing the same market, technology, or mechanisms; or the set of all programs conducted by one organization.

Program: a mechanism for encouraging energy efficiency. May be funded by a variety of sources and pursued by a wide range of approaches. Typically includes multiple measures.

Program Potential: the efficiency potential possible given specific program funding levels and designs. Often, program potential studies are referred to as “achievable” in contrast to “maximum achievable.”

Replacement on Burnout (ROB): a measure is not implemented until the existing technology it is replacing fails. An example would be an energy efficient water heater being purchased after the failure of the existing water heater.



Remaining Useful Life (RUL): The length of time a measure is expected to remain in operation (the length of time until its effective useful life is at an end).

Retrofit: refers to an efficiency measure or efficiency program that seeks to encourage the replacement of functional equipment before the end of its operating life with higher-efficiency units (also called “early retirement”) or the installation of additional controls, equipment, or materials in existing facilities for purposes of reducing energy consumption (e.g., increased insulation, low flow devices, lighting occupancy controls, economizer ventilation systems).

Technical Potential: the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the efficiency measures. It is often estimated as a “snapshot” in time assuming immediate implementation of all technologically feasible energy saving measures, with additional efficiency opportunities assumed as they arise from activities such as new construction.



Appendix E. EERAM Economic Tests

Measure, program, end-use, building type, and overall portfolio level costs and benefits are calculated in EERAM. Some of these costs and benefits are calculated as net and others as gross. Net values take into account free riders by using net-to-gross adjustment values. The costs and benefits calculated include:

- Administrative costs (always gross)
- Avoided cost benefits (always net)
- Incentive costs (always gross)
- Incremental technology costs (gross or net)
- Utility bill reductions (gross or net)

Within the “Financial Tests” worksheet, these streams of costs and benefits are converted to a net present value using the discount rate input in the “Summary Parameters” worksheet. Using this data, four financial tests are calculated. These include:

Total Resource Cost (TRC)^{21,22,23}: The TRC test measures the net resource benefits from the perspective of all ratepayers by combining the net benefits of the program to participants and non-participants. The benefits are meant to be the sum of the avoided costs of the supply-side resources avoided or deferred, and other benefits that accrue to participants or the utility.²⁴ The TRC costs encompass the cost of the measures/equipment installed, and the costs incurred by the program administrator. The formulation:

TRC = Benefits / Costs where:

- Benefits = avoided costs + other utility benefits + other participant benefits
- Costs = administrative costs + net incremental technology costs

Program Administrator Cost Test (PAC)²¹: Sometimes referred to as the utility cost test, this test compares the utility’s avoided cost benefits with energy efficiency program expenditures (incentives plus administrative costs). The formulation:

PAC = Benefits / Costs where:

- Benefits = avoided costs + other utility benefits
- Costs = administrative costs + incentives

²¹ California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects. October 2001. http://www.energy.ca.gov/greenbuilding/documents/background/07-J_CPUC_STANDARD_PRACTICE_MANUAL.PDF

²² CPUC D0606063, Attachment 9. <http://www.cpuc.ca.gov/NR/rdonlyres/101F0713-7277-43A8-883D-8EF2712EFA8A/0/NumericalExamplesNTGAdjtoTRCD0709043.pdf>

²³ CPUC http://docs.cpuc.ca.gov/published/final_decision/73172-10.htm

²⁴ For purposes of this study, only avoided generation investments and fuel purchases were included in the benefits.



Ratepayer Impact Test (RIM)²¹: This test measures what happens to customer bills or rates due to changes in utility revenue and operating costs caused by the program. The formulation:

RIM = Benefits / Costs where:

- Benefits = avoided costs
- Costs = administrative costs + incentives + net bill reductions

Participant Cost Test (PCT)²¹: This test measures the quantifiable benefits and costs to the customer due to participation in the program. The formulation:

PCT = Benefits / Costs where:

- Benefits = incentives + gross bill reductions
- Costs = gross incremental technology costs

In the 2012 model for the PCT, instead of gross benefits and costs, net benefits and costs were used.

Overall, the effect and resulting calculations are the same between the two (gross or net) approaches to valuing benefits and costs in the PCT

Figure 24 presents the formula for each of the four benefit/cost tests.

Figure 24. Benefit/Cost Test Formulas

Cost Test	Formula	Key of Terms	
Program Administrator Cost Test (PAC)	$PAC = (A + B) / (D + E)$	A = PV Avoided Costs (always net)	E = PV Incentive Costs (always gross)
Participant Cost Test (PCT)	$PCT = (E + \text{gross } G) / \text{gross } F$	B = PV Other Utility Benefits (always net)	F = PV Technology Costs (gross or net)
Rate Impact Measure Cost Test (RIM)	$RIM = A / (D + E + \text{net } G)$	C = PV Other Participant Benefits (always net)	G = PV Bill Reductions (gross or net)
Total Resource Cost Test (TRC)	$TRC = (A + B + C) / (E + \text{net } F)$	D = PV Administrative Costs (always gross)	PV = Present Value



Appendix F. 2012 Baseline Study

Nova Scotia 2012 Baseline Study:
Residential Sector &
Business, Nonprofit and Institutional Sector

Presented to



November 20th, 2013

Presented by
Todd Williams, Managing Director
333 Bay Street, Suite 1250
Toronto, ON M5H 2R2
647.288.5204, TWilliams@Navigant.com

Stu Slote, Associate Director (Project Manager)
802.526.5113, Stu.Slote@Navigant.com

Nick Beaman, Managing Consultant (Baseline Study Lead)
802.526.5107, Nick.Beaman@Navigant.com

Navigant
www.navigant.com



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Executive Summary

E.1 Study Objectives

The primary objectives of this study were to:

1. Develop data by sector and end use that is specific to the Province of Nova Scotia.
2. Develop data to inform the Nova Scotia energy efficiency potential study.

E.2 Study Methods

Market Assessment Approach

The industry practice in developing market characterizations for demand-side management (DSM) assessments and baseline forecasts has been to use, where needed, data from secondary sources such as Statistics Canada. These data are often used as starting points, with other available data that is more specific to the jurisdiction being examined used to update these starting point data.

In this assignment, the focus is on the Province of Nova Scotia. Navigant made full use of Efficiency Nova Scotia Corporation (ENSC) and Nova Scotia Power, Inc. (NSPI) data, including consumption data by sector and rate class, as well as any demand forecasting and demand-side management (DSM) evaluation work by ENSC. To the fullest extent practicable, available Nova Scotia data was used to inform the assessment, including the 2009 Nova Scotia Residential Baseline Study and the 2011 Nova Scotia Residential Socket Study.

Baseline Data Sources

Figure 25 provides a summary of all the data sources used throughout this report. When possible, studies which included higher statistical confidence and precision were used.

Residential Sector Baseline

The primary source of data used in determining the residential baseline was a 2012 online general population panel survey conducted by Corporate Research Associates (CRA), Inc. on behalf of Navigant, referred to as the Energy Usage Study. On-site data collection was used to supplement the online study, as well as other data sources, when needed. Additional data used to calculate baselines and measure densities were obtained from a recent ENSC study (the 2011 Socket Study) and from NRCan and Statistics Canada data sets (the Comprehensive Energy Use Database, the 2007 Survey of Household Energy Use, the 2006 Census and the 2011 Census).

Business, Nonprofit and Institutional (BNI) Sector Baseline

The primary source of data used in determining the BNI baseline was a 2012 telephone business survey conducted by Corporate Research Associates (CRA), Inc. on behalf of Navigant. On-site data collection was used to supplement the survey, as well as other data sources, when needed.



Sample Design and Segmentation

For the Residential sector, the primary data source consisted of an online survey conducted by CRA on behalf of Navigant (n=1,501). The online data were supplemented with on-site surveys with a sample size of 31 residents. For the BNI sector, the primary data collection approach consisted of on-site surveys with a sample size of 30. Due to the small sample size, results from the on-site surveys are used in a qualitative manner. Where possible, Navigant has provided supplementary data.

Figure 25. Residential Summary of Data Sources

Source Label	Source	Sample Size
A	Corporate Research Associates, Inc. on behalf of Efficiency Nova Scotia, 2011 Socket Study. (2011).	n= 1004
B	Corporate Research Associates, Inc. on behalf of Navigant, 2012 Residential Energy Usage Online Panel Study. (2012).	n=1,501
C	Corporate Research Associates, Inc. on behalf of Navigant, Commercial & Industrial Business Baseline End-User Telephone Study. (2012).	n=96
D	ENERGY STAR website. (2013, April). From http://www.energystar.gov/?c=home_sealing.hm_improvement_insulation_table	N/A
E	Health Canada website. (2013, April). From http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/diseases-maladies/legionnaire-eng.php#a5	N/A
F	Natural Resources Canada (NRCan), Office of Energy Efficiency Commercial and Institutional Building Energy Use Survey 2000. (2002, December). From http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/cibeus_description.cfm	n=20,332
G	Natural Resources Canada (NRCan), Office of Energy Efficiency 2007 Survey of Household Energy Use (SHEU-2007). (2007). From http://oee.nrcan.gc.ca/publications/statistics/sheu-summary07/sheu.cfm	n=9,773
H	Natural Resources Canada (NRCan), Office of Energy Efficiency 2008 Commercial and Institutional Consumption of Energy Survey. (2008). From http://oee.nrcan.gc.ca/publications/statistics/cices08/index.cfm	n=3,342
I	Natural Resources Canada (NRCan), Survey of Commercial and Institutional Energy Use – Building 2009 (2012, December) From http://oee.nrcan.gc.ca/publications/statistics/scieu09/scieu_e.pdf	n=5,704
J	Natural Resources Canada (NRCan), Comprehensive Energy Use Database, 1990 to 2010. (2012). From http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/list.cfm	N/A
K	Statistics Canada, 2006 Census of Population: Statistics Canada Catalogue no 97-554-XCB2006022. (2006). From https://www12.statcan.gc.ca/census-recensement/2006/dp-pd/index-eng.cfm	N/A
L	Statistics Canada, 2011 Census of Population: Statistics Canada Catalogue no.98-313-XCB2011022. (2011). From http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/index-eng.cfm	N/A
M	Residential On-Site Survey	n=31
N	BNI On-Site Survey	n=30
O	Navigant Consulting, on behalf of Nova Scotia Power Incorporated, 2009 Nova Scotia Residential Baseline Study. (2010).	n=68



E.3 Key Residential Findings

Basic Home Characteristics

This section summarizes the basic home characteristics of residential dwellings in Nova Scotia. Figure 26 summarizes the findings for basic home characteristics.

Figure 26. Residential Dwelling Type Profile

Measure/Characteristic	Market Characterization	Source
Dwelling Type	75% of all dwellings are single-family (detached and attached) homes.	B
Dwelling Age	The majority (58%) of all dwellings in Nova Scotia were built after 1971, and the majority of single-family homes (58%) were also built after this date.	K
Dwelling Size	The average dwelling floor space for all dwelling types is 1,550 square feet and 1,765 square feet for single-family homes.	J
	Nearly three-quarters of all dwellings are between 1,000 and 3,500 square feet.	B
Dwelling Height (Number of Stories)	55% of all dwellings are at least two stories tall, 29% are single-story, and 10% are split-entry.	B



Building Shell

This section provides a summary of the residential building shell measures present at the 31 surveyed homes. Figure 27 summarizes the key findings of building shell measures.

Figure 27. Residential Building Shell Profile

Measure/Characteristic	Key Findings	Source
Wall Construction Types	For homes older than 20 years, 66% have 2x4 construction and 31% have 2x6 construction. For newer homes, 84% reported 2x6 construction, 11% have adiabatic or shared walls, and the remaining 5% are concrete block walls.	M
Above Grade Wall Insulation	10% of homes are both older than 20 years old and have loose-fill wall insulation. Over time, this type of insulation can gravitate to the bottom of wall cavities and become very ineffective. < 2% of homes have no wall insulation at all.	M
Above Grade Wall Insulation R-Value	Over 73% of residential homes reported having batt insulation, but R-Value varied depending on wall construction type. 2x4 construction had an average insulation R-Value of 13.2. 2x6 construction had an average insulation R-Value of 16.5. (These averages did not vary by home vintage.)	M
Ceiling Insulation Depth	16% of residential homes have less than 5" of ceiling insulation. 6% of these homes have no ceiling insulation at all.	M
Ceiling Insulation R-Value	Average insulation R-Value for homes older than 20 years is 19.3. Homes newer than 20 years have average insulation R-Value of 27.4.	M
Increasing Ceiling Insulation	Based on survey findings, there seem to be significant savings available in increasing the ceiling insulation levels of homes older than 20 years.	M
Roof Construction and Colour	98% of homes have asphalt shingle roofs. Over 85% of roofs are dark coloured, while 11% are light coloured.	M
Single-Pane Windows	The majority of windows are single pane in 5% of homes in Atlantic Canada.	G
Low-E Tinted Windows	The majority of windows are Low-E in 11% of homes in Atlantic Canada.	G



Residential Lighting

A summary of the distribution of all lighting types for both interior and exterior lamps is shown in Figure 28. There was an average of 51 lamps installed per household surveyed with a variety of different lamp types ranging from incandescent, CFL, linear fluorescent, and LED, among others.

Figure 28. Residential Lighting Characterization Profile

Measure/Characteristic	Distribution	Source
Incandescent	Incandescent lighting represents 51% of all indoor lamps installed.	A
Halogen	Halogen lamps represent 10% of the total lamps installed and 16% of the total wattage installed.	M
CFL	CFLs represent 43% of all lamps installed and 19% of the total installed wattage.	A
Fluorescent Lighting	43% of homes in Atlantic Canada use fluorescent tubes. Of this 43%, the majority (71%) have 5 or fewer such fixtures installed in their homes.	G
LED	LED lamps represent 4% of the total installed lamps and less than 1% of the total installed wattage.	A
Other / Don't Know	Other lamps, including unidentifiable lamp types, represent less than 0.5% of the total lamps installed and less than 0.25% of the total wattage.	M



Residential HVAC

This section summarizes the details of the residential space heating systems. Figure 29 summarizes the key findings for residential heating equipment

Figure 29. Residential Heating Equipment Profile

Measure/Characteristic	Key Findings	Source
Electric Heating - Primary	31% of all primary heating systems are electric.	B
Electric Heating - Backup	59% of households have a secondary heating system installed. Of these, 32% are electric baseboard or room units.	G
Fuel Oil Heating	46% of primary heating systems are fuel oil.	B
Programmable Thermostats	27% of all primary systems currently have a programmable thermostat.	B
Primary Heating System Maintenance	Just over 40% of all primary heating systems have been maintained within the last year. 32% have never been serviced.	M

A summary of air-conditioning systems is shown in Figure 30.

Figure 30. Residential Cooling Equipment Profile

Measure/Characteristic	Key Findings	Source
Electric Fans	42% of residential homes have electric fans as their primary cooling system.	B
Room Air Conditioning (RAC)	18% of residential homes report owning air conditioning units	B
Electric Heat Pump	5% of residential homes had electric heat pumps as their primary cooling system.	B
Central Air Conditioning	3% of residential homes have central air conditioning as their primary cooling system.	B



Residential Plug Loads

Figure 31 presents details on the plug load electrical technologies. Included are televisions, entertainment boxes [DVD, digital video recorder (DVR), video games], and computers and computer peripherals.

Figure 31. Residential Plug Load Profile

Measure/Characteristic	Key Findings	Source
ENERGY STAR® Televisions	47% of televisions are ENERGY STAR® rated.	G
Television Hours of Use	Televisions had an average daily reported use of 3.4 hours.	M
Televisions on Energy Management Systems (EMS)	29% of all televisions are plugged into a power strip that can be manually turned off at night.	M
Entertainment Boxes	There are 2.76 entertainment boxes per residential household. These are defined as DVD players, Digital Video Recorders (DVRs), and video game systems.	B
Digital Video Recorders (DVRs)	There are 0.63 DVRs per residential household, and 51% of homes have at least one DVR.	B
Entertainment Box Hours of Daily Use	DVRs and video game systems have an average daily use of over 8 hours.	B
Entertainment Boxes on Energy Management Systems (EMS)	22% of all entertainment boxes are plugged into a power strip that can be manually turned off at night.	M
Smart Power Strips for Plug Loads	Navigant found no smart power strips monitoring vampire ²⁵ energy loads of residential plug load equipment. This looks to be an area of opportunity for ENSC.	M

²⁵ Various appliances and electronic devices that are ready to operate or in standby mode act like “vampires” silently using energy even when they are turned “off.” This energy, known as standby or phantom energy loss, represents a relatively small percentage of a home’s electricity use.



Residential Water Heating

Figure 32 presents details on the water heating equipment present in the surveyed homes.

Figure 32. Residential Water Heating Profile

Measure / Characteristics	Key Findings	Source
Electric Water Heating	61% of surveyed primary water heaters were electric resistance.	B
	The average capacity for electric resistance water heaters was 38 gallons. 88% of electric resistance water heaters were located in conditioned spaces, the majority of which (64%) were set at a medium temperature setting.	M
Non-Electric Water Heating	39% of water heaters surveyed had fuel types other than electric resistance (ER). The most common of these were fuel oil, which constituted 35% of all water heaters.	B
	The average capacity was 38 gallons, and about 53% of the non-electric water heaters were located in conditioned spaces. 58% of these water heaters were set at a medium temperature setting.	M
Secondary Water Heaters	Of the 1500 households surveyed online, 76 contained a secondary water heater. The water heaters were electric resistance, oil, solar, propane, and other.	B
Water Heater Capacity	The average capacity of water heating systems is 38 gallons. The minimum capacity of surveyed systems was 15 gallons, while the maximum capacity was 60 gallons.	M
Water Heater Location	72% of all residential water heaters are located in conditioned space.	M
Auxiliary Measures	Tank and pipe wrap were the only auxiliary measures installed on surveyed water heaters. These measures are present on 28% and 26% of water heaters ²⁶ , respectively ²⁷ .	B
Tank Temperature	Nearly 62% of all residential water heaters are set at a medium (125°F) setpoint. Another 18% are set at a high (150°F) setpoint, while another 14% are set at a low (90°F) setpoint. Temperature setpoints are unknown for 7% of water heaters, all of which are fuel oil.	M

Residential Appliances

This section presents findings for residential appliances. Figure 33 summarizes the findings for all residential appliances.

²⁶ According to the 2012 Energy Use survey, 28% of respondents (regardless of fuel type) had tank wrap on their water heater, 26% had pipe wrap, and 3% used water heater timers.

²⁷ It should be noted that the majority of new water heaters installed typically have insulation integral to the tank.

**Figure 33. Residential Appliances Profile**

Measure / Characteristic	Key Findings	Source
Residential Range Cooktops	95% of all Residential ranges are electric	B
	8% of residential ranges are ENERGY STAR® rated.	M
Residential Ovens	All homes have an oven; 96% are electric.	B
	Of the electric ovens, 7% are convection and the rest are standard.	M
	The average age of ovens is 10 years old.	
Residential Dishwashers	64% of residential dwellings contain a dishwasher.	B
	20% of dishwashers are ENERGY STAR® rated.	M
	18% of dishwasher owners said they used the Energy Saver option all of the time, while another 16% said they only use it some of the time. 66% use the Heat Booster option all of the time.	
	The average age of dishwashers is nearly 10 years old.	
Residential Clothes Washers	98% of households own a clothes washer, and 31% are front loading.	B
	The majority (65%) of households in Atlantic Canada complete between two to three (28%) and four to seven (37%) loads of laundry per week in both summer and winter.	G
Residential Clothes Dryers	96% of homes own a clothes dryer	B
	The majority (62%) of households dry between two and three (26%) and four and seven (36%) loads of laundry during winter weeks.	G
	The majority (62%) of households dries between one or less (38%) and two and three (24%) loads of laundry during summer weeks.	



E.4 Key Business, Nonprofit and Institutional (BNI) Findings

It should be noted that certain results below were derived from a sample size of 30 on-site visits and should be used in a qualitative manner. Where possible, Navigant has used results from additional primary sources.

BNI Sector – General Building Information

Surveyors collected information regarding general building characteristics such as age, size, operating schedules, and more. The following sections present the results for key BNI building characteristics. A summary of general building information is listed in Figure 34.

Figure 34. BNI General Buildings Profile

Characteristic	Key Findings	Source
Facility Age	85% of BNI facilities were built post-1970 (weighted by floor space).	I
	The average year of construction was between 1970 and 1999 (weighted by floor space).	I
Building Size	41% of all BNI facilities are 5,000 sq. ft. or less. 14% of facilities were between 5,001 and 10,000 sq. ft. 18% of facilities were between 10,000 and 25,000 sq. ft. 8% of facilities were between 25,001 and more.	C
Business Hours	4% of facilities have weekly hours of 36 hours or less, 22% have hours between 37 and 48, 17% have weekly hours between 49 and 72 hours, 14% have hours between 73 and 96, 8% have hours between 97 and 120, and 34% have hours between 121 and 168, weighted by number of facilities.	I

Building Envelope

This section provides details of the commercial building shell measures present at the on-site surveyed commercial buildings envelope types. Figure 35 summarizes the key findings of building shell measures.

**Figure 35. BNI Building Shell Profile**

Measure/Characteristic	Key Findings	Source
Wall Construction Types	Considering all commercial exterior wall area, 20% has concrete block construction, 15% has 2x6 wood frame construction, 14% has 2x6 metal frame construction, and 14% has adiabatic or shared walls.	N
Exterior Wall Insulation Types	43% of all commercial wall area has batt or blanket insulation. 27% of all commercial wall area does not have any insulation.	N
Roof Construction Type	46% of commercial roof area is framed (28% with an attic, 18% without an attic). 31% of commercial roof area is constructed with metal decking.	N
Roof Surface	33% of commercial roof area has a metal surface. 16% of commercial roofs have an asphalt roll/shingle surface.	N
Roof Finish	51% of commercial roof area has a flat finish. 24% of commercial roof area has a reflective finish.	N
Roof Colour	Only 12% of commercial roof area is dark.	N
Floor Types	More than half of commercial floor area is slab-on-grade.	N
Window Panes	99.6% of commercial window area has two panes.	N
Window Glazing Types	Grocery/supermarket and health care/hospital facilities only contain clear window glazing, and most non-food retail centers only have clear window glazing. The majority of industrial facilities and restaurants have tinted window glazing. The majority of 'other commercial' facilities contain reflective window glazing.	N
Window Glazing Features	The majority of commercial windows do not have any glazing features, with the exception of health care/hospital facilities and restaurants which each have about 90% low-E and gas-filled windows.	N
Window Frame Types	Commercial window frames are metal, with the main exception being vinyl windows in health care/hospital facilities.	N
Window Film	99.8% of commercial window area does not have any added window film.	N



Lighting

Sixty-one percent of all lighting types by installed wattage were indoor, while 39 percent were outdoor.

Indoor Lighting

Figure 36 lists key findings for the BNI indoor lighting profile in Nova Scotia. Findings include high level results regarding fixture types, wattages, and control types.

Figure 36. BNI Indoor Lighting Profile

Measure/Characteristic	Key Findings	Source
Fixture Types	Fluorescent lights, including both standard and high performance models, make up 94% of installed lamps and 89% of installed wattage. The second most common lamp type is CFLs, which make up 3% of installed lamps and 1% of installed wattage.	N
Wattage	The average wattage of indoor lamps is 36 Watts. The highest average wattage was in industrial facilities, with an average of 42 Watts per lamp, followed by 'Other Commercial' sites at an average of 40 Watts per lamp.	N
Control Type	Only 6% of indoor BNI lighting has controls beyond a standard manual switch. 58% of lighting is controlled by an on/off switch, while another 32% is continuous lighting with no controls.	N



Outdoor Lighting

Figure 37 lists key findings for the BNI outdoor lighting profile in Nova Scotia. Findings include high level results regarding fixture types, wattages, and control types.

Figure 37. BNI Outdoor Lighting Profile

Measure/Characteristic	Key Findings	Source
Fixture Types	One-quarter of all outdoor fixtures are High Pressure Sodium Vapor. CFLs and Metal Halides each constituted 17% of the rest of the outdoor lighting fixture types. Neon lights made up another 14% of the distribution. The rest of the lighting types made up less than 10% each.	N
Wattage	Neon lamps are the dominant lamp type by wattage, making up over 85% of the distribution. The average wattage for all outdoor lamp types is 138 watts. Wattages range from 10-100 Watts, depending on the lamp.	N
Control Type	82% of sites have motion sensors, photocells, or time clocks as outdoor lighting controls. Of these control types, 86% are time clocks.	N



HVAC and Water Heating

Figure 38 summarizes the key findings of the BNI HVAC survey.

Figure 38. BNI HVAC Profile

	Measure / Characteristic	Key Findings	Source
HVAC	Single-Zone HVAC System Age	The on-site surveyors identified 477 single-zone HVAC systems. Two-thirds (66%) of single-zone HVAC systems are baseboard/radiant systems, followed by unit ventilators or heaters (13%).	N
	Primary Heating Fuel Type	Nearly two-thirds (65%) of all single-zone HVAC systems used electricity as a fuel type. Fuel oil and liquid propane gas (LPG) represent 3% each (6% total) of fuel types for single-zone HVAC systems.	N
	Heating System Type	More than half (53%) of all facilities sampled had baseboard heaters. Boilers and electric resistance heaters were in 19% and 10%, respectively, of facilities sampled. Air source heat pumps, furnaces, and radiant heaters comprise the remaining heating systems and were in 8% of surveyed facilities.	N
	Boiler Delivery Systems	The majority (79%) of boilers were hot water boilers. 21% of boilers were a steam delivery system. The mean boiler age was 12.6 years.	N
	Hot Water Circulation Pump Speed Controls	28% of all pumps were 0.15 horsepower (hp). Pumps that were 0.2, 0.25, 0.75, and 3 hp in size represented 20%, 8%, 8%, and 4% of all pumps, respectively.	N
	Cooling System Types	According to the Commercial and Institutional Building Energy Use Survey (CIBEUS) 2000 reported that in Atlantic Canada as a whole, 60% of C&I buildings had mechanical cooling of some kind.	F
		Of the systems that did have a cooling component, 95% were direct expansion while 5% were chillers. The mean size of all cooling units was 2.9 tons with a mean efficiency of 9.8 EER and 13 SEER.	N
Water Heating	Water Heating Equipment Types	88% of all water heaters were standard water heaters (i.e., tank water heaters). 8% of water heaters were instantaneous, or tankless, water heaters, while 5% were boilers. The average age of all water heaters was 6.6 years. The average size water heater was 4.1 kW and 96.5 kBtuh.	N
	Water Heating Fuel Types	The majority of water heaters were fueled by electricity. Five percent of units were fueled by liquid propane gas (LPG), while fuel oil and natural gas represented 2.5% each (5% total) of fuel types for water heaters.	N



Measure / Characteristic	Key Findings	Source
Water Heating Pipe and Tank Insulation	85% of pipes leading into the water heater were not insulated, while 12.5% were insulated. Similarly, 82.5% of tanks were not externally insulated (e.g., blanket wrap), while 12.5% were externally insulated ²⁸ .	N
Water Heating Recirculation Pump	85% of water heaters did not have recirculation pumps installed, while 10% did have recirculation pumps installed. 5% of water heaters were noted as unknown, or "Don't Know", if a recirculation pump was installed.	N

Refrigeration

Figure 39 lists key findings for the BNI refrigeration profile in Nova Scotia.

Figure 39. BNI Refrigeration Profile

Measure/Characteristic	Key Findings	Source
Compressors	Compressors were in industrial facilities, restaurants, and 'other commercial' facilities. However, insufficient data exists to properly characterize the market in terms of compressors. ²⁹	N
Walk-in space lighting	Nearly 63% of space lighting in BNI walk-ins is fluorescent, while another 25% is incandescent. The rest are unknown. ³⁰	N
Walk-in lighting controls	88% of lighting in BNI walk-ins is controlled via a wall switch. The rest of the control types are unknown.	N
Walk-in motor types	A quarter of the motors in BNI walk-ins are shaded pole, while the rest are unknown. 14% of motors have evaporative fan controls.	N

²⁸ It should be noted that the vast majority of new water heaters installed typically have insulation integral to the tank.

²⁹ Regardless of the types and capacities of refrigeration compressor in Nova Scotia, significant opportunity exists to implement compressor system controls, such as free cooling refrigeration economizers, and floating head pressure control with liquid pressure amplification (LPA). Refrigeration economizer controls turn off the compressor and evaporator when the outdoor air temperature is at or below the cooler or freezer dry bulb temperature setpoint, making use of cold outdoor air to meet setpoints with lower power circulation fans to ensure proper air mixing. Floating head pressure controls on larger refrigeration racks in grocery stores can likewise be an additional source of annual energy savings.

³⁰ There is significant opportunity for LED lighting savings in refrigerated spaces.



Motors and Compressed Air

Figure 40 provides a summary characterization of motor and compressed air measures for the BNI segments.

Figure 40. BNI Motors and Compressed Air Profile

Measure/Characteristic	Key Findings	Source
Process motor types	The majority (62%) of motors are pump motors and material handling/conveying motors.	N
Motor controls and efficiency	All identified motors are standard efficiency and constant speed. ³¹	N
Air compressor types	The majority (82%) of air compressors are reciprocating two-stage, single acting (RTS) units.	N
Air compressor hours of use	RTS type air compressors are using 73 hp about 49 hours a week. ³²	N
Air dryer on compressed air systems	The majority (90%) of air compressors do not have an air dryer.	N

³¹ It should be noted that, although no high efficient motors or variable-speed drives were observed in the facilities surveyed, it would be expected that a portion of all motors and motor control types would be considered efficient.

³² Compressed air is expensive. End uses can often be served at lower cost using electrically-powered solutions, rather than compressed air. Additionally, separating end uses to allow each compressed air system to operate at its lowest possible air pressure setpoint is another way to reduce costs associated with compressed air use. Navigant recommends investigation of electrically-powered alternatives to compressed air use, and recommends lowering air pressure setpoints for existing systems to the extent possible.



3. Introduction

ENSC has indicated that NSPI may be updating its Integrated Resource Plan (IRP) prior to 2014. Navigant understands that ENSC requires estimates of DSM potential energy and winter peak demand savings for a 26-year period (2015 through 2040) to inform the development of this IRP.

Navigant developed a 26-year DSM potential analysis to inform the IRP process. To inform and support the potential analysis, and to ensure that the assumptions for the current baseline of energy efficiency in Nova Scotia are current, Navigant conducted a market assessment of the current baseline of energy efficiency equipment and building characterization. Navigant also reviewed, and as appropriate, updated measure-level details that will be included in the potential analysis.

3.1 *Purpose of the Study*

The purpose of conducting this study for ENSC includes:

- To develop **Nova Scotia baseline information**, with saturations of DSM measures in Nova Scotia for residential and business, nonprofit and institutional buildings. This information will ensure that the starting point for the DSM potential estimation process is accurate and current.

3.2 *Organization of the Report*

The remainder of the report includes the following sections:

Section 2 – Residential Baseline Study Methodology

Section 3 – Business, Nonprofit and Institutional Baseline Study Methodology

Section 4 – Residential Market Characterization

Section 5 – Business, Nonprofit and Institutional Market Characterization

Appendix A – References

Appendix A – On-site Data Collection Tools

3.3 *Data Sources*

Figure 41 provides a summary of all the data sources used throughout this report. The primary source of data used in determining the baseline was the 2012 study conducted by Corporate Research Associates (CRA), Inc. on behalf of Navigant, referred to as the Energy Usage Study. On-site data collection was used to supplement the aforementioned study, as well as other data sources, when needed.

Additional data used to calculate baselines and measure densities were obtained from a recent ENSC study (the 2011 Socket Study) and from NRCan and Statistics Canada data sets (the Comprehensive Energy Use Database, the 2007 Survey of Household Energy Use, the 2006 Census and the 2011 Census).

**Figure 41. BNI Summary of Data Sources**

Source Label	Source	Sample Size
A	Corporate Research Associates, Inc. on behalf of Efficiency Nova Scotia, 2011 Socket Study. (2011).	n= 1004
B	Corporate Research Associates, Inc. on behalf of Efficiency Nova Scotia, 2012 Residential Energy Usage Online Panel Study. (2012).	n=1,501
C	Corporate Research Associates, Inc. on behalf of Efficiency Nova Scotia, Commercial & Industrial Business Baseline End-User Telephone Study. (2012).	n=96
D	ENERGY STAR website. (2013, April). From http://www.energystar.gov/?c=home_sealing.hm_improvement_insulation_table	N/A
E	Health Canada website. (2013, April). From http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/diseases-maladies/legionnaire-eng.php#a5	N/A
F	Natural Resources Canada (NRCan), Office of Energy Efficiency Commercial and Institutional Building Energy Use Survey 2000. (2002, December). From http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/cibeus_description.cfm	n=20,332
G	Natural Resources Canada (NRCan), Office of Energy Efficiency 2007 Survey of Household Energy Use (SHEU-2007). (2007). From http://oee.nrcan.gc.ca/publications/statistics/sheu-summary07/sheu.cfm	n=9,773
H	Natural Resources Canada (NRCan), Office of Energy Efficiency 2008 Commercial and Institutional Consumption of Energy Survey. (2008). From http://oee.nrcan.gc.ca/publications/statistics/cices08/index.cfm	n=3,342
I	Natural Resources Canada (NRCan), Survey of Commercial and Institutional Energy Use – Building 2009 (2012, December) From http://oee.nrcan.gc.ca/publications/statistics/scieu09/scieu_e.pdf	n=5,704
J	Natural Resources Canada (NRCan), Comprehensive Energy Use Database, 1990 to 2010. (2012). From http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/list.cfm	N/A
K	Statistics Canada, 2006 Census of Population: Statistics Canada Catalogue no 97-554-XCB2006022. (2006). From https://www12.statcan.gc.ca/census-recensement/2006/dp-pd/index-eng.cfm	N/A
L	Statistics Canada, 2011 Census of Population: Statistics Canada Catalogue no.98-313-XCB2011022. (2011). From http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/index-eng.cfm	N/A
M	Residential On-Site Survey	n=31
N	BNI On-Site Survey	n=30



4. Residential Baseline Study Methodology

This section provides an overview of the data sources and methods used to develop the Residential baseline characterization.

4.1 Data Sources

The primary source of data used in determining the residential baseline was the 2012 study conducted by Corporate Research Associates (CRA), Inc. on behalf of Efficiency Nova Scotia, referred to as the Energy Usage Study. On-site data collection was used to supplement the CRA study, as well as other data sources, when needed.

Additional data used to calculate baselines and measure densities were obtained from a recent ENSC study (the 2011 Socket Study) and from NRCan and Statistics Canada data sets (the Comprehensive Energy Use Database, the 2007 Survey of Household Energy Use, the 2006 Census and the 2011 Census).

4.1.1 Sample Design and Segmentation

For the residential sector, the primary data source consisted of online surveys conducted by CRA that were supplemented with on-site surveys with a sample size of 31 residents. For the BNI sector, the primary data collection approach consisted of on-site surveys with a sample size of 30.

4.1.1.1 Residential On-Site Surveys

Figure 42 summarizes the residential on-site sample design for this study. The sample was based on residential dwelling construction type and fuel type. Although an original sample of 30 was planned, a total of 31 residential dwellings were included in the final analysis.

Figure 42. Residential Sample Design

Dwelling Construction Type	Fuel Type			Total
	Electricity	Oil	Other	
Multi-Family and Others	2	2	0	4
Single-family - Less than 1,500 square feet	3	6	2	11
Single-family - Larger than 1,500 square feet	5	7	3	15
Total	10	15	5	30

4.1.2 On-Site Data Collection Approach

4.1.2.1 Residential On-Site Surveys

On-site surveys were conducted with 31 Nova Scotia residential dwellings. Surveyors collected detailed equipment and building information for each residence by inspection. In addition to the on-site surveys,



Navigant leveraged data collected as part of an on-site survey to supplement the study conducted by Corporate Research Associates (CRA) which included 1,501 respondents.

The on-site inspections collected a detailed inventory of lighting, HVAC, water heating, refrigeration, other kitchen appliances, and electronic equipment, and also collected information on building envelope and site characteristics. Surveys generally took one surveyor two to four hours to complete. The residential on-site survey instrument is included in Appendix B.

4.2 *Data Analysis Approach*

The approach for data analysis involved quality control, descriptive statistics, comparison of results across data sets, and summary of corroborated results to describe the market baselines. The analysis concludes with a discussion of findings especially meaningful to program planning.

All data collected were reviewed for quality control. All on-site survey responses were reviewed for validity and completeness by engineers who worked closely with surveyors to ensure data quality throughout the survey period. Initial analysis of vetted data involved tabulating frequencies of responses and calculating saturations of standard and efficient equipment by site.

Baseline results that are corroborated by one or more other data sets are summarized in this report. Results meaningful to program planning are highlighted and explored in the final section.



5. Business, Nonprofit and Institutional Baseline Study Methodology

This section provides an overview of the data sources and methods used to develop the BNI baseline characterization.

5.1 Data Sources

The primary data collection approach consisted of on-site surveys with a sample size of 30 Nova Scotia businesses. The surveys collected primary data from Nova Scotia businesses. On-site surveys collected in-depth equipment saturation and building envelope data by inspection of a smaller sample. On-site survey participants were recruited randomly from a stratified sample of Nova Scotia businesses. It should be noted that certain results below were derived from a sample size of 30 on-site visits. Although the results obtained represent a 90 percent confidence with +/- of 15 percent margin of error, they should be used in a qualitative manner. Where possible, Navigant has used supplementary data.

Additional data used to calculate baselines and measure densities were obtained from recent ENSC studies (the 2012 CRA Commercial & Industrial Business Baseline End User Study) and from NRCan and Statistics Canada data sets (the 2008 Commercial & Institutional Consumption of Energy Survey (CICES) and the Commercial and Institutional Building Energy Use Survey (CIBEUS) 2000).

5.2 On-Site Sampling Approach

The sample was designed to represent a broad cross section of Nova Scotia BNI customers in terms of building usage type and fuel type. Ultimately 30 BNI on-site surveys were completed.

5.2.1 BNI On-Site Surveys

Figure 43 summarizes the residential sample design for this study. The sample was based on building usage type and fuel type. A total of 30 businesses were included in the final analysis.

Figure 43. BNI Sample Design

Business Type	Fuel Type			Total
	Electricity	Oil	Other	
Other Commercial	7	6	3	16
Restaurant	0	0	2	2
Health Care/Hospital	0	1	1	2
Retail (non-food)	3	2	2	7
Industrial/Manufacturing	1	0	1	2
Grocery/Supermarket	0	1	0	1
Total	11	10	9	30



It should be noted that, although 30 unique businesses were included in the sample, one business had two facilities on different meters; therefore, the surveyors considered these as two projects. For this reason, the total number of facilities included in the analysis will be $n=31$. Navigant also distributed the on-site surveys by the total facility square footage. Figure 44 summarizes the distribution of BNI facilities by total square footage.

Figure 44. BNI Sample Distribution by Facility Square Footage

Facility Square Footage	Sites Visited
Less than 1,000 square feet	1
1,001 to 2,000 square feet	2
2,001 to 3,000 square feet	2
3,001 to 5,000 square feet	4
5,001 to 10,000 square feet	5
10,001 to 15,000 square feet	3
25,001 to 50,000 square feet	3
50,001 to 100,000 square feet	1
15,001 to 25,000 square feet	1
Don't know - Small	4
Don't know - Large	4
Total	30

5.3 *Data Collection Approach*

5.3.1 **BNI On-Site Surveys**

On-site surveys were conducted with 30 Nova Scotia businesses. Surveyors collected detailed equipment and building information for each business by inspection. The inspection collected a detailed inventory of lighting, HVAC, water heating, refrigeration, motors and compressors, and also collected information on building envelope and site characteristics. Surveys generally took two surveyors four to six hours to complete. The BNI on-site survey instrument is included in Appendix B.

5.4 *Data Analysis Approach*

The approach for data analysis involved quality control, descriptive statistics, comparison of results across data sets, and summary of corroborated results to describe the market baselines. The analysis concludes with a discussion of findings especially meaningful to program planning.

All data collected were reviewed for quality control. All on-site survey responses were reviewed for validity and completeness by engineers who worked closely with surveyors to ensure data quality.



throughout the survey period. Initial analysis of vetted data involved tabulating frequencies of responses and calculating saturations of standard and efficient equipment by site.

Baseline results that are corroborated by one or more other data sets are summarized in this report. Results meaningful to program planning are highlighted and explored in the final section.



6. Residential Market Characterization

This section describes the residential sector findings obtained from the key data collection and analysis activities conducted by the Navigant team. Data were gathered from on-site surveys of Nova Scotia residences (31) during the fall of 2012. The on-site surveys were used to gather information on building characteristics and baseline saturations of efficient and standard lighting, HVAC, water heating, and refrigerators and other appliances, as well as awareness of energy efficiency measures and perceived barriers to installation of energy efficiency measures. The results from the on-site visits were used to supplement the larger online survey.

6.1 Residential Home Basic Characteristics

This section describes the basic home characteristics of the residential dwellings in the Nova Scotia. Figure 45 summarizes the findings for basic home characteristics.

Figure 45. Residential Dwellings Profile

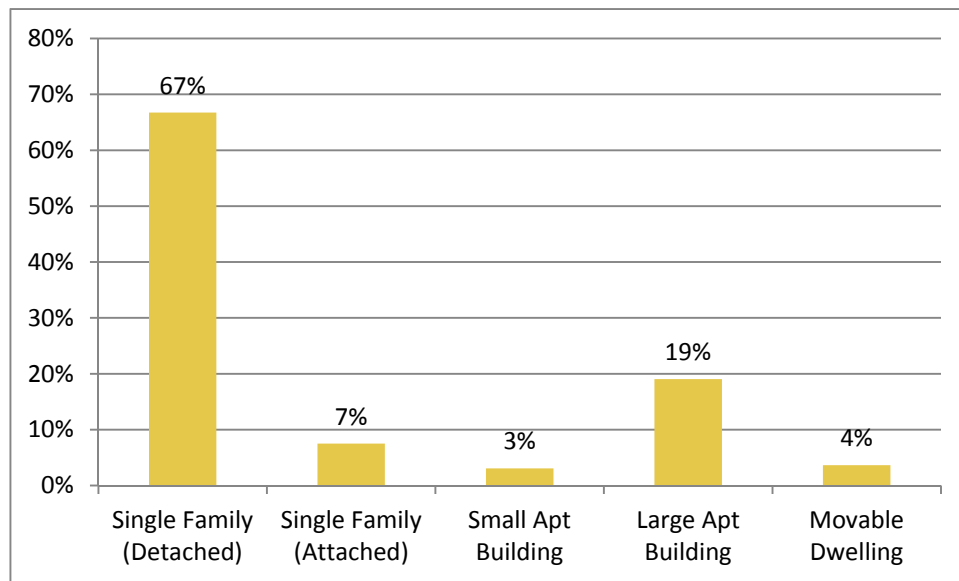
Measure/Characteristic	Market Characterization	Source
Dwelling Type	75% of all dwellings are single-family.	B
Dwelling Age	The majority (58%) of all dwellings in Nova Scotia were built after 1971, and the majority of single-family homes (58%) were also built after this date.	K
Dwelling Size	The average dwelling floor space for all dwelling types is 1,550 square feet and 1,765 square feet for single-family homes.	J
	Nearly three-quarters of all dwellings are between 1,000 and 3,500 square feet.	B
	The average total conditioned square-footage is 1,562 sq. ft.	M
Dwelling Height (Number of Stories)	55% of all dwellings are at least two stories tall, 29% are single-story, and 10% are split-entry.	B



6.1.1 Home Type

A summary of residential dwelling types is presented in Figure 46. Seventy-four percent of residential dwellings are classified as Single-Family, which includes both Attached and Detached homes built to be occupied by a single-family. The remaining dwellings were Moveable Dwellings (4%) and Large and Small Apartments (4% and 8% respectively).

Figure 46. Residential Dwelling Type



Source: Statistics Canada

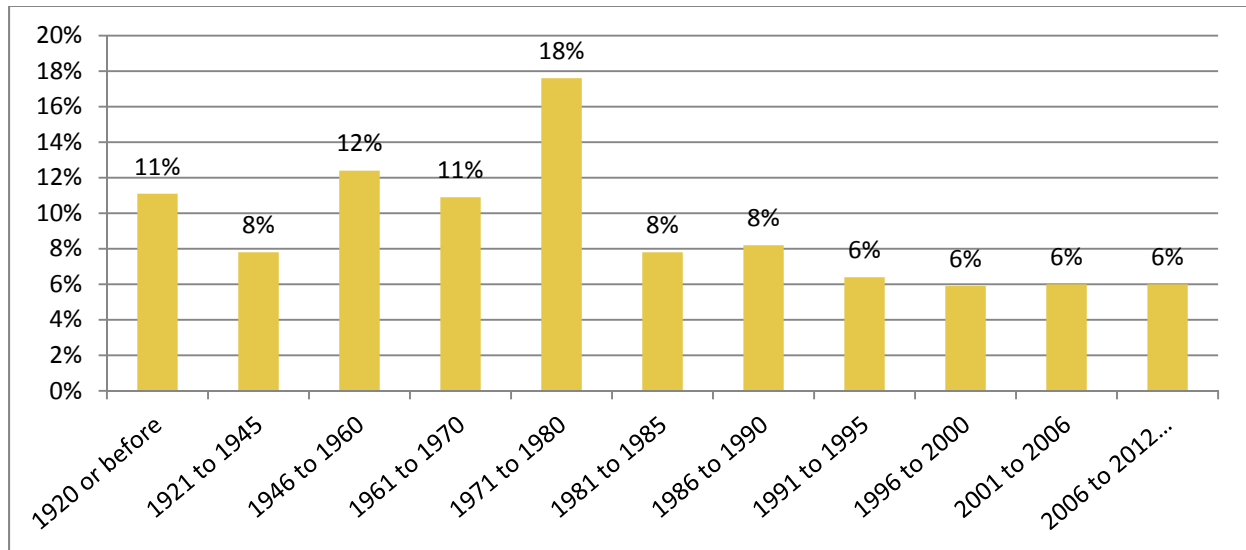
Small apartment buildings are multifamily structures that have 2 to 4 units. Large apartment buildings are multifamily structures with 5 or more units.



6.1.2 Home Age

Figure 47 reflects home vintages as reported by Statistics Canada. This indicates 58 percent of homes in Nova Scotia built since 1971.³³

Figure 47. Residential Year of Construction



Source: Statistics Canada 2006 Census

6.1.3 Home Size

The average dwelling floor space for all dwelling types is 1,550 square feet and 1,765 square feet for single-family homes. Nearly three-quarters of all dwellings are between 1,000 and 3,500 square feet. The average total conditioned³⁴ square-footage is 1,562 sq. ft.

³³ Note that Statistics Canada figures were drawn from the 2006 Census – as such, Navigant made the assumption that new house construction between 2001 and 2006 was identical to that between 2006 and 2012.

³⁴ Conditioned Space is defined as space that is designed to be thermally conditioned through either heating or cooling for the purpose of maintaining a set temperature range.



6.2 *Residential Building Shell*

This section provides details of the residential building shell measures present at the 31 surveyed homes. Figure 48 summarizes the key findings of building shell measures.

**Figure 48. Residential Building Shell Profile**

Measure/Characteristic	Key Findings	Source
Wall Construction Types	For homes older than 20 years, 66% have 2x4 construction and 31% have 2x6 construction. For newer homes, 84% reported 2x6 construction, 11% have adiabatic or shared walls, and the remaining 5% are concrete block walls.	M
Above Grade Wall Insulation	10% of homes are both older than 20 years old and have loose-fill wall insulation. < 2% of homes have no wall insulation at all.	M
Above Grade Wall Insulation R-Value	Over 73% of Residential homes reported having batt insulation, but R-Value varied depending on wall construction type. 2x4 construction had an average insulation R-Value of 13.2. 2x6 construction had an average insulation R-Value of 16.5.	M
Ceiling Insulation Depth	16% of Residential homes have less than 5" of ceiling insulation. 6% of homes have no ceiling insulation at all.	M
Ceiling Insulation R-Value	Average insulation R-Value for homes older than 20 years is 19.3. Homes newer than 20 years have average insulation R-Value of 27.4.	M
Roof Construction and Colour	98% of homes have asphalt shingle roofs. Over 85% of roofs are dark coloured, while 11% are light coloured.	M
Single-Pane Windows	The majority of windows are single pane in 5% of homes in Atlantic Canada.	G
Low-E Tinted Windows	The majority of windows are Low-E in 11% of homes in Atlantic Canada.	G



6.2.1 Exterior Walls

A description of the findings on exterior home walls, broken out by age of home, is presented in Figure 49. Eighty-four percent of homes newer than 20 years are built with 2x6 construction, while two-thirds of homes older than 20 years are built with 2x4 construction.

Figure 49. Residential Exterior Wall Construction and Insulation Profile

Exterior Wall Criteria	Homes Older than 20 years	Homes Newer than 20 years	Total Residential	Source
Exterior Wall Construction				
2x4 Stick Built	66.6%	0.0%	50.1%	M
2x6 Stick Built	31.6%	83.9%	44.6%	M
Adiabatic (shared wall)	1.8%	10.7%	4.0%	M
Concrete Block Wall	0.0%	5.4%	1.3%	M
Total by Category	100.0%	100.0%	100.0%	
Exterior Wall Insulation				
Batt	66.6%	0.0%	50.1%	M
Expanded Foam	31.6%	83.9%	44.6%	M
Loose Fill	1.8%	10.7%	4.0%	M
Not Filled	0.0%	5.4%	1.3%	M
Other*	100.0%	100.0%	100.0%	
Total by Category				
Average Insulation R-Value for 2x4 Construction	13.2	-	13.2	M
Average Insulation R-Value for 2x6 Construction	16.3	16.9	16.6	M
Average Insulation R-Value for Concrete Block Construction	-	5.4	5.4	M

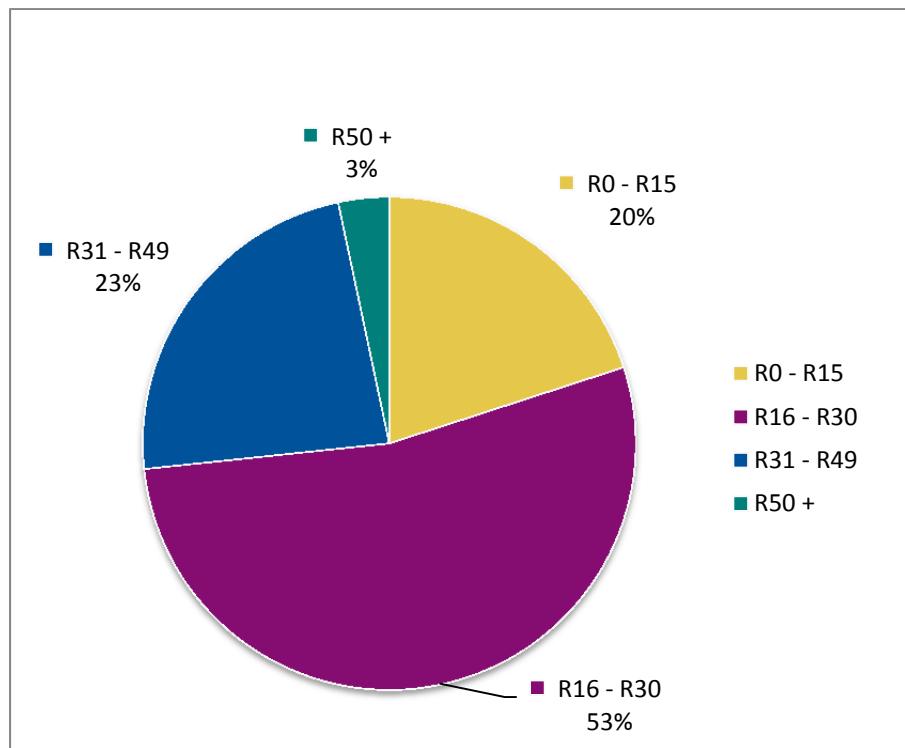
Source: Residential on-site surveys



6.2.2 Ceiling or Attic Insulation

The percent of homes with various levels of ceiling or attic insulation in terms of R-value is shown in Figure 50. According to ENERGY STAR® standards, the proper level of insulation for the upper Northeast is R49 – R60³⁵. On-site survey results show that 97 percent of homes are under-insulated in their ceilings and attics.

Figure 50. Residential Ceiling Insulation R-Values



Source: Residential on-site surveys

6.2.3 Windows

It should be noted, that due to the relatively small sample size of the on-site surveys and wide margin of error, these results should be used in a qualitative manner.

The majority of windows are single pane in 5 percent of homes in Atlantic Canada. The majority of windows are Low-E in 11 percent of homes in Atlantic Canada.

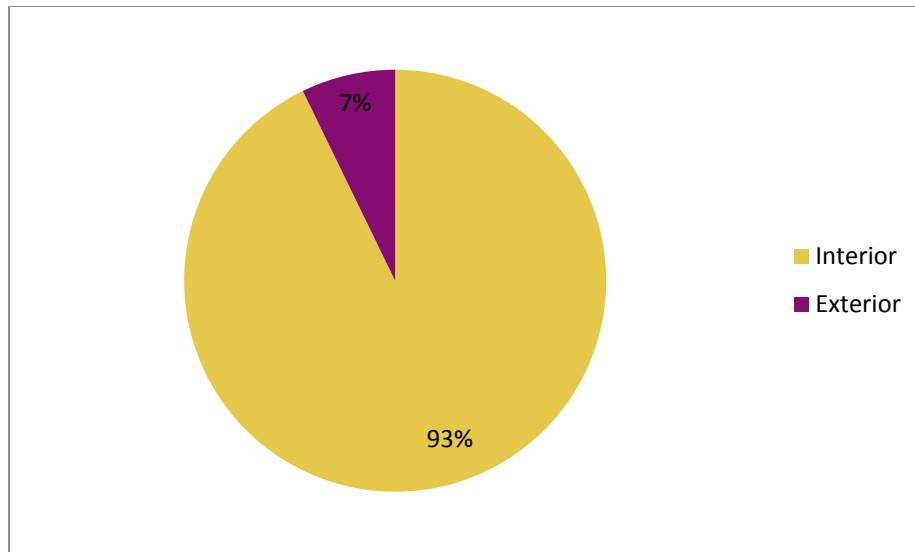
³⁵ From ENERGY STAR® website: http://www.energystar.gov/?c=home_sealing.hm_improvement_insulation_table.



6.3 Residential Lighting

Figure 51 summarizes the location of the residential lighting surveyed for ENSC (weighted by wattage). Ninety-three percent of all lighting types were interior while 7 percent were exterior.

Figure 51. Residential Lighting Location by Wattage



Source: Residential on-site surveys

Figure 52 summarizes the distribution of all lighting types for both interior and exterior lamps. Incandescent lighting represents 51 percent of all indoor lamps installed while CFLs represent 43 percent of all lamps installed and 19% of the total installed wattage. Forty-three percent of homes in Atlantic Canada use fluorescent tube while the majority (71%) has 5 or fewer such fixtures installed in their homes. LED lamps represent 4% of the total installed lamps and less than 1 percent of the total installed wattage.

**Figure 52. Residential Lighting Profile**

Measure/Characteristic	Distribution	Source
Incandescent	Incandescent lighting represents 51% of all indoor lamps installed.	A
Halogen	Halogen lamps represent 10% of the total lamps installed and 16% of the total wattage installed.	M
CFL	CFLs represent 43% of all lamps installed and 19% of the total installed wattage.	A
Fluorescent Lighting	43% of homes in Atlantic Canada use fluorescent tubes. Of this 43%, the majority (71%) have 5 or fewer such fixtures installed in their homes.	G
LED	LED lamps represent 4% of the total installed lamps and less than 1% of the total installed wattage.	A
Other / Don't Know	Other lamps, including unidentifiable lamp types, represent less than 0.5% of the total lamps installed and less than 0.25% of the total wattage.	M

6.4 Residential HVAC

6.4.1 Space Heating

Figure 53 presents details of the residential space heating systems. Thirty-one percent of all primary heating systems are electric, while 32 percent of all backup heating systems are electric baseboard or room units. Fifty-nine percent of households have a secondary heating system installed. Forty-six percent of primary heating systems use fuel oil. Twenty-seven percent of all primary heating systems have a programmable thermostat installed. Just over 40 percent of all primary heating systems have been maintained within the last year while 32 percent have never been serviced.

Figure 53. Residential Heating Equipment Profile

Measure/Characteristic	Key Findings	Source
Electric Heating - Primary	31 % of all primary heating systems are electric.	B
Electric Heating - Backup	32% of all backup heating systems are electric baseboard or room units. 59% of households have a secondary heating system installed.	G
Fuel Oil Heating	46% of primary heating systems are fuel oil.	B
Programmable Thermostats	27% of all primary systems currently have a programmable thermostat.	B



Primary Heating System Maintenance	Just over 40% of all primary heating systems have been maintained within the last year. 32% have never been serviced.	M

6.4.2 Space Cooling

Figure 54 presents details on the air-conditioning systems. Forty-two percent of residential homes have electric fans as their primary cooling system while 18 percent of homes report owning air conditioning units. Five percent of residential homes had electric heat pumps as their primary cooling system while 3% of homes have central air conditioning as their primary cooling system.

Figure 54. Residential Cooling Equipment Profile

Measure/Characteristic	Key Findings	Source
Electric Fans	42% of homes have electric fans as their primary cooling system	B
Room Air Conditioning (RAC)	18% of homes report owning air conditioning units	B
Electric Heat Pump	5% of homes had electric heat pumps as their primary cooling system.	B
Central Air Conditioning	3% of homes have central air conditioning as their primary cooling system.	B



6.5 Residential Plug Loads

Figure 55 presents details on the plug load electrical technologies. Included are televisions, entertainment boxes (DVD, DVR, video games), and computers and computer peripherals.

Figure 55. Residential Plug Loads Profile

Measure/Characteristic	Key Findings	Source
ENERGY STAR® Televisions	47% of televisions are ENERGY STAR® rated	G
Television Hours of Use	Televisions had an average daily reported use of 3.4 hours.	M
Televisions on Energy Management Systems (EMS)	Only 29% of all televisions are plugged into a power strip that can be manually turned off at night.	M
Entertainment Boxes	There are 2.76 entertainment boxes per household. These are defined as DVD players, Digital Video Recorders (DVRs), and video game systems.	B
Digital Video Recorders (DVRs)	There are 0.63 DVRs per household, and 51% of homes have at least one DVR.	B
Entertainment Box Hours of Daily Use	DVRs and video game systems have an average daily use of over 8 hours.	B
Entertainment Boxes on Energy Management Systems (EMS)	22% of all entertainment boxes are plugged into a power strip that can be manually turned off at night.	M
Smart Power Strips for Plug Loads	Navigant found no smart power strips monitoring vampire energy loads of plug load equipment. This looks to be an area of opportunity for ENSC.	M

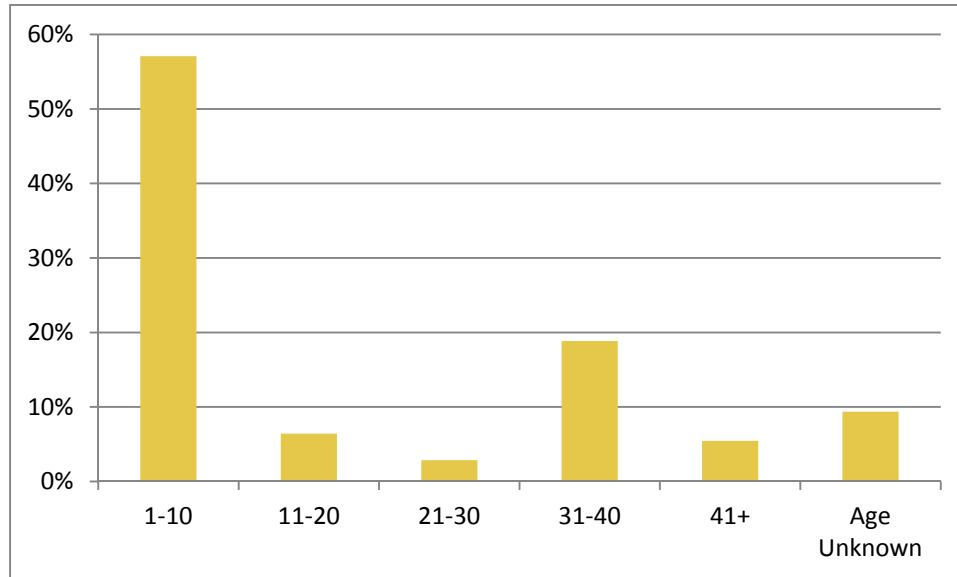
6.5.1 ENERGY STAR® Televisions and Computers

Figure 56 shows the number of televisions and computers per home found during the on-site survey (Source M). Of the homes visited, seventy televisions were installed, with the average household having two televisions. Forty-seven percent of televisions in Atlantic Canada are ENERGY STAR® rated. Televisions had an average daily reported use of 3.4 hours. Only 29 percent of all televisions are plugged into a power strip that can be manually turned off at night.

There are 2.76 entertainment boxes per Residential household. These are defined as DVD players, Digital Video Recorders (DVRs), and video game systems. There are 0.63 DVRs per Residential household, and 51 percent of homes have at least one DVR. DVRs and video game systems have an



average daily use of over 8 hours. Navigant's on-site survey found that 22 percent of all entertainment boxes are plugged into a power strip that can be manually turned off at night.



Source: Residential on-site surveys



7. Business, Nonprofit and Institutional Market Characterization

This section describes the BNI sector findings obtained from data collection and analysis activities conducted by the Navigant team. Data were gathered via 30 BNI on-site surveys during the fall of 2012 and winter of 2013. The on-site surveys were used to gather information on building characteristics and baseline saturations of efficient and standard lighting, HVAC, water heating, refrigeration and motors and compressed air. The results for BNI buildings surveyed are present in the following segments:

1. General Building Information
2. Building Envelope
3. Lighting
4. HVAC
5. Refrigeration
6. Motors and Compressed Air

It should be noted that certain results below were derived from a sample size of 30 on-site visits and are used in a qualitative manner. Where possible, Navigant has provided results from additional primary sources.

7.1 BNI General Building Information

Surveyors collected information regarding general building characteristics such as age, size, operating schedules, and more. The following sections present the results for key building characteristics. A summary of general building information is presented in Figure 74

Figure 74. BNI General Buildings Profile

Characteristic	Key Findings	Source
Facility Age	85% of BNI facilities were built post-1970 (weighted by floor space).	I
	The average year of construction was between 1970 and 1999 (weighted by floor space).	I
Building Size	41% of all BNI facilities are 5,000 sq. ft. or less. 14% of facilities were between 5,001 and 10,000 sq. ft. 18% of facilities were between 10,000 and 25,000 sq. ft. 8% of facilities were between 25,001 and more.	C
Business Hours	4% of facilities have weekly hours of 36 hours or less, 22% have hours between 37 and 48, 17% have weekly hours between 49 and 72 hours, 14% have hours between 73 and 96, 8% have hours between 97 and 120, and 34% have hours between 121 and 168, weighted by number of facilities.	I



7.1.1 Facility Age (Source I)

The majority (85%) of facilities were built post-1970. The average year of construction was between 1970 and 1999 (weighted by floor space). The year of construction is related to space heating and space cooling energy use. Shell construction issues such as leaks, cracks, and drafts due to aging or damaged construction materials and shifting structures, can increase the energy used for space conditioning, particularly for older facilities.

7.1.2 Building Size (Source C)

Forty-one percent of all BNI facilities are 5,000 sq. ft. or less. Fourteen percent of facilities were between 5,001 and 10,000 sq. ft. Eighteen percent of facilities were between 10,000 and 25,000 sq. ft. Eight percent of facilities were 25,001 sq. ft. or more.

7.1.3 Business Hours (Source I)

Four percent of facilities have weekly hours of 36 hours or less, 22 percent have hours between 37 and 48, 17 percent have weekly hours between 49 and 72 hours, 14 percent have hours between 73 and 96, 8 percent have hours between 97 and 120, and 34 percent have hours between 121 and 168, weighted by number of facilities.

7.2 BNI Building Envelope

This section provides details of the commercial building shell measures present at the on-site surveyed commercial buildings envelope types. Figure 75

Figure 75 summarizes the key findings of building shell properties. Envelope characteristics and shell tightness have a significant interactive effect with space heating and cooling capacities and runtimes.

Improving the overall shell thermal insulation, including glazing, and reducing infiltration, can create an opportunity to introduce reduced capacity high efficiency mechanical equipment.

**Figure 75. BNI Building Shell Profile**

Measure / Characteristic	Key Findings	Source
Wall Construction Types	Considering all commercial exterior wall area, 20% has concrete block construction, 15% has 2x6 wood frame construction, 14% has 2x6 metal frame construction, and 14% has adiabatic or shared walls.	N
Exterior Wall Insulation Types	43% of all commercial wall area has batt or blanket insulation. 27% of all commercial wall area does not have any insulation.	N
Roof Construction Type	46% of commercial roof area is framed (28% with an attic, 18% without an attic). 31% of commercial roof area is constructed with metal decking.	N
Roof Surface	33% of commercial roof area has a metal surface. 16% of commercial roofs have an asphalt roll/shingle surface.	N
Roof Finish	51% of commercial roof area has a flat finish. 24% of commercial roof area has a reflective finish.	N
Roof Colour	Only 12% of commercial roof area is dark.	N
Floor Types	More than half of commercial floor area is slab-on-grade.	N
Window Panes	99.6% of commercial window area has two panes.	N
Window Glazing Types	Grocery/supermarket and health care/hospital facilities only contain clear window glazing, and most non-food retail centers only have clear window glazing. The majority of industrial facilities and restaurants have tinted window glazing. The majority of 'other commercial' facilities contain reflective window glazing.	N
Window Glazing Features	The majority of commercial windows do not have any glazing features, with the exception of health care/hospital facilities and restaurants which each have about 90% low-E and gas-filled windows.	N
Window Frame Types	Commercial window frames are metal, with the main exception being vinyl windows in health care/hospital facilities.	N
Window Film	99.8% of commercial window area does not have any added window film.	N

Source: BNI on-site surveys



7.2.1 Exterior Wall Construction Types

Figure 76 below describes the findings on commercial exterior wall construction types, broken out by building type. Considering all commercial building wall areas, 20 percent are concrete block construction, 15 percent are 2x6 wood frame construction, 15 percent are 2x6 metal frame construction, and 15 percent are adiabatic or shared walls. A relatively small percentage of commercial building wall area is 2x4 wall construction. The exterior wall construction types vary significantly by building type.

Figure 76. BNI Exterior Wall Construction Types

Exterior Wall Construction Type	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
2x4 Wood Frame	0%	22%	0%	3%	0%	12%	5%	N
2x6 Wood Frame	0%	33%	16%	20%	30%	4%	15%	N
2x4 Metal Frame	0%	0%	0%	1%	0%	0%	0%	N
2x6 Metal Frame	0%	0%	33%	3%	13%	15%	15%	N
8" Solid Concrete	0%	22%	0%	2%	0%	10%	4%	N
10" Solid Concrete	0%	0%	0%	7%	0%	4%	4%	N
12" Solid Concrete	0%	0%	0%	3%	0%	0%	1%	N
Concrete Block	50%	0%	33%	12%	0%	19%	20%	N
Brick	0%	0%	0%	0.6%	0%	0%	0.3%	N
Corrugated Metal	0%	0%	17%	13%	0%	0%	11%	N
Adiabatic (shared wall)	50%	11%	0%	23%	13%	16%	15%	N
Other	0%	0%	0%	2%	0%	0%	1%	N
Unidentified	0%	11%	0%	11%	43%	21%	10%	N
Total	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys



7.2.2 Exterior Wall Insulation Types

Figure 77 shows commercial exterior wall insulation types, broken out by building type. Forty-three percent of all BNI building exterior wall area has batt or blanket insulation. Twenty-seven percent does not have any insulation at all. Exterior wall insulation types are moderately similar across commercial building types.

Figure 77. BNI Exterior Wall Insulation Types

Exterior Wall Insulation Type	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
Batt or Blanket	0%	38%	50%	40%	43%	43%	43%	N
Expanded Polystyrene	0%	25%	26%	8%	0%	10%	13%	N
Loose Fill	0%	25%	0%	2%	0%	0%	2%	N
Rigid Board	0%	0%	0%	0.7%	0%	0%	0.4%	N
Other	50%	0%	0%	5%	0%	0%	3%	N
None	50%	0%	24%	33%	13%	19%	27%	N
Unidentified	0%	13%	0%	12%	43%	28%	13%	N
Total	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys

7.2.3 Roof Construction Types, Surfaces, Finishes, and Colours

Figure 78 summarizes the BNI roof construction types, surfaces, finishes, and colours among various BNI building types. Forty-six percent of BNI roof area is framed, 28 percent has an attic and 18 percent does not have an attic. Thirty-one percent of BNI roof area is constructed using metal decking. All three grocery/supermarket facilities surveyed have a framed roof with an attic. CIBEUS 2000 reports that 31 percent of roof types in Atlantic Provinces are deck type roof construction, 24 percent are framed with attic type construction, 19 percent are metal truss roof construction, 13 percent are wood truss construction, and 12 percent are unknown.

Thirty-three percent of all BNI roof area has a metal surface. Twenty-one percent and 16 percent of BNI roof area has built-up and asphalt roll/shingle roof surface, respectively.

Considering all BNI roof area finishes, fifty-one percent is flat, 24 percent is reflective, and 25 percent is not identified. Sixty-seven percent of industrial/manufacturing facility roof area surveyed contains a reflective finish.

Thirty-six percent of all BNI roof area is a medium colour, and only twelve percent is dark. All three grocery/supermarket facilities surveyed have a dark asphalt roll/shingle roof. Non-food retail BNI buildings have a fairly even distribution of roof colours.



Figure 78. BNI Roof Construction Types, Surfaces, Finishes, and Colours

Roof Criteria	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
Roof Construction Type								
Adiabatic (shared wall)	0%	17%	0%	2%	0%	0%	1%	N
Framed With Attic	100%	33%	33%	26%	0%	26%	28%	N
Framed Without Attic	0%	33%	33%	5%	35%	29%	18%	N
Metal Decking	0%	0%	35%	29%	15%	38%	31%	N
Unidentified	0%	17%	0%	39%	50%	8%	22%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	
Roof Surface								
Asphalt Roll/Shingle	100%	67%	0%	24%	0%	14%	16%	N
Built-up	0%	0%	0%	21%	35%	39%	21%	N
Metal	0%	0%	66%	17%	15%	34%	33%	N
Wood Shingle	0%	0%	0%	0%	0%	6%	2%	N
Unidentified	0%	33%	34%	38%	50%	7%	29%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	
Roof Finish								
Flat	100%	67%	34%	48%	50%	84%	51%	N
Reflective	0%	0%	66%	13%	0%	0%	24%	N
Unidentified	0%	33%	0%	40%	50%	16%	25%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	
Roof Colour								
Light	0%	0%	66%	17%	0%	24%	30%	N
Medium	0%	67%	34%	36%	50%	37%	36%	N
Dark	100%	0%	0%	10%	0%	28%	12%	N
Unidentified	0%	33%	0%	38%	50%	11%	22%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys



7.2.4 Floor

Figure 79 displays the BNI floor types broken down by BNI building type. More than half of BNI floor area is slab-on-grade. 34 percent of health care/hospital facilities' floor area has an unheated basement.

Figure 79. BNI Floor Types

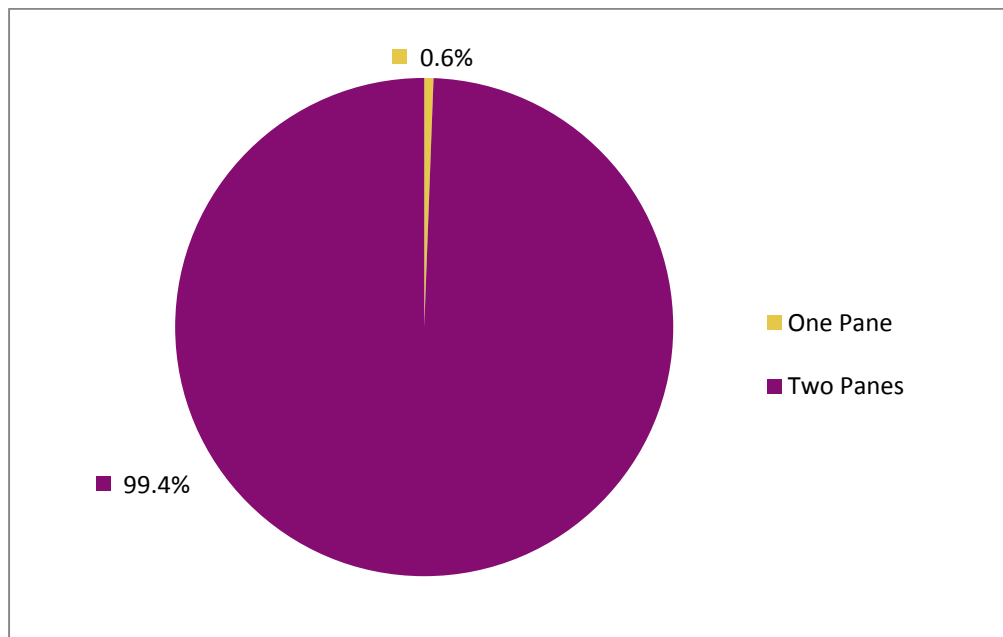
Floor Type	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
Adiabatic (shared wall)	0%	0%	0%	2%	0%	0%	1%	N
Crawl	0%	0%	0%	3%	0%	0%	1%	N
Slab	50%	17%	50%	59%	50%	50%	53%	N
Unheated Basement	0%	34%	0%	0%	0%	0%	1%	N
Unidentified	50%	50%	50%	36%	50%	50%	44%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys

7.2.5 Windows/Fenestration

Figure 80 shows that almost all commercial windows have two panes. Over 99 percent of window area surveyed was two pane.

Figure 80. BNI Window Panes

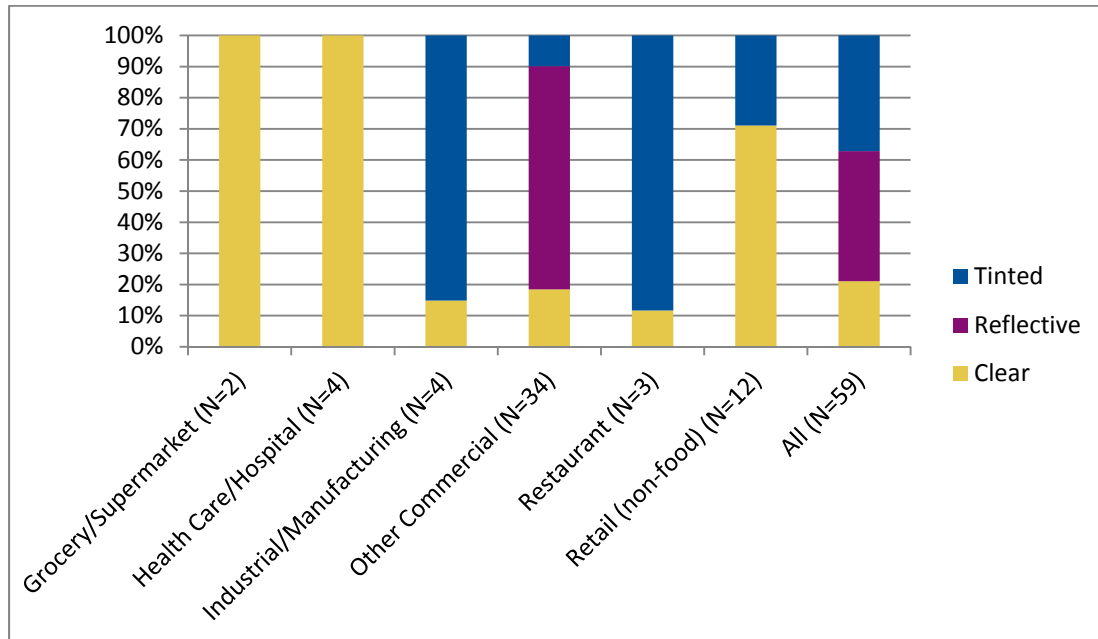


Source: BNI on-site surveys



Figure 81 displays the BNI floor types broken down by building type. Grocery/supermarket and health care/hospital facilities do not contain any treated window glazing. Most non-food retail centers do not have any treated window glazing. A majority of industrial facilities and restaurants have tinted window glazing. The majority of other BNI facilities contain reflective window glazing.

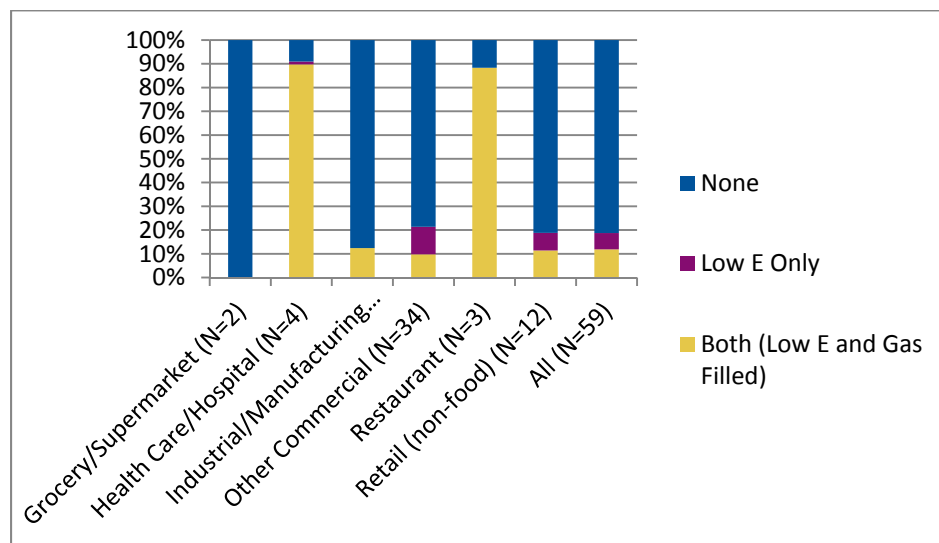
Figure 81. BNI Window Glazing Type



Source: BNI on-site surveys

Figure 82 presents BNI window glazing features by commercial building type. The majority of BNI windows do not have any glazing features, with the exception of health care/hospital facilities and restaurants, which each have about 90 percent low-E and gas-filled windows.

Figure 82. BNI Window Glazing Features

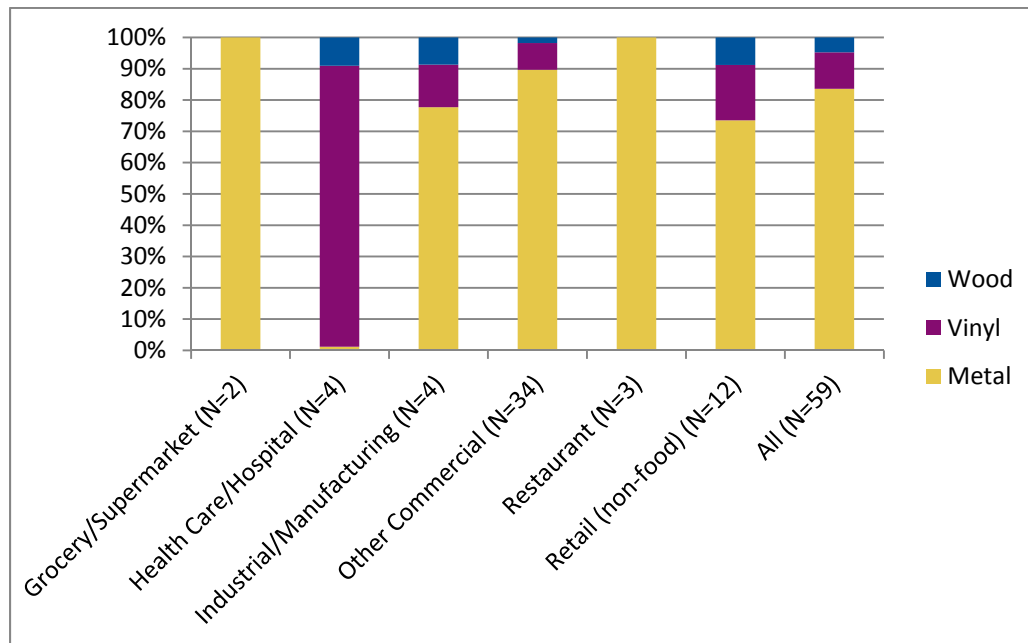


Source: BNI on-site surveys



Figure 83 displays BNI window frame types broken down by building type. Most BNI window frames are metal, with the main exception being vinyl windows in most health care/hospital facilities.

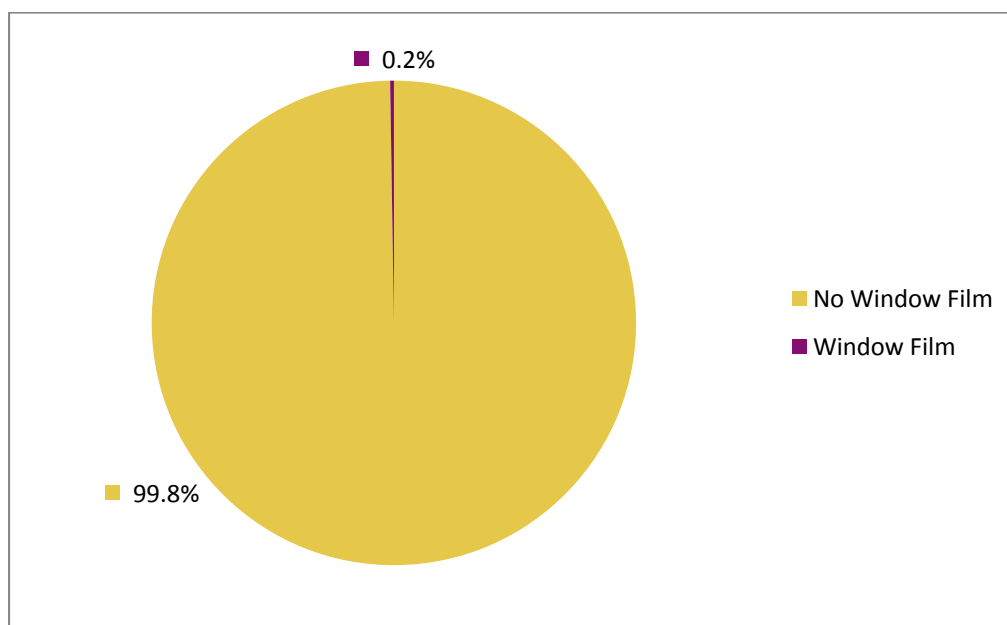
Figure 83. BNI Window Frame Types



Source: BNI on-site surveys

Figure 84 shows that almost all BNI windows do not currently have window film.

Figure 84. BNI Window Film

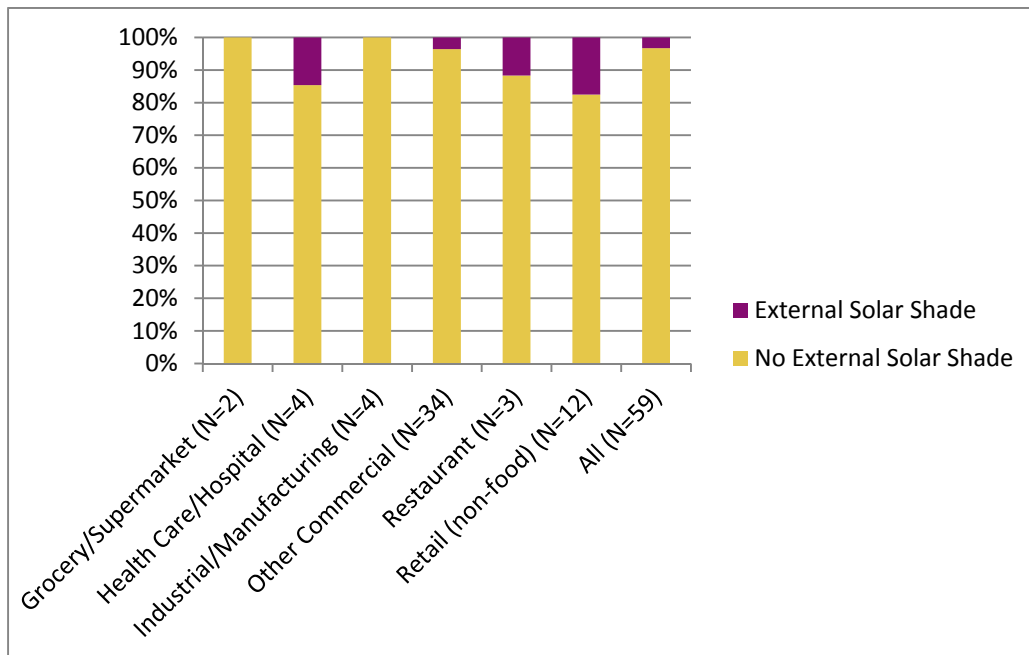


Source: BNI on-site surveys



Almost all BNI windows do not have an exterior solar shade, as shown in Figure 85.

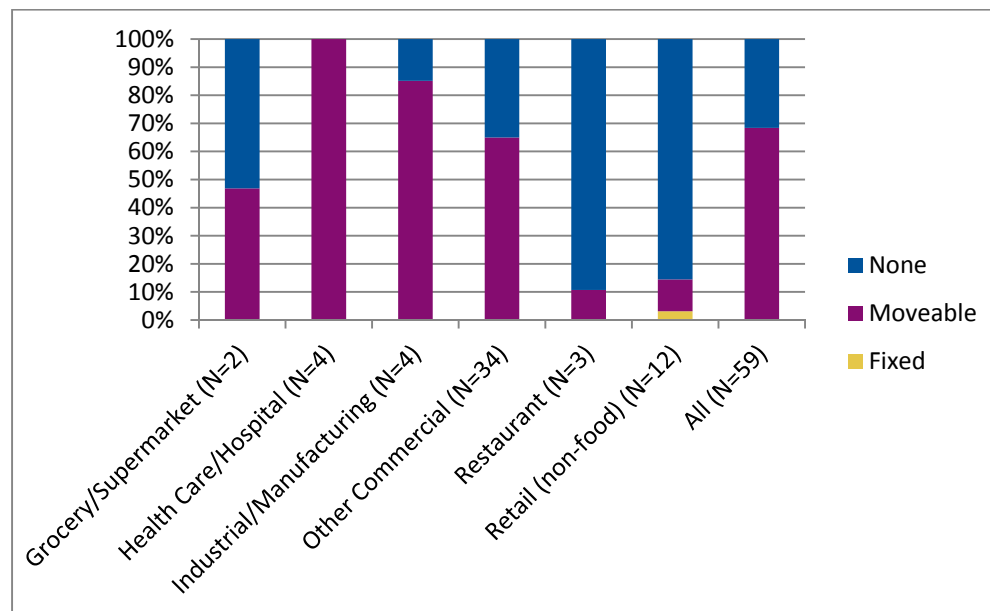
Figure 85. BNI Window Exterior Solar Shade



Source: BNI on-site surveys

Figure 86 shows BNI window interior shade types broken down by building type. About 68 percent of window area has moveable interior shades, with most of the remainder not having any interior shades at all. Of all BNI buildings, only a small percentage of non-food retail facilities have fixed interior shades.

Figure 86. BNI Window Interior Shades



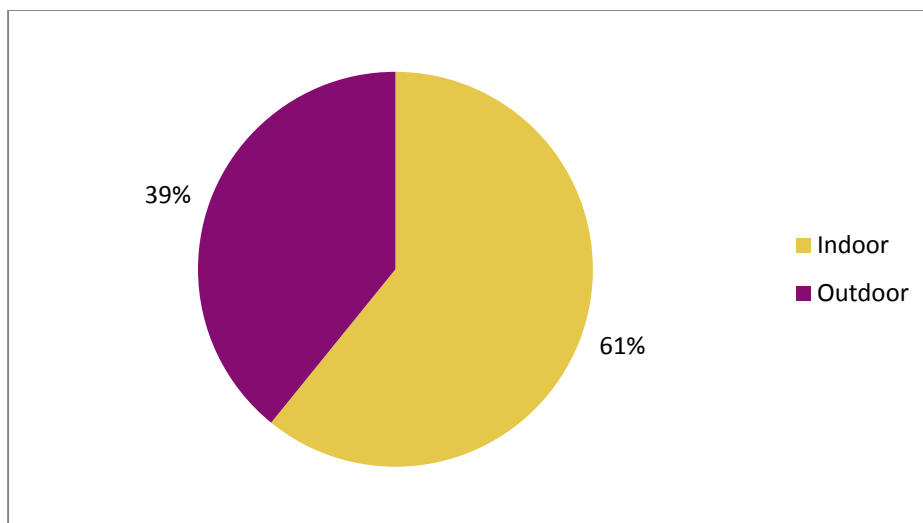
Source: BNI on-site surveys



7.3 BNI Lighting

Figure 87 summarizes the location of the BNI lighting surveyed for ENSC (weighted by wattage). Sixty-one percent of all lighting types were indoor while 39 percent were outdoor.

Figure 87. BNI Lighting Location Distribution



Source: BNI on-site surveys

7.3.1 Indoor Lighting

Figure 88 lists key findings for the BNI indoor lighting profile. Findings include high level results regarding fixture types, wattages, and control types. Reduced indoor lighting power in interior conditioned spaces typically increases the heating energy needed in the winter in occupied spaces.

Figure 88. BNI Indoor Lighting Profile

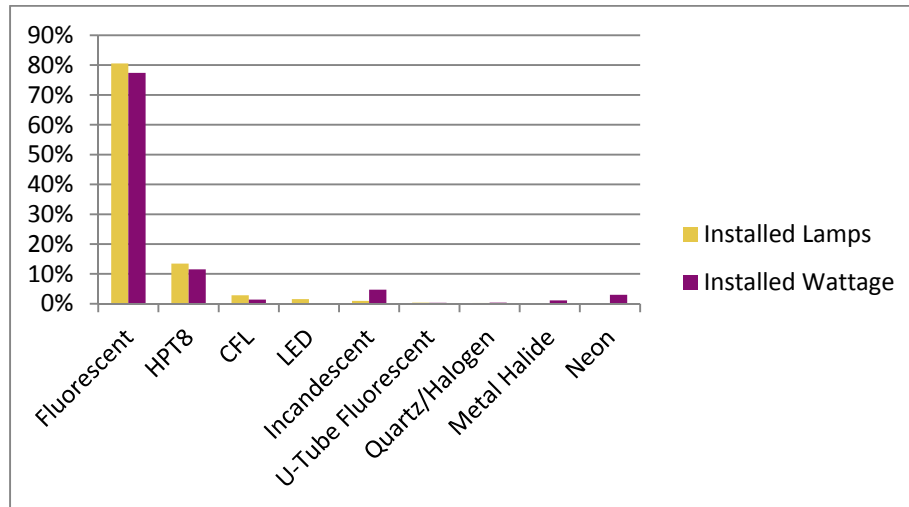
Measure Characteristic	Key Findings	Source
Fixture Types	Fluorescent lights, including both standard and high performance models, make up 94% of installed lamps and 89% of installed wattage. The second most common lamp type is CFLs, which make up 3% of installed lamps and 1% of installed wattage.	N
Wattage	The average wattage of indoor lamps is 36 Watts. The highest average wattage was in industrial facilities, with an average of 42 Watts per lamp, followed by 'Other Commercial' sites at an average of 40 Watts per lamp.	N
Control Type	Only 6% of indoor BNI lighting has controls beyond a standard manual switch. 58% of lighting is controlled by an on/off switch, while another 32% is continuous lighting with no controls.	N

Source: BNI on-site surveys



Figure 89 summarizes the interior lighting lamp type distribution, weighted by installed wattage. Eighty-one percent of all interior lights recorded were standard-output fluorescent lamps, while another 13 percent were high-output fluorescent lamps. Standard fluorescent lamps also represented 77 percent of installed wattage, while high performance HPT8s represented another 12 percent. This illustrates that fluorescents clearly compose the dominant lighting type in ENSC BNI buildings. Exact distribution values for all lighting types are listed in Figure 90.

Figure 89. BNI Installed Lamps vs. Installed Wattage



Source: BNI on-site surveys

Figure 90. BNI Installed Lamps vs. Installed Wattage

Lamp Type	Installed Lamps	Installed Wattage	Source
Fluorescent	81%	77%	N
HPT8	13%	12%	N
CFL	3%	1%	N
LED	2%	0%	N
Incandescent	1%	5%	N
U-Tube Fluorescent	0%	0%	N
Quartz/Halogen	0%	0%	N
Metal Halide	0%	1%	N
Neon	0%	3%	N

Source: BNI on-site surveys



Fluorescent lamps also dominate the market in terms of fixture types, as shown in Figure 91. Almost 60 percent of indoor fixtures in ENSC's BNI market are standard fluorescent, while another 22 percent are high performance T8 fluorescent fixtures. This is in contrast to the 2012 CRA CIBBS telephone survey indicates that there is still significant potential for efficient fluorescent lighting such as HPT8 and T5HO fixtures in Nova Scotia, particularly for T5 fixtures. A majority of participants surveyed did not state 'already installed' as a barrier to installing fluorescent lighting in their commercial buildings. On average across efficient fluorescent types, 15 percent of respondents stated that Fluorescent Lighting was Already Installed at Their Facility, and Other Reasons, were given as primary barriers to implementation.

Figure 91. BNI Distribution of Fixture Type

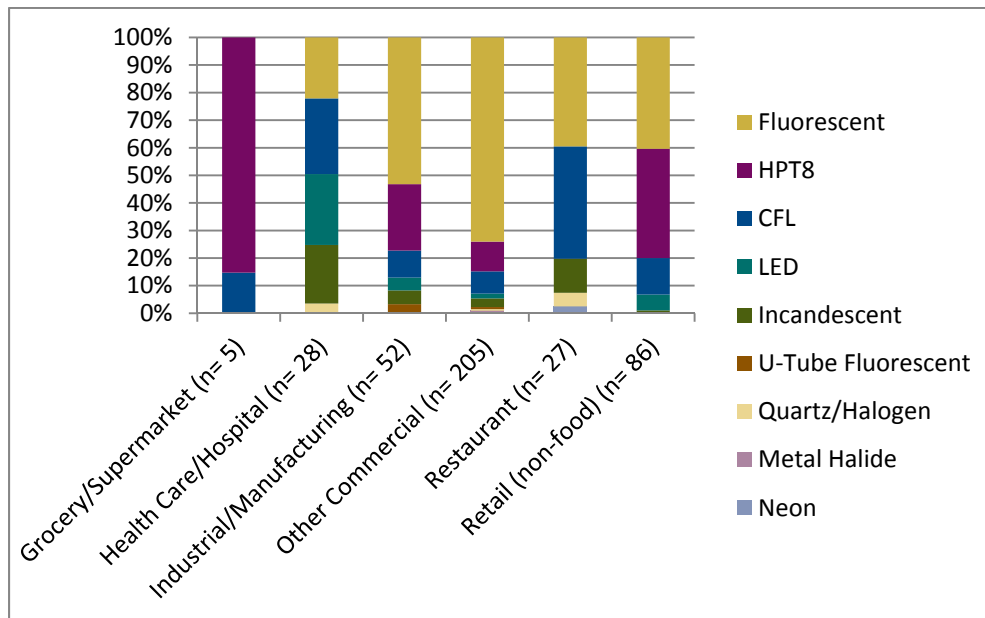
Lamp Type	Fixture Distribution	Source
Fluorescent	57%	N
HPT8	22%	N
CFL	11%	N
LED	4%	N
Incandescent	3%	N
U-Tube Fluorescent	1%	N
Quartz/Halogen	1%	N
Metal Halide	0%	N
Neon	0%	N

Source: BNI on-site surveys

A breakdown of fixture distribution by building type is illustrated in Figure 92. Standard fluorescent fixtures are the most common fixture type in industrial facilities, non-food retail facilities, and 'other commercial' buildings. HPT8s are the most common in grocery stores, while CFLs are most common in health care facilities and restaurants.



Figure 92. BNI Fixture Distribution by Building Type



Source: BNI on-site surveys



7.3.2 Outdoor Lighting

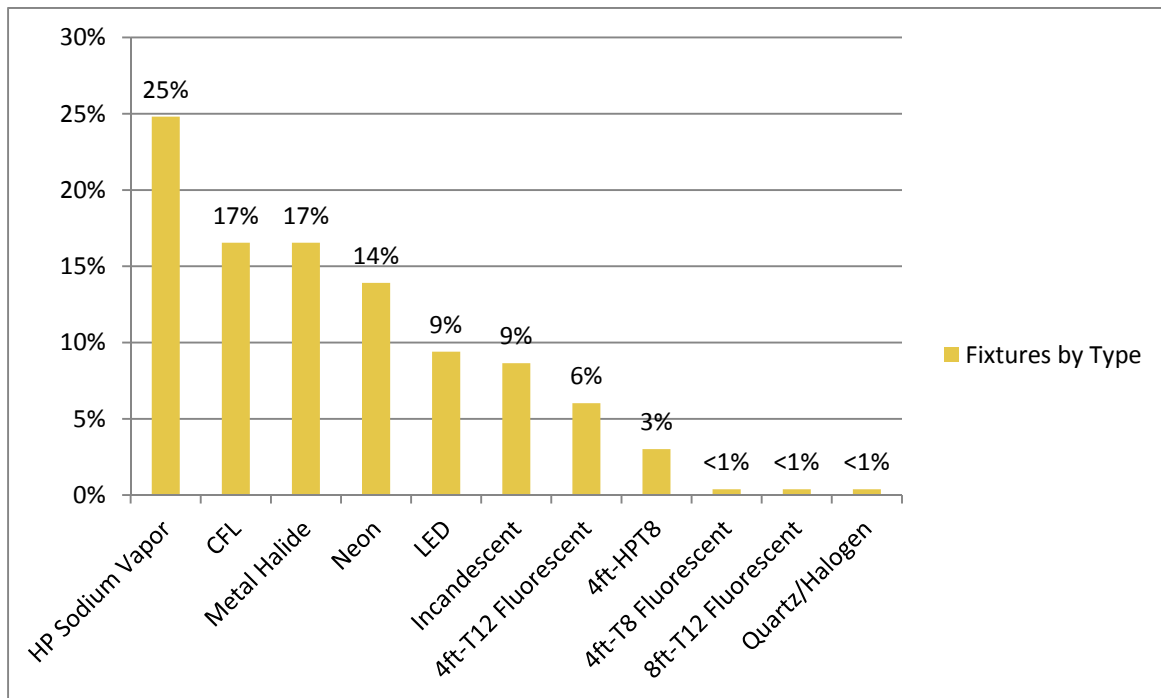
Figure 93 lists key findings for the BNI outdoor lighting profile. Findings include high level results regarding fixture types, wattages, and control types.

Figure 93. BNI Outdoor Lighting Profile

Measure Characteristic	Key Findings	Source
Fixture Types	One-quarter of all outdoor fixtures are High Pressure Sodium Vapor. CFLs and Metal Halides each constituted 17% of the rest of the outdoor lighting fixture types. Neon lights made up another 14% of the distribution. The rest of the lighting types made up less than 10% each.	N
Wattage	Neon lamps are the dominant lamp type by wattage, making up over 85% of the distribution. The average wattage for all outdoor lamp types is 138 watts. Wattages range from 10-100 Watts, depending on the lamp.	N
Control Type	82% of sites have motion sensors, photocells, or time clocks as outdoor lighting controls. Of these control types, 86% are time clocks.	N

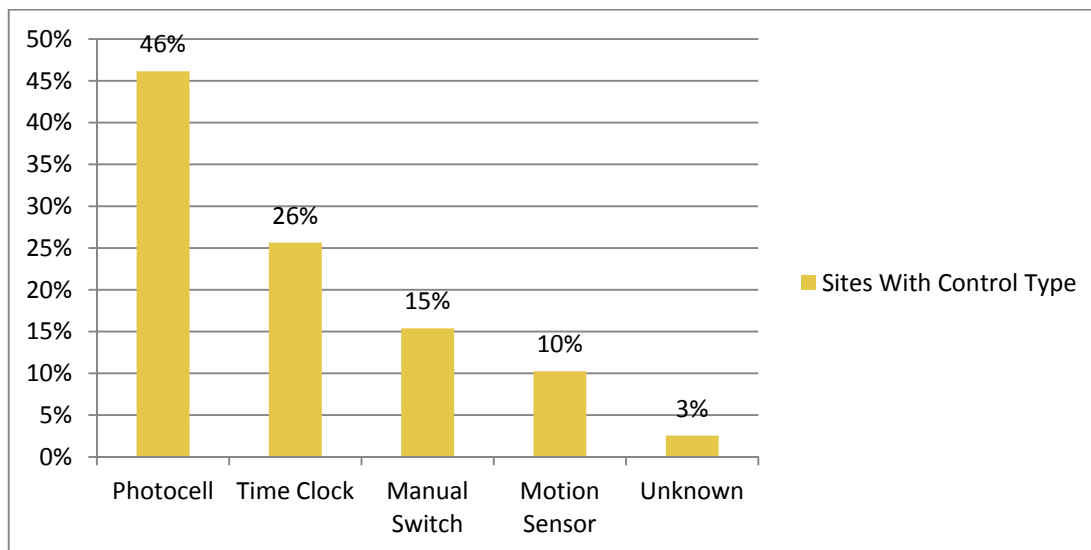
Source: BNI on-site surveys (Source "N")

As shown in Figure 94, high-pressure sodium vapor is the most common exterior fixture type, constituting nearly a quarter of the market share. This is followed by CFLs and metal halides, with nearly 17 percent of the market, respectively.

**Figure 94. BNI Fixture Type Distribution**

Source: BNI on-site surveys

As mentioned above, 82 percent of all sites have some form of automated control systems for their exterior lights, most of which are photocells. Figure 95 shows the control types on exterior lights.

Figure 95. BNI Control Types for Sites with Exterior Lights

Source: BNI on-site surveys

7.4 BNI HVAC and Water Heating

Figure 96 summarizes the key findings of the BNI HVAC survey

**Figure 96. BNI HVAC and Water Heating Profile**

	Measure Characteristic	Key Findings	Source
HVAC	Single-Zone HVAC System Age	The on-site surveyors identified 477 single-zone HVAC systems. Two-thirds (66%) of single-zone HVAC systems are baseboard/radiant systems followed by unit ventilators or heaters (13%).	N
	Primary Heating Fuel Type	Nearly two-thirds (65%) of all single-zone HVAC systems used electricity as a fuel type. Fuel oil and liquid propane gas (LPG) represent 3% each (6% total) of fuel types for single-zone HVAC systems.	N
	Heating System Type	More than half (53%) of all facilities sampled had baseboard heaters. Boilers and electric resistance heaters were in 19% and 10%, respectively, of facilities sampled. Air source heat pumps, furnaces, and radiant heaters comprise the remaining heating systems and were in 8% of surveyed facilities.	N
	Boiler Delivery Systems	The majority (79%) of boilers were hot water boilers. 21% of boilers were a steam delivery system. The mean boiler age was 12.6 years.	N
	Hot Water Circulation Pump Speed Controls	28% of all pumps were 0.15 horsepower (hp). Pumps that were 0.2, 0.25, 0.75, and 3 hp in size represented 20%, 8%, 8%, and 4% of all pumps, respectively.	N
	Cooling System Types	According to the Commercial and Institutional Building Energy Use Survey (CIBEUS) 2000 reported that in Atlantic Canada as a whole, 60% of C&I buildings had mechanical cooling of some kind.	F
		Of the systems that did have a cooling component, 95% were direct expansion while 5% were chillers. The mean size of all cooling units was 2.9 tons with a mean efficiency of 9.8 EER and 13 SEER.	N



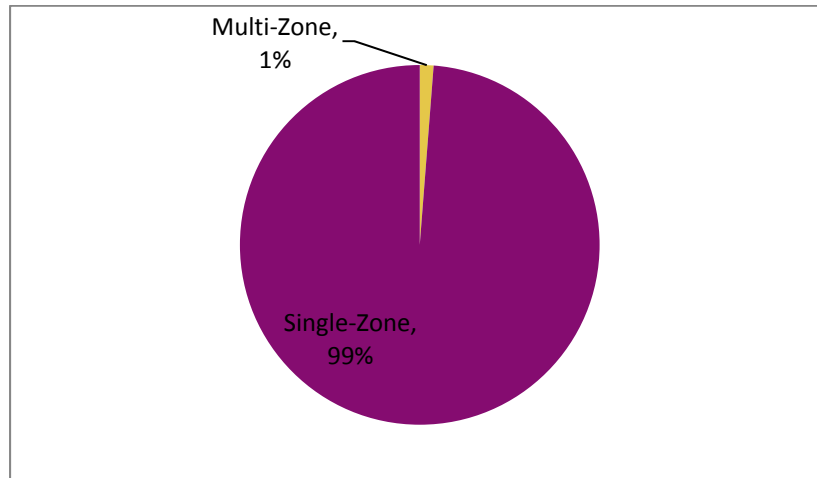
Water Heating	Water Heating Equipment Types	88% of all water heaters were standard water heaters (i.e., tank water heaters). 8% of water heaters were instantaneous, or tankless, water heaters, while 5% were boilers. The average age of all water heaters was 6.6 years. The average size water heater was 4.1 kW and 96.5 kBtuh.	N
	Water Heating Fuel Types	The majority of water heaters were fueled by electricity. Five percent of units were fueled by liquid propane gas (LPG), while fuel oil and natural gas represented 2.5% each (5% total) of fuel types for water heaters.	N
	Water Heating Pipe and Tank Insulation	85% of pipes leading into the water heater were not insulated, while 12.5% were insulated. Similarly, 82.5% of tanks were not externally insulated (e.g., blanket wrap), while 12.5% were externally insulated.	N
	Water Heating Recirculation Pump	85% of water heaters did not have recirculation pumps installed, while 10% did have recirculation pumps installed. 5% of water heaters were noted as unknown, or "Don't Know", if a recirculation pump was installed.	N

Source: BNI on-site surveys



The majority (99%) of HVAC systems are single-zone systems while 1 percent are multi-zone systems, as shown in Figure 97. Single-zone systems are typically considered “simple” systems in the energy code, and multi-zone systems are categorized as “complex” systems. Each system type has different requirements to comply with the energy code, which affects HVAC systems at time of replacement.

Figure 97. BNI Distribution of Single-Zone and Multi-Zone Systems



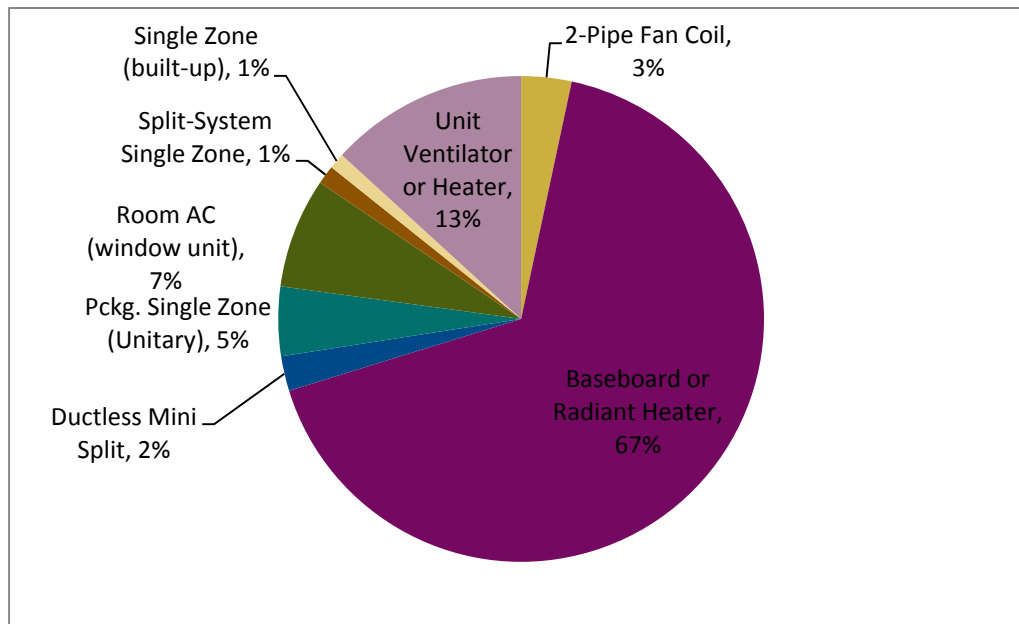
Source: BNI on-site surveys



7.4.1 Single-Zone Distribution Systems

The on-site surveyors identified 477 single-zone HVAC (SZHVAC) distribution systems and gathered all available data for each system. Figure 98 shows that two-thirds (66%) of single-zone HVAC systems are baseboard/radiant systems followed by unit ventilators or heaters (13%). Room AC, packaged single zone, and ductless mini-split, make up 7 percent, 5 percent, and 2 percent of single-zone systems, respectively.

Figure 98. BNI Distribution of Single-Zone HVAC Systems

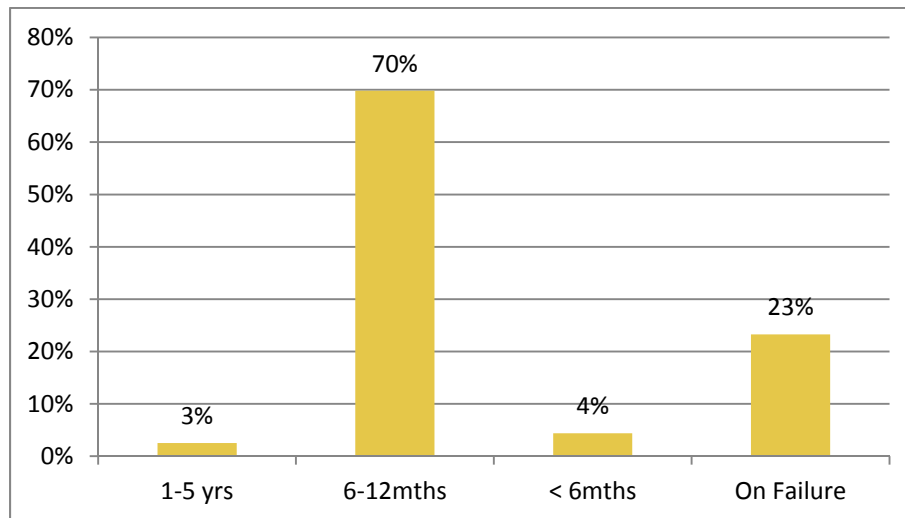


Source: BNI on-site surveys

Figure 99 summarizes the estimated maintenance of single-zone HVAC units. Seventy percent of the facilities surveyed estimated that they conduct maintenance on existing equipment every 6 to 12 months. Twenty-three percent of those surveyed reported that they conduct maintenance on an “as-needed” or “on failure” need. Three percent estimated that they conduct maintenance on their single-zone HVAC system every 1 to 5 years, while 4 percent estimated they conducted maintenance on a period of less than 6 months.



Figure 99. BNI Single-Zone HVAC Maintenance



Source: BNI on-site surveys

7.4.2 Multi-Zone Systems

Although Navigant included multi-zone HVAC systems in the BNI survey, very few of the facilities sampled contained multi-zone systems. This may be a factor of the relatively small sampled of 30 on-site visits in a very diverse market. HVAC systems that do not serve a dedicated, single zone are classified as multi-zone systems. A total of one multi-zone cooling system was observed. This system was a 10 ton direct expansion unit. Two multi-zone air handling units were observed, as well as one multi-zone electric heating unit. The heating unit was noted as "Other" by the survey team.

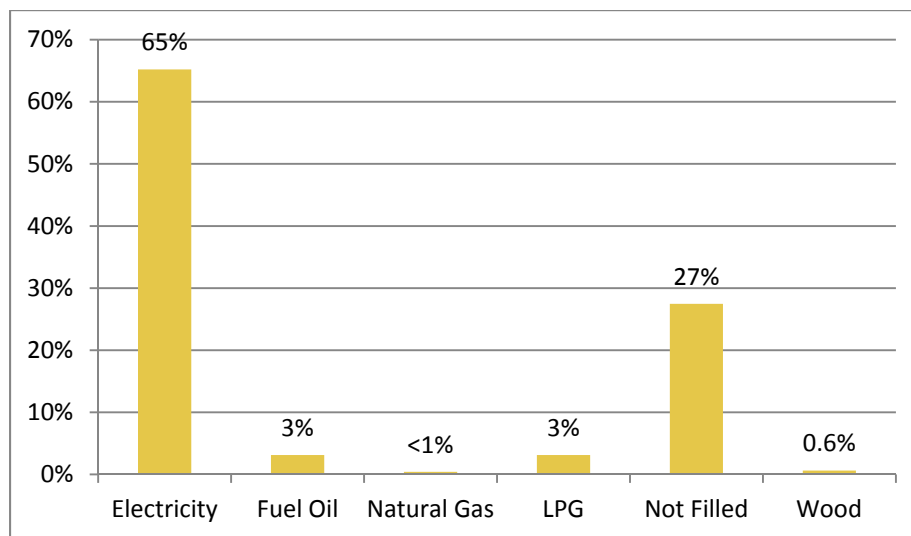


7.5 BNI Heating Systems

7.5.1 Heating Fuel Type

The BNI survey indicated that nearly two-thirds (65%) of all single-zone HVAC systems used electricity as a fuel type, as shown in Figure 100. Fuel oil and liquid propane gas (LPG) represent 3 percent each (6% total) of fuel types for single-zone HVAC systems. The 2012 CRA CIBBS telephone survey recorded that electrically operated air source and ground source heat pumps are not commonly installed. These electrically operated devices are several times more efficient than electric resistance heating devices, and could have a significant impact in Nova Scotia where 65 percent of heating is electric.

Figure 100. BNI Single-Zone System Fuel Type



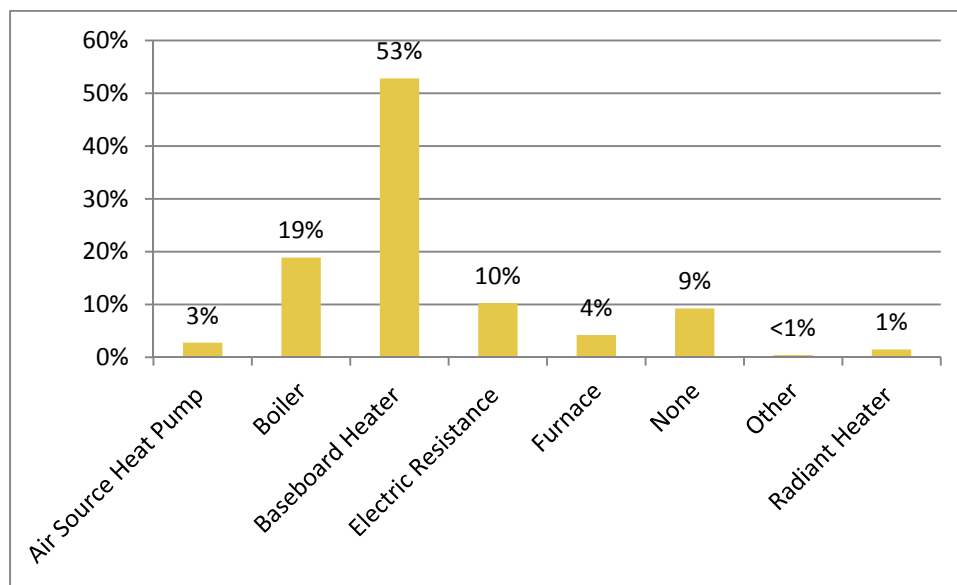
Source: BNI on-site surveys



7.5.2 Heating System Type

The BNI survey indicated that more than half (53%) of all facilities sampled had baseboard heaters, as shown in Figure 101. Boilers and electric resistance heaters comprised 19 percent and 10 percent, respectively. Air source heat pumps, furnaces, and radiant heaters comprise 8 percent of the remaining heating systems. This low penetration of air source and ground source heat pumps, coupled with the 65 percent electrical heating fuel type found by Navigant, suggests there is significant potential in Nova Scotia to reduce energy use and cost using air source and ground source heat pumps as a heating source, instead of electric resistance heating. Nine percent of facilities did not have a single-zone heating system.

Figure 101. BNI Single-Zone Heating System Type



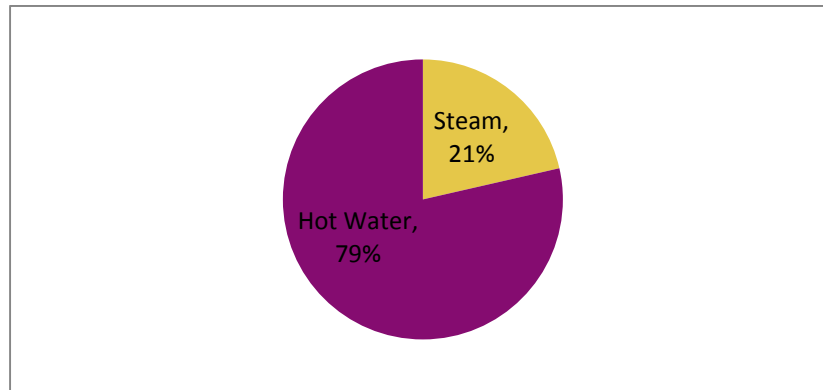
Source: BNI on-site surveys

7.5.3 Boilers

Figure 102 summarizes the distribution of boiler delivery systems. The majority (79%) of boilers were hot water boilers. In cold climates such as Nova Scotia, there may be an opportunity for condensing boilers to operate closer to their peak condensing thermal efficiency due to lower return water temperatures. Twenty-one percent of boilers used a steam delivery system. The mean boiler age was 12.6 years.



Figure 102. BNI Boiler Delivery System by Type

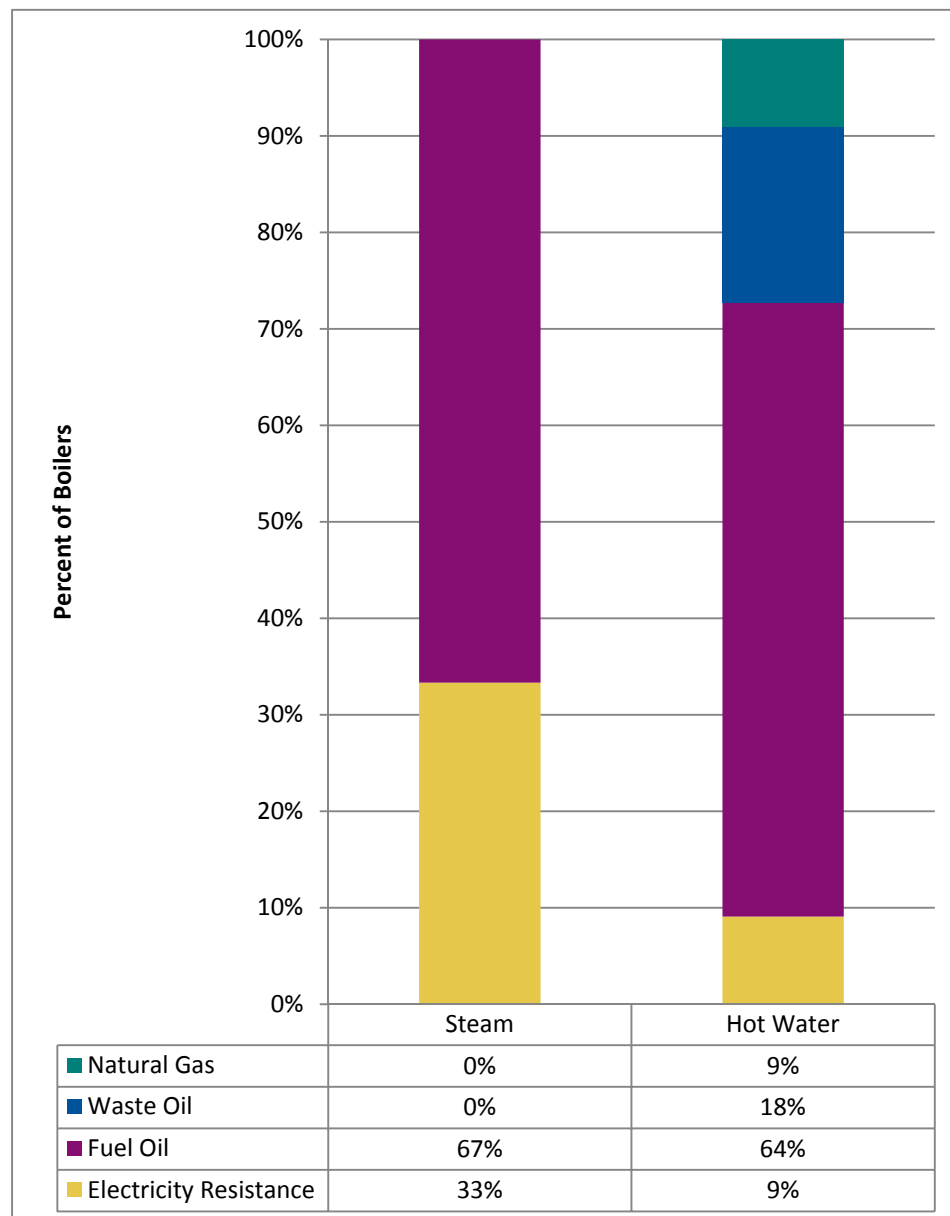


Source: BNI on-site surveys



Figure 103 summarizes the breakdown of boiler fuel types by delivery mechanism. Two-thirds of steam boilers were “fuel oil” type, while one-third were “electricity resistance” type. Hot water boilers were distributed among four fuel types, natural gas, waste oil, fuel oil, and electricity resistance, representing approximate, 9 percent, 18 percent, 64 percent, and 9 percent of fuel types, respectively.

Figure 103. BNI Boiler Fuel Types by Delivery System



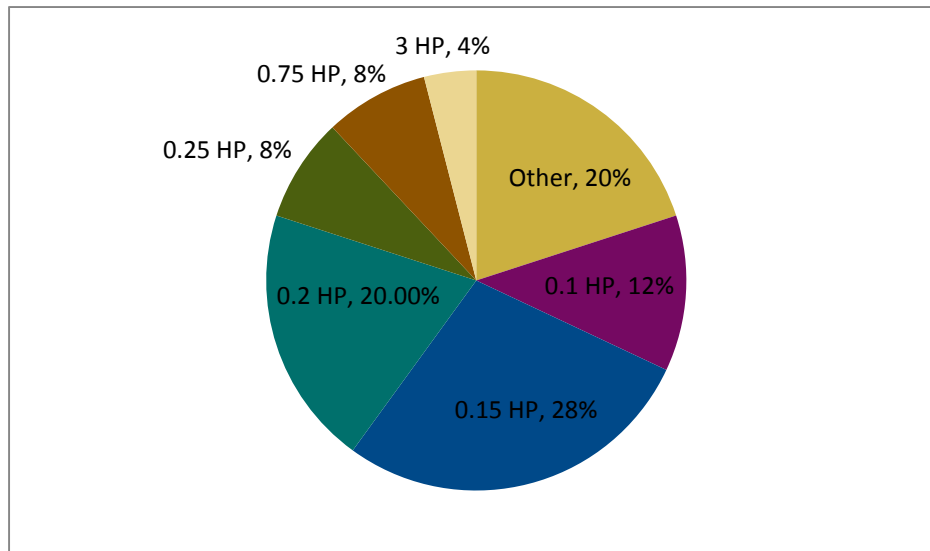
Source: BNI on-site surveys



7.5.4 Hot Water Circulation Pumps

Figure 104 summarizes the distribution of hot water circulation pumps in the facilities surveyed. Twenty-eight percent of all pumps were 0.15 horsepower (hp). Pumps that were 0.2, 0.25, 0.75, and 3 hp in size represented 20 percent, 8 percent, 8 percent, and 4 percent, respectively. Twenty percent of hot water circulation pumps were noted by surveyors as “Don’t Know.”

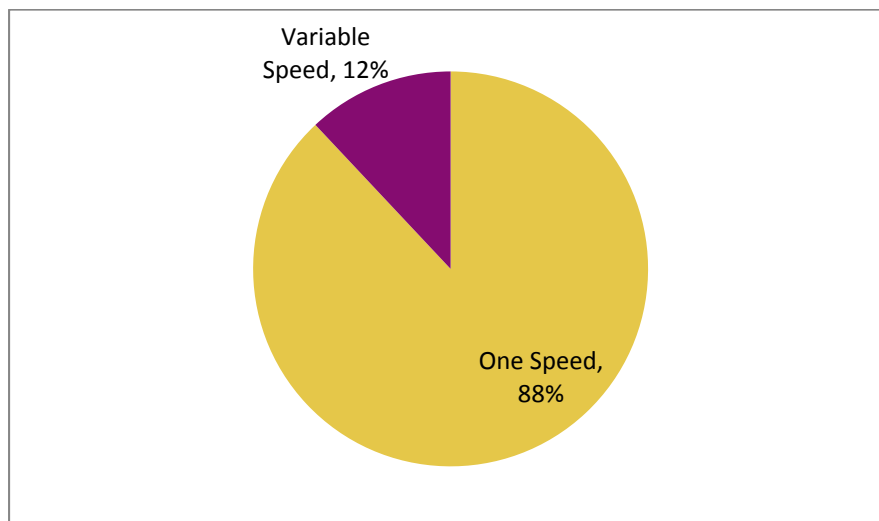
Figure 104. BNI Hot Water Circulation Pump Distribution by Size



Source: BNI on-site surveys

Figure 105 summarizes the control types of hot water circulation pumps. Eighty-eight percent of all hot water pumps were one speed, while 12 percent were variable speed.

Figure 105. BNI Hot Water Circulation Pump Speed Control Type



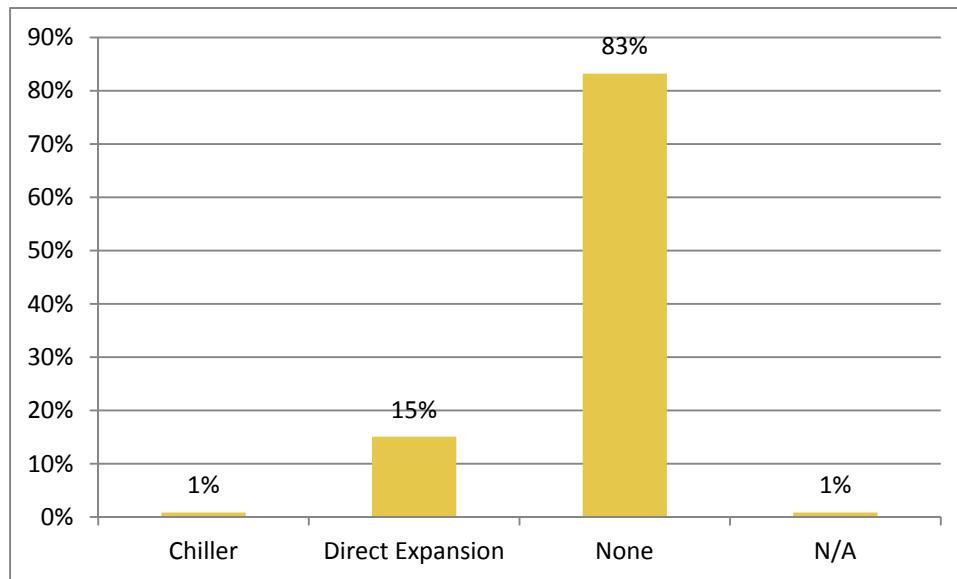
Source: BNI on-site surveys



7.6 BNI Cooling Systems

Figure 106 summarizes the type of cooling units among all single-zone HVAC systems. Eighty-three percent of all single-zone systems do not have a cooling component. Of the systems that did have a cooling component, ninety-five percent were noted by surveyors to be direct expansion while 5 percent were chillers. The mean size of all cooling units was observed to be 2.9 tons with a mean efficiency of 9.8 EER and 13 SEER.

Figure 106. BNI Types of Cooling for Single-Zone HVAC

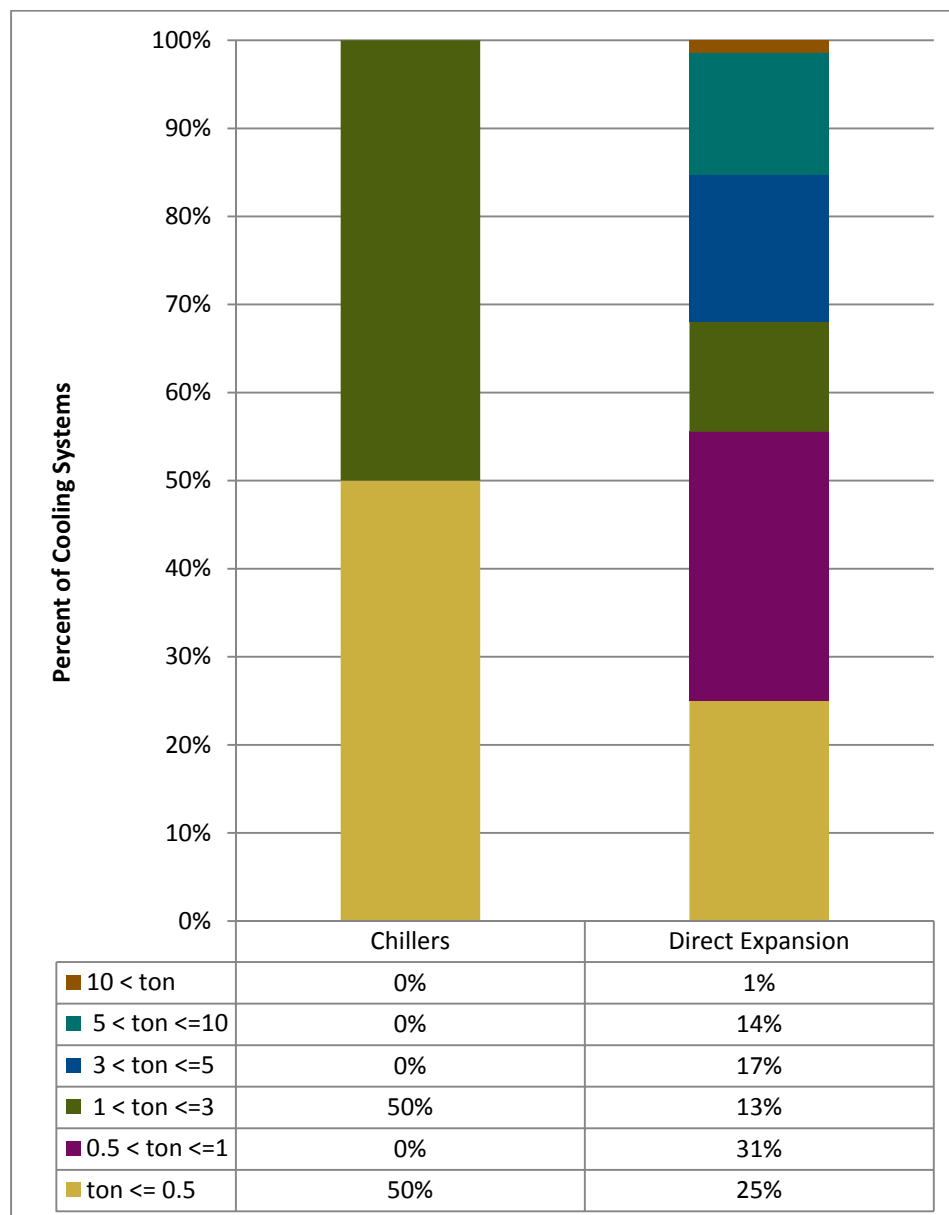


Source: BNI on-site surveys



Figure 107 summarizes the size distribution of all single-zone cooling systems within both the Chiller and Direct Expansion categories. Only two instances of single-zone chillers were recorded by the surveyors, with unit's sizes ranging from less than 0.5 tons to between 1 and 3 tons. Direct expansion cooling systems had a broader range in sizing, with 25 percent of units being less than 0.5 tons. Thirty-one percent of units were greater than 0.5 and less than or equal to 1 tons. Thirteen percent of units were greater than 1 tons but less than or equal to 3 tons. Seventeen percent of direct expansion units were greater than 3 tons but less than or equal to 5 tons. Fourteen percent of units were greater than 5 tons but less than or equal to 10 tons. Only 1 percent of direct expansion units were recorded as being greater than 10 tons. For comparison, CIBEUS 2000 reported that in Atlantic Canada as a whole, 60 percent of C&I buildings had mechanical cooling of some kind.

Figure 107. BNI Distribution of Sizes for Single-Zone Cooling



Source: BNI on-site surveys



Figure 108 summarizes the efficiency (in EER) by system size range for all direct expansion cooling systems surveyed.

Figure 108. BNI Direct Expansion Average Efficiency (EER) by Size Range

System Size Range	Average Efficiency EER	Source
ton ≤ 0.5	11.00	N
0.5 < ton ≤ 1	9.63	N
1 < ton ≤ 3	9.00	N
3 < ton ≤ 5	9.70	N
5 < ton ≤ 10	9.50	N
10 < ton	10.00	N
<i>Source: BNI on-site surveys</i>		

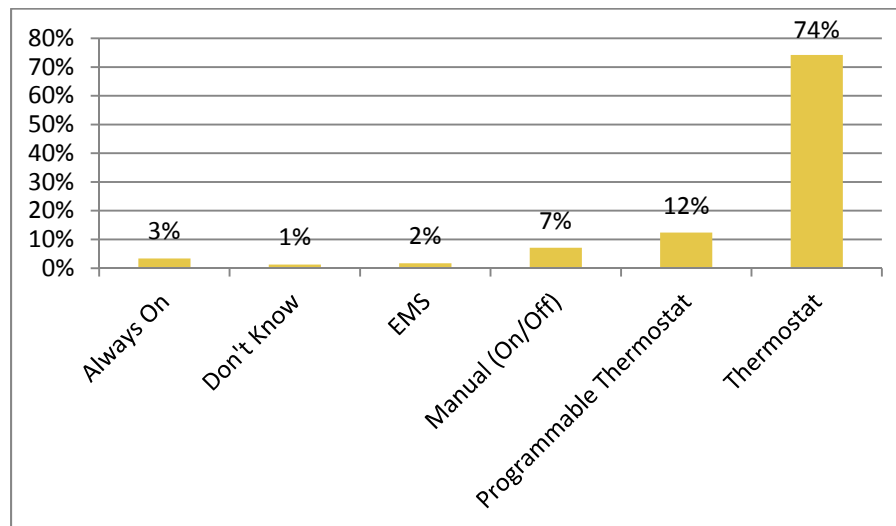
7.6.1 Chillers

Only one chiller was found in the facilities included in the survey. The chiller was an electric fuel type with no variable speed drive (VSD) installed. The chiller had a capacity of 9 tons.

7.7 BNI HVAC Controls

Figure 109 displays the most common control types for HVAC systems in the facilities sampled. Thermostats represent 74 percent of HVAC control types, while programmable thermostats and manual on/off switches represent 12 percent and 7 percent, respectively. Controls that were noted by the surveyor as “Always On” or energy management systems (EMS) represent 3 percent and 2 percent respectively.

Figure 109. BNI HVAC Control Types



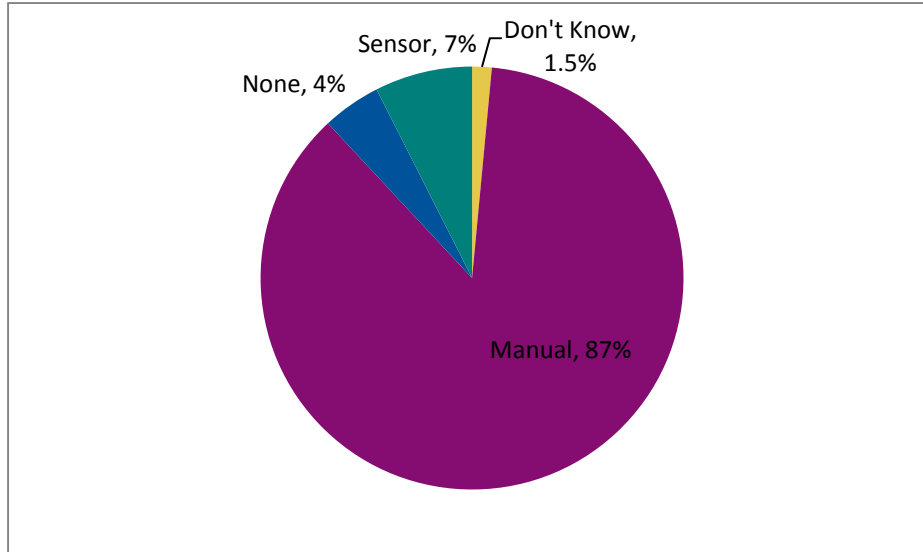
Source: BNI on-site surveys



7.7.1 Exhaust Fans

Eighty-seven percent of exhaust fans are controlled manually, as shown in Figure 110. Seven percent of exhaust fans are controlled by a sensor, while 4 percent were reported as not having a control type (e.g. always on fans). The control type for 1.5 percent of the exhaust fans surveyed was reported as unknown or “Don’t Know”.

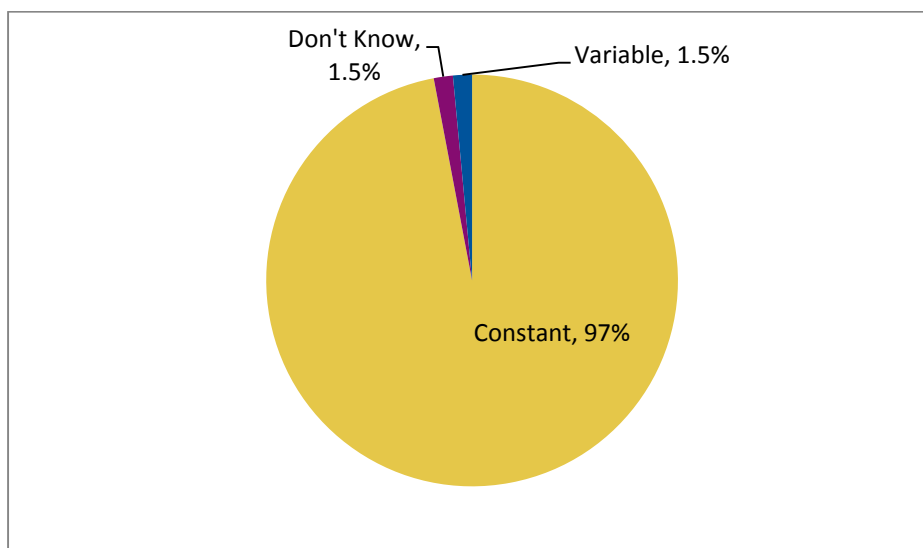
Figure 110. BNI Distribution of Exhaust Fan Control Type



Source: BNI on-site surveys

Figure 111 summarizes the distribution of exhaust fan drive speed types. Ninety-seven percent of exhaust fans were noted to be constant speed type, while 1.5 percent were reported as variable speed fans. Surveyors reported 1.5 percent of fan speed types as unknown or “Don’t Know”.

Figure 111. BNI Distribution of Exhaust Fan Drive Speed Type



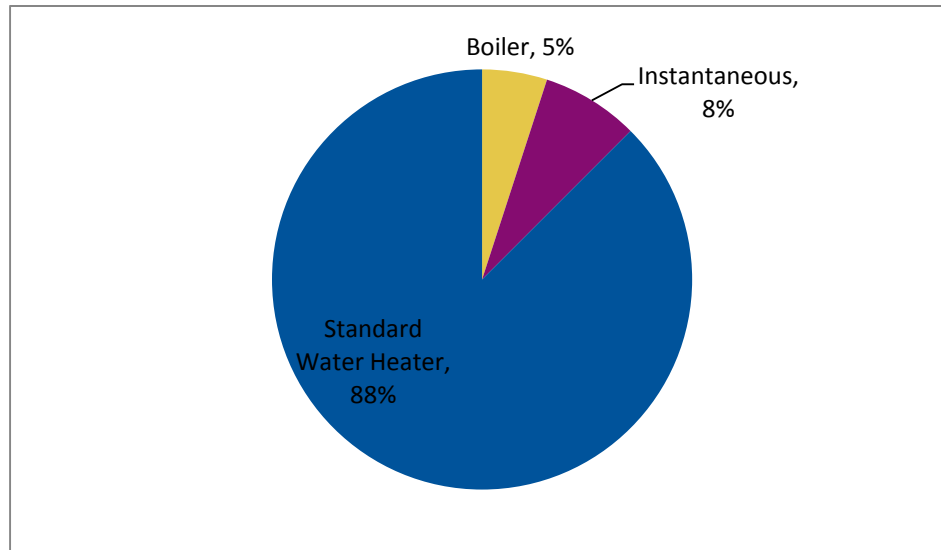
Source: BNI on-site surveys



7.7.2 Water Heating

Figure 112 summarizes the types of water heaters in the facilities surveyed. Eighty-eight percent of all water heaters were standard water heaters (i.e., tank water heaters). Eight percent of water heaters were instantaneous, or tankless, water heaters, while 5 percent were boilers. The average age of all water heaters was 6.6 years. The average size water heater was 4.1 kW and 96.5 kBtuh.

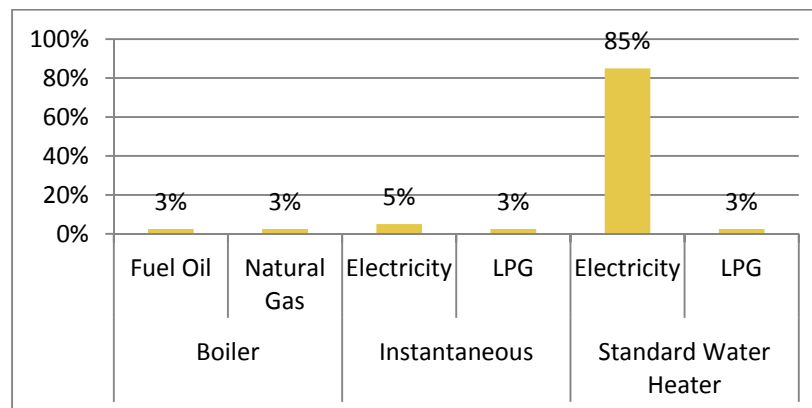
Figure 112. BNI Water Heater Type Distribution



Source: BNI on-site surveys

As shown in Figure 113, the majority (cumulatively 90%) of water heaters were fueled by electricity. Five percent of units were fueled by liquid propane gas (LPG), while fuel oil and natural gas represented 2.5 percent each (5% total) of fuel types for water heaters.

Figure 113. BNI Distribution of Fuel Types Among Water Heaters

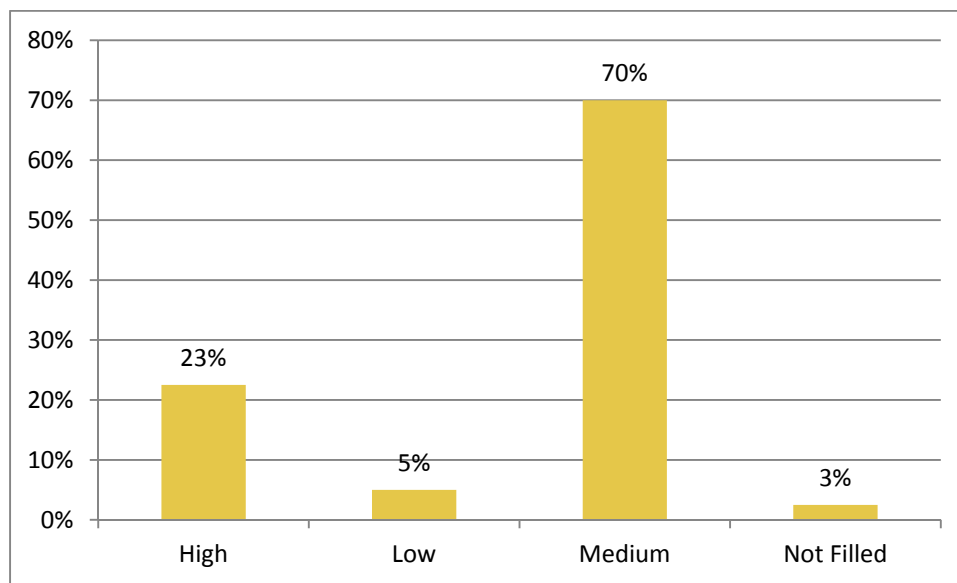


Source: BNI on-site surveys



Figure 114 shows the distribution of temperature set points for water heater observed. Seventy percent of units were set between 43 °C (110 °F) and 60 °C (140 °F) (i.e., medium), while 23 percent of units were above 60 °C (140°F) (i.e., high) and 5 percent of units were set below 110 °F (i.e., low). It should be noted that Health Canada recommends setting water heaters to a temperature of 50 °C (122 °F) to reduce the risk of legionellosis.

Figure 114. BNI Distribution of Water Heating Temperature Set Point

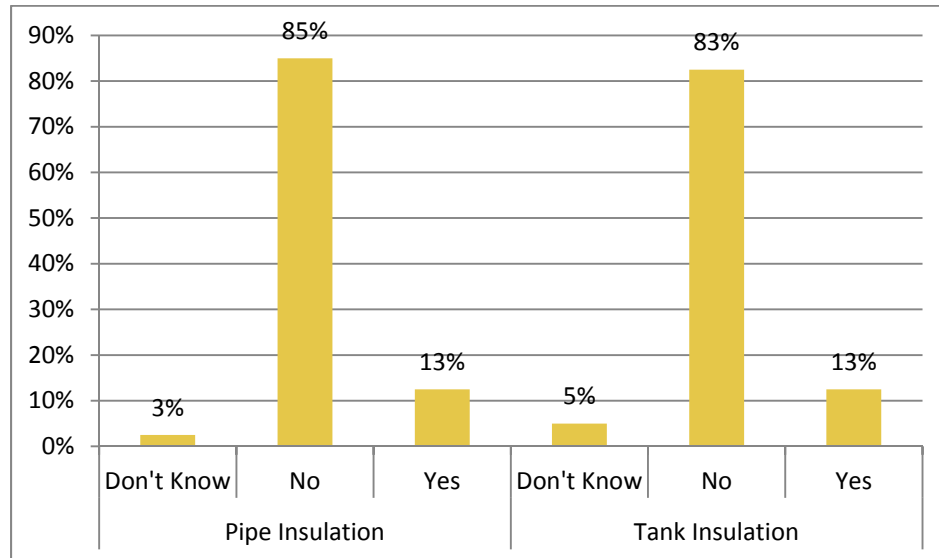


Source: BNI on-site surveys



Figure 115 summarizes the distribution of water heating insulation either on the tank or on the pipe. Eighty-five percent of pipes leading into the water heater were not insulated, while 13 percent were insulated. Similarly, 83 percent of tanks were not externally insulated (e.g., blanket wrap), while 13 percent had insulation.

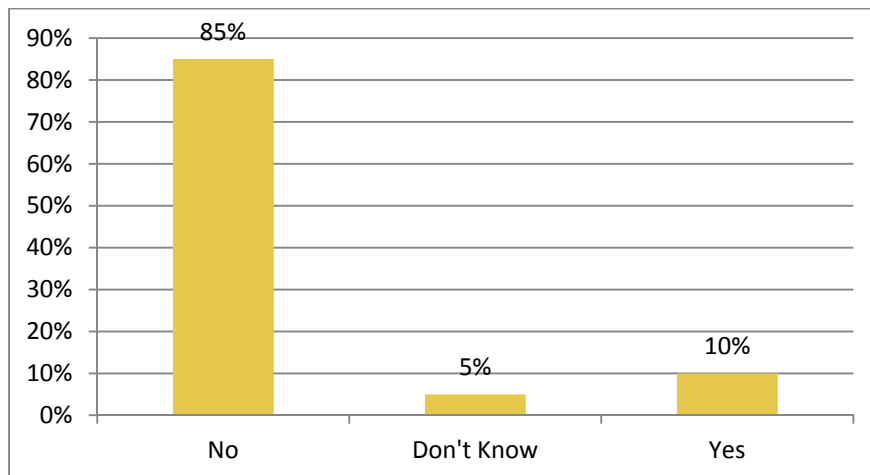
Figure 115. BNI Distribution of Water Heating Insulation



Source: BNI on-site surveys

As shown in Figure 116, 85 percent of water heaters did not have recirculation pumps installed, while 10 percent did have recirculation pumps installed. Five percent of water heaters were noted as unknown, or “Don’t Know”, if a recirculation pump was installed.

Figure 116. BNI Water Heat Recirculation Pump



Source: BNI on-site surveys



7.8 BNI Refrigeration

Market Characterization – Refrigeration

Figure 117 lists key findings for the BNI refrigeration profile.

Figure 117. BNI Refrigeration Profile

Market Characteristic	Key Findings	Source
Compressors	Compressors were in industrial facilities, restaurants, and ‘other commercial’ facilities. However, insufficient data exists to properly characterize the market in terms of compressors.	N
Walk-in space lighting	Nearly 63% of space lighting in BNI walk-ins is fluorescent, while another 25% is incandescent. The rest are unknown.	N
Walk-in lighting controls	Eighty-eight percent of lighting in BNI walk-ins is controlled via a wall switch. The rest of the control types are unknown.	N
Walk-in motor types	A quarter of the motors in BNI walk-ins are shaded pole, while the rest are unknown. 14% of motors have evaporative fan controls.	N

Source: BNI on-site surveys

Figure 118 provides a list of refrigeration equipment in BNI sites. Of the equipment types in BNI facilities, 55 percent are glass door beverage cases, as illustrated in Figure 119.

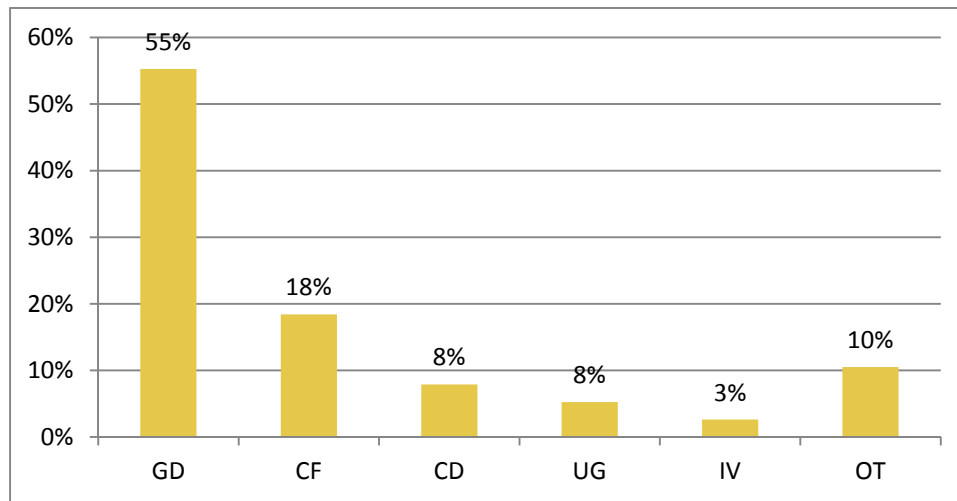
Figure 118. BNI Refrigeration Types

Equipment Code	Equipment Description	Size of Default	Source
GD	Glass door beverage cases (e.g. vendor supplied) from 2 to 4 doors	3 doors	N
CD	Closed door storage cases, one to three doors	2 doors	N
UG	Upright glass door freezer cases from one to three doors	2 doors	N
CF	Coffin type glass top freezer cases (usually ice cream) typically 6 or 8 ft.	7 ft.	N
OT	Other: self-contained refrigeration not listed above	1 unit	N
IV	Ice vending machines (hotel-sized icemaker) – Only self-contained units	1 unit	N

Source: BNI on-site surveys



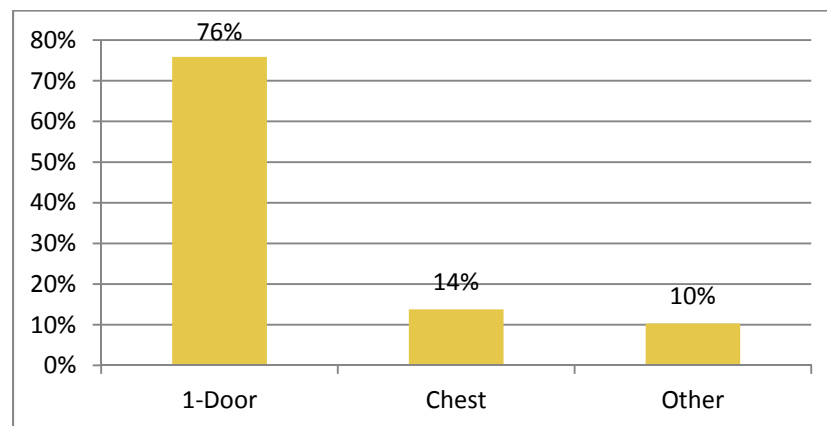
Figure 119. BNI Refrigeration Equipment Types Distribution



Source: BNI on-site surveys

Of all non-BNI refrigeration equipment type on BNI sites, 76 percent are 1-door cases, with another 14 percent being chest-style refrigerators. As shown in Figure 120, the final 10 percent are classified as 'other.'

Figure 120. Non-BNI Type Refrigeration Equipment Types Distribution



Source: BNI on-site surveys



7.9 *BNI Motors and Compressed Air*

7.9.1 Market Characterization – Motors and Compressed Air

Figure 121 provides a summary characterization of motor and compressed air measures for the BNI segments.

Figure 121. BNI Motors and Compressed Air Profile

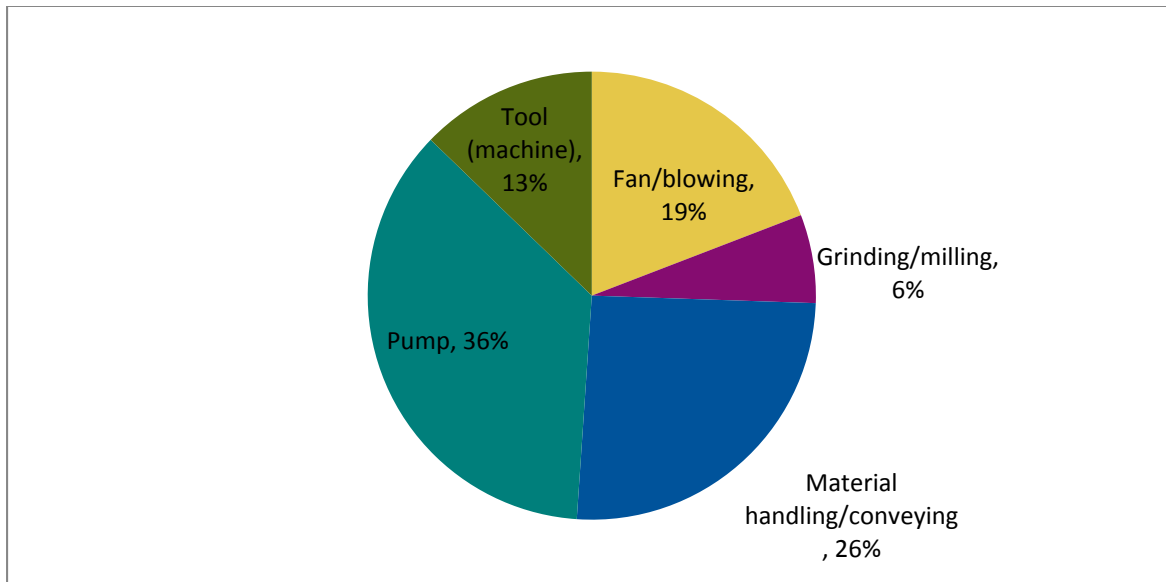
Measure/Characteristic	Key Findings	Source
Process motor types	The majority (62%) of motors are pump motors and material handling/conveying motors.	N
Motor controls and efficiency	All identified motors are standard efficiency and constant speed.	N
Air compressor types	The majority (82%) of air compressors are reciprocating two-stage, single acting (RTS) units.	N
Air compressor hours of use	RTS type air compressors are using 73 hp about 49 hours a week.	N
Air dryer on compressed air systems	The majority (90%) of air compressors do not have an air dryer.	N



7.9.2 Motors

The majority (62%) of motors in the BNI sample are pump motors and material handling/conveying motors, as shown in Figure 122. Process motors were present in the industrial/manufacturing, retail non-food and 'other commercial' segments of the BNI sample.

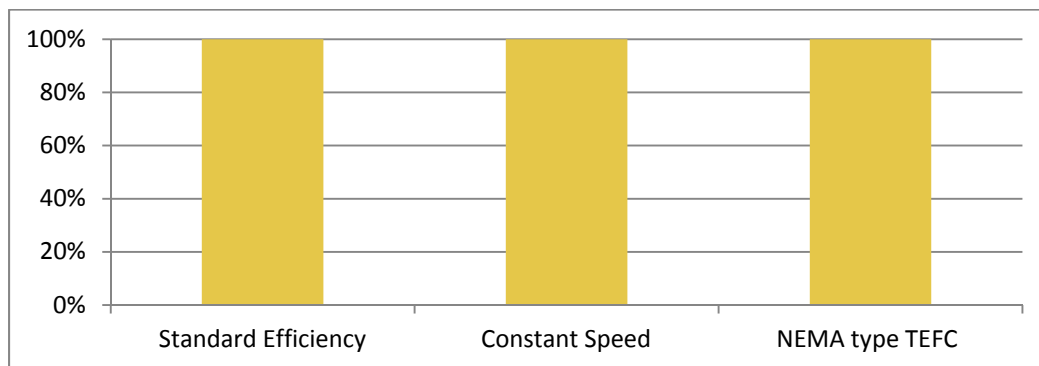
Figure 122. BNI Distribution of Process Motor Types



Source: BNI on-site surveys

Figure 123 shows that all of the motors surveyed are constant speed motors and classified as standard efficiency. All motors have a NEMA type of TEFC (totally enclosed fan cooled). Opportunities exist to increase efficiency levels of motors through both increasing equipment efficiency and adding variable controls.

Figure 123. BNI Motor Controls, Efficiency and NEMA Type



Source: BNI on-site surveys



The rated horsepower for process motor units ranges from 0.1hp to 30hp with a mean horsepower of 3.7hp. The total horsepower by motor type is shown in Figure 124.

Figure 124. BNI Total Motor Horsepower by Type

Motor Type	Number of Motor Units	Total Horsepower (hp)	Source
Fan/blowing	9	40	N
Grinding/milling	3	10.8	N
Material handling/conveying	12	34.5	N
Pump	16	84.5	N
Tool (machine)	1	5.1	N
Total	6	174.8	

Source: BNI on-site surveys

7.9.3 Compressed Air

The majority (82%) of the air compressors surveyed are reciprocating two-stage, single acting (RTS) units, as shown in Figure 125. Only one unit out of all air compressors is a smaller capacity single-stage model while all other units (91%) are two-stage compressors, which are more efficient and often longer lasting than their single-stage counterparts. All air compressor units were located in the industrial/manufacturing and 'other commercial' segments of the BNI sample. Navigant recommends investigation of electrically powered alternatives to compressed air use where possible, and recommends lowering air pressure setpoints for existing systems to the extent possible to control the high cost of compressed air systems. This can sometimes be achieved by separating unlike compressed air end uses onto separate systems.

Figure 125. BNI Distribution of Air Compressor Type

Air Compressor Type	Number of Units	Percent of Total	Source
Reciprocating (Single-stage, Single-acting) (RSS)	1	9%	N
Reciprocating (Single-stage, Double-acting) (RST)	0	0%	N
Reciprocating (Two-stage, Double-acting) (RTD)	1	9%	N
Reciprocating (Two-stage, Single-acting) (RTS)	9	82%	N
Rotary Screw (Two-Stage)	0	0%	N
Centrifugal	0	0%	N
Unknown	0	0%	N

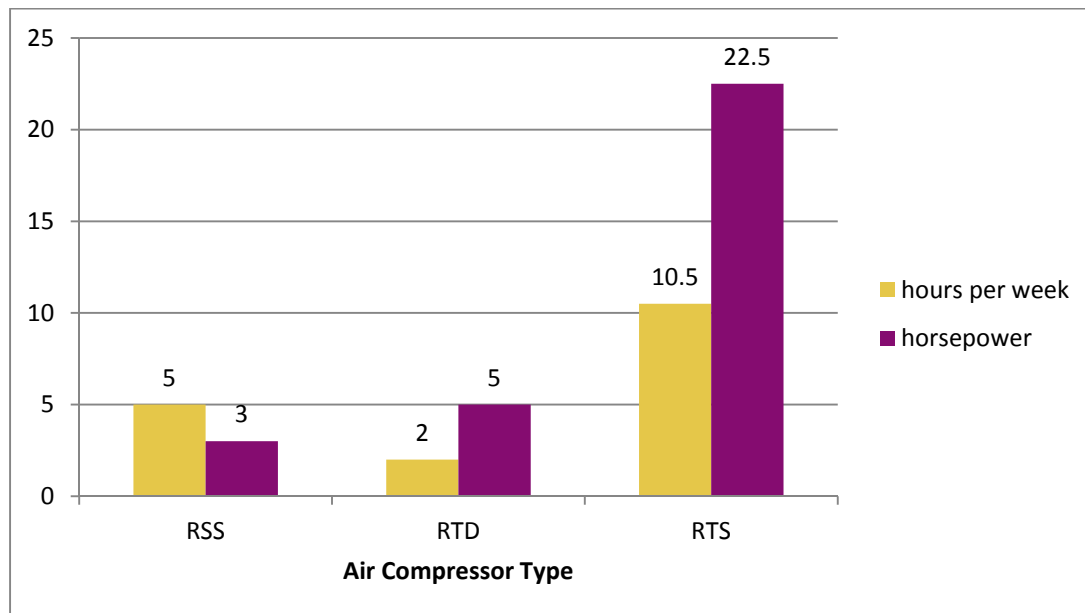


Other	0	0%	N
All	11	100%	

Source: BNI on-site surveys

The air compressors in the 'other commercial' segment are using a total of 30.5hp about 8 hours per week, as shown in Figure 126. Figure 127 shows that air compressors in the industrial/manufacturing segment of the BNI sample are using a total of 50hp about 40 hours per week.

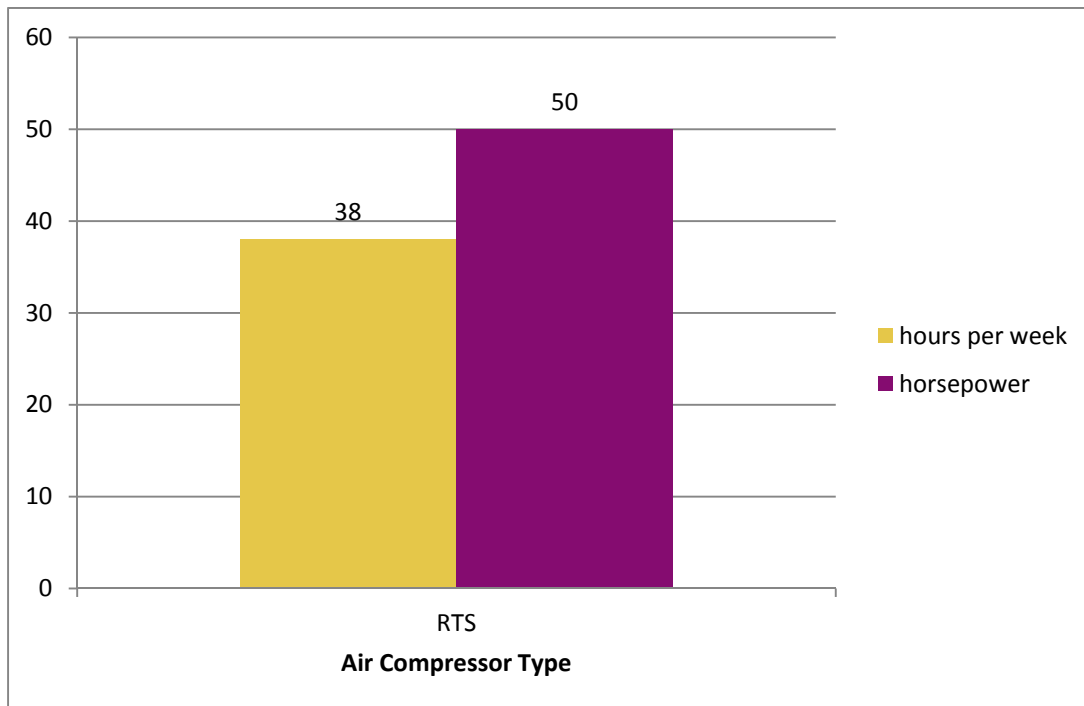
Figure 126. BNI 'Other Commercial' Air Compressor Hours of Weekly Use by Horsepower



Source: BNI on-site surveys



Figure 127. BNI Industrial Air Compressor Hours of Weekly Use by Horsepower



Source: BNI on-site surveys



The majority (90%) of air compressors do not have an air dryer, as shown in Figure 1284. Air dryers maintain higher quality compressed air, typically necessary for industrial purposes, but also consume more energy and typically operate continuously unless an efficient cycling air dryer is employed. Out of all the air compressors, only one RTS unit running at 7.5hp had an air dryer present.

Figure 128. BNI Air Dryer Verification by Air Compressor Type

Air Compressor Type	Number of Units	Air Dryer Present
Reciprocating (Single-stage, Single-acting) (RSS)	1	No
Reciprocating (Two-stage, Double-acting) (RTD)	1	No
Reciprocating (Two-stage, Single-acting) (RTS)	8	No
	1	Yes

Source: BNI on-site surveys (Source "N")

Figure 56 shows the distribution of televisions and computers by type, as well as the percent of each type that are ENERGY STAR® rated.

Source: Residential on-site surveys

Figure 56. Televisions and Computers per Household

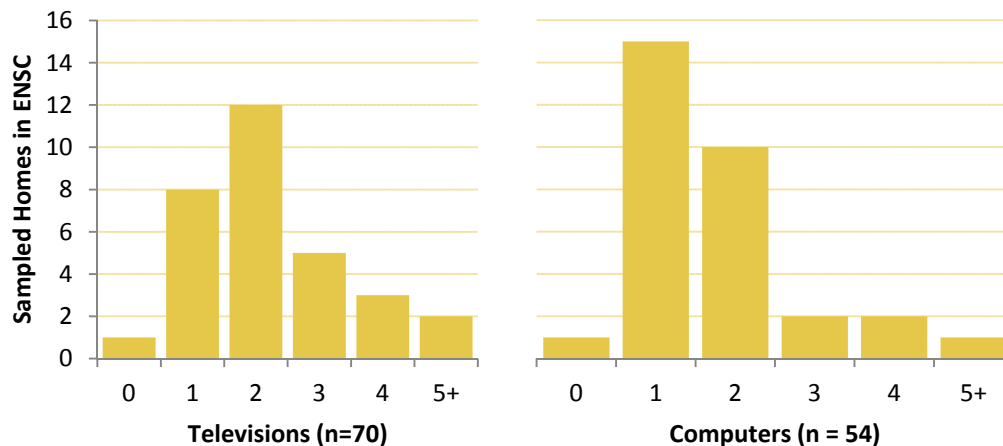
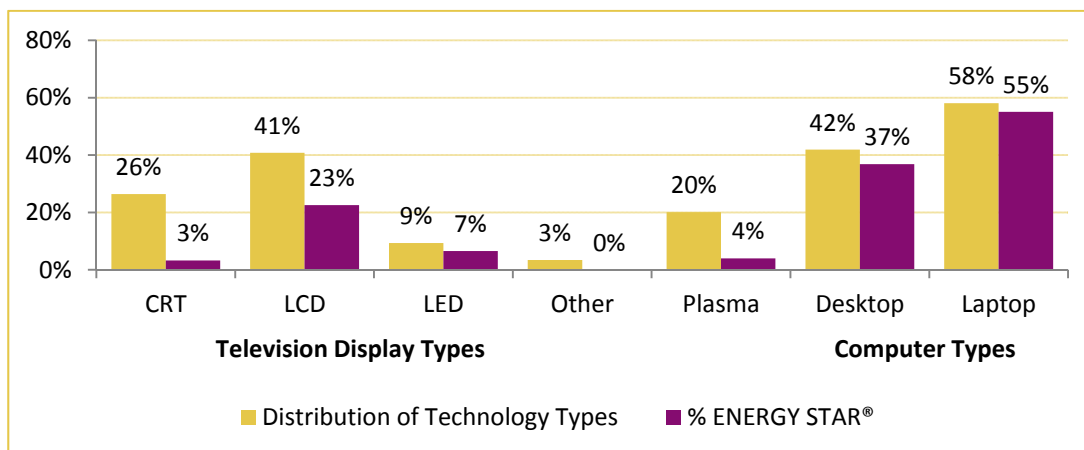


Figure 57. Television Display Types and Computer Types and Percent ENERGY STAR®





On-site survey results found that about 25 percent of all plug load devices are on a power strip that can be manually turned off at night. The rest are either not on a power strip, or on a strip that is left on all the time. Due to the increase in plug load devices in homes, a “smart strips” is one way to reduce “vampire loads” for these devices that operate at some level, 24 hours a day. A list of terminology for home entertainment system is provided in

Figure 58. Terminology for Home Entertainment System Components

Component	Abbreviation
Digital Video Disk	DVD
Digital Video Recorder	DVR
Other	OT
Videocassette Recorder	VCR
Video Game System	VS



7.10 Residential Water Heating

This section presents details on the water heating equipment present in the surveyed homes. A summary of residential water heating characterization is presented in Figure 59.

Figure 59. Residential Water Heating Profile

Measure / Characteristics	Key Findings	Source
Electric Water Heating	61% of surveyed primary water heaters were electric resistance.	B
	The average capacity for electric resistance water heaters was 38 gallons. 88% of electric resistance water heaters were located in conditioned spaces, the majority of which (64%) were set at a medium temperature setting.	M
Non-Electric Water Heating	39% of water heaters surveyed had fuel types other than electric resistance (ER). The most common of these were fuel oil, which constituted 35% of all water heaters.	B
	The average capacity was 38 gallons, and about 53% of the non-electric water heaters were located in conditioned spaces. 58% of these water heaters were set at a medium temperature setting.	M
Secondary Water Heaters	Of the 1500 surveyed online, 76 contained a secondary water heater. The water heaters were electric resistance, oil, solar, propane, and other.	B
Water Heater Capacity	The average capacity of water heating systems is 38 gallons. The minimum capacity of surveyed systems was 15 gallons, while the maximum capacity was 60 gallons.	M
Water Heater Location	72% of all residential water heaters are located in conditioned space.	M
Auxiliary Measures	Tank and pipe wrap were the only auxiliary measures installed on surveyed water heaters. These measures are present on 28% and 26% of water heaters, respectively ³⁶ .	B
Tank Temperature	Nearly 62% of all residential water heaters are set at a medium (125°F) setpoint. Another 18% are set at a high (150°F) setpoint, while another 14% are set at a low (90°F) setpoint. Temperature setpoints are unknown for 7% of water heaters, all of which are fuel oil.	M

³⁶ It should be noted that the majority of new water heaters installed typically have insulation integral to the tank.



7.10.1 Water Heater Fuel Type

Sixty-one percent of surveyed primary water heaters were electric resistance. The average capacity for electric resistance water heaters was 38 gallons. Eighty-eight percent of electric resistance water heaters were located in conditioned spaces, the majority of which (64%) were set at a medium temperature setting.

7.10.2 Water Heater Capacity

Figure 60 provides the average capacity of water heaters by fuel type. Similarly,

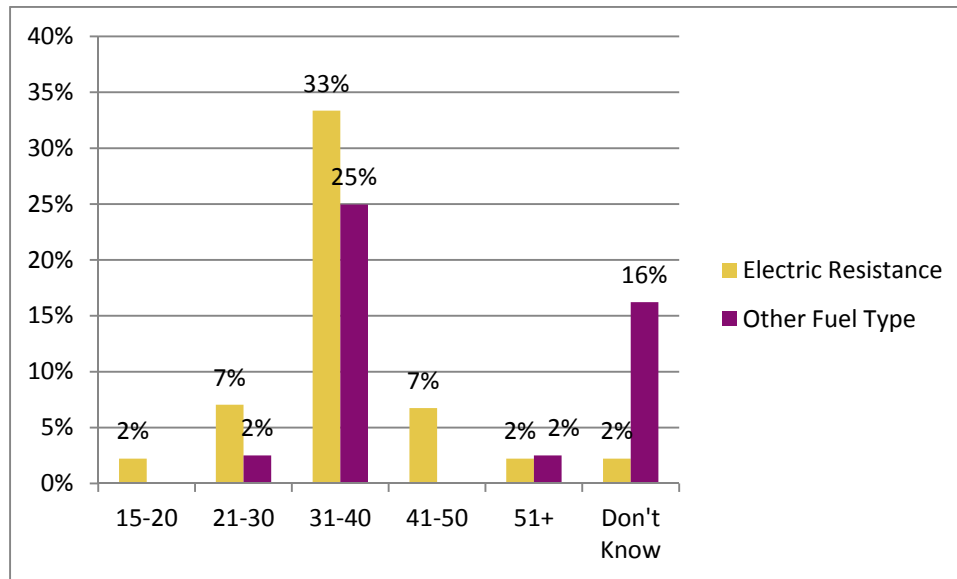
Figure 61 shows the distribution of water heater capacity ranges for both electric resistance water heaters and water heaters of other fuel types. The average water heater capacity across all fuel types is 38 gallons.

Figure 60. Residential Average Water Heating Capacity

Water Heater Fuel Type	Average Capacity (gallons)	Source
Electric Resistance	38.0	M
Natural Gas	40.0	M
Propane or Bottled gas	40.0	M
Fuel Oil	33.6	M

Source: Residential on-site surveys

Figure 61. Residential Water Heating Capacity Distribution: Percent of Overall Distribution



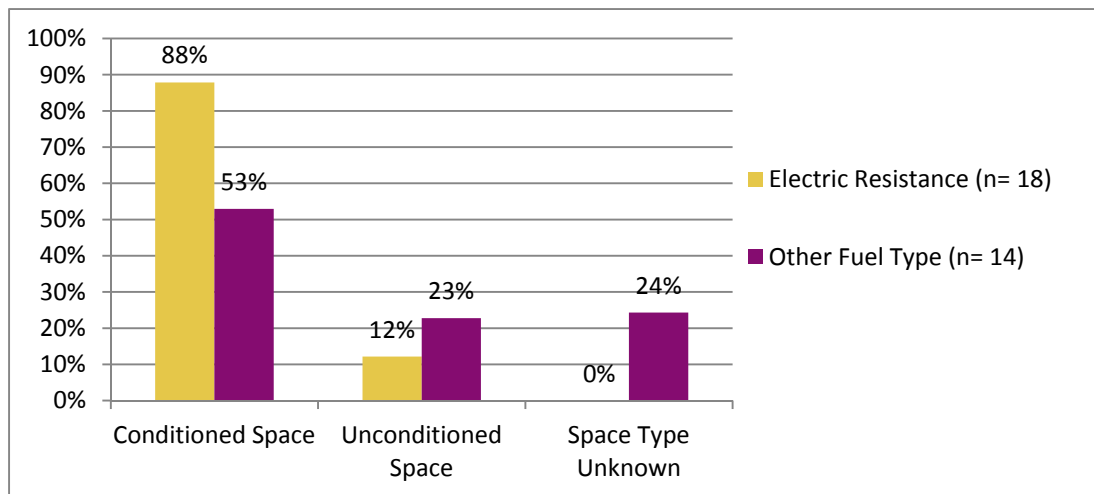
Source: Residential on-site surveys



Water Heater Location (Conditioned vs. Unconditioned)

Figure 62 illustrates the percent of both electric resistance water heaters and water heaters of other fuel types that are located in conditioned versus unconditioned space. Eighty-eight percent of electric resistance water heaters are located in conditioned space, while 53 percent of water heaters with other fuel types are located in conditioned space.

Figure 62. Residential Water Heating Location by Fuel Type



Source: Residential on-site surveys

7.10.3 Water Heater Auxiliary Measures

Figure 63 summarizes the auxiliary water heater measures that were installed. Both tank wrap and pipe wrap were installed on water heaters. Twenty-one percent of water heaters surveyed had tank wraps installed, while 19 percent of water heaters had pipe wrap installed on nearby piping.

Figure 63. Residential Water Heating Auxiliary Measures Profile

Auxiliary Measures	Distribution	Source
Tank Wrap	Tank wraps ³⁷ are present on 28% of residential water heaters.	B
Timer	3% of dwellings have water heater timers.	B
Add-On Heat Pump	No add-on heat pumps were present on residential water heaters.	M
Pipe Wrap	Pipe wrapping is present on 26% of residential water heaters.	B
Drain Water Heat Recovery	No drainwater heat recovery systems were present on residential water heaters.	M

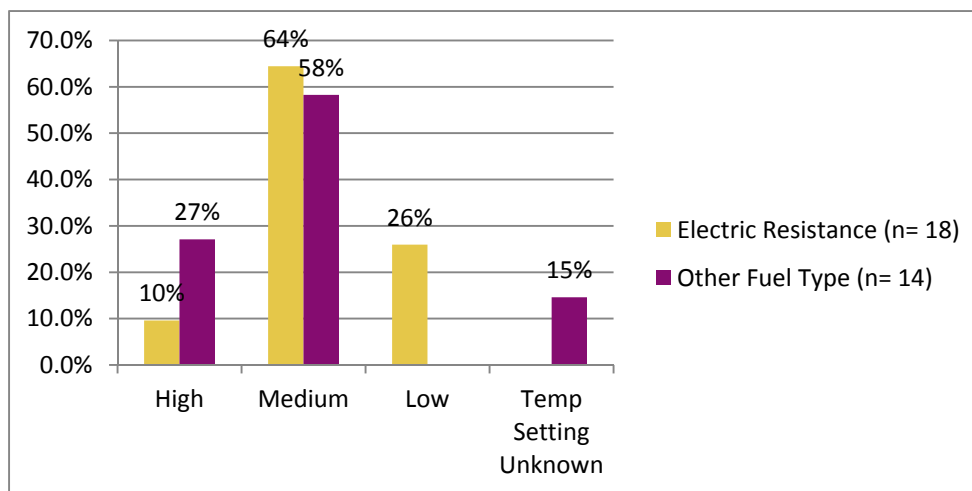
³⁷ It should be noted that the vast majority of new water heaters installed typically have insulation integral to the tank.



7.10.4 Water Heater Temperature Setting

Figure 64 shows the distribution of water heater temperature settings. The majority of both electric resistance water heaters (64%) and water heaters with other fuel types (58%) have medium (125°F) temperature setpoints. It should be noted that Health Canada recommends setting water heaters to a temperature of 50 °C (122 °F), which is the medium setpoint, to reduce the risk of legionellosis³⁸.

Figure 64. Residential Water Heater Temperature Settings



Source: Residential on-site surveys

7.10.5 Low-Flow Faucet Aerators and Low Flow Showerheads

Figure 65 summarizes the findings for faucet aerators and low flow showerheads. Thirty-three percent of dwellings have faucet aerators on all faucets, while 9 percent of dwellings had aerators on some, but not all faucets. Fifty-six percent of dwellings have low flow showerheads installed on all showerheads, while 5 percent have low flow showerheads installed on some, but not all showers.

Figure 65. Residential Faucet Aerators Profile

Measure/Characteristic	Key Findings	Source
Faucet Aerators	33% of dwellings have faucet aerators on all faucets, while 9% of dwellings had aerators on some, but not all faucets.	B
Low Flow Showerheads	56% of dwellings have low flow showerheads installed on all showerheads, while 5% have low flow showerheads installed on some, but not all showers.	B

³⁸ <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/diseases-maladies/legionnaire-eng.php#a5>



7.11 Residential Appliances

This section presents findings residential appliances. Figure 66 provides summary findings for all residential appliances. Over 95 percent of all residential ranges are electric, and 8 percent are ENERGY STAR® rated. All homes sampled have an oven; 96 percent are electric. Of the electric ovens, 7 percent are convection and the rest are standard. Sixty-four percent of residential dwellings sampled contain a dishwasher and about 20 percent of those are ENERGY STAR® rated. Ninety-eight percent of homes own a clothes washer, but only 31 percent are front loading, ENERGY STAR® rated. Ninety-six percent of homes own a clothes dryer, 94 percent of which are electrically operated.

Figure 66. Residential Appliances Profile

Measure/Characteristic	Key Findings	Source
Residential Range Cooktops	95% of all Residential ranges are electric	B
	8% of ranges are ENERGY STAR® rated.	M
Residential Ovens	All homes sampled have an oven; 96% are electric.	B
	Of the electric ovens, 7% are convection and the rest are standard. The average age of ovens is 10 years old.	M
Residential Dishwashers	64% of residential dwellings sampled contain a dishwasher.	B
	20% of dishwashers are ENERGY STAR® rated. 18% of dishwasher owners said they used the Energy Saver option all of the time, while only another 16% said they only use it some of the time. However, 66% use the Heat Booster option all of the time. The average age of dishwashers is nearly 10 years old.	M
Residential Clothes Washers	98% of homes own a clothes washer, and 31% are front loading.	B
	The majority (65%) of households in Atlantic Canada complete between two to three (28%) and four to seven (37%) loads of laundry per week in both summer and winter.	G
Residential Clothes Dryers	96% of homes own a clothes dryer.	B
	The majority (62%) of households dry between two and three (26%) and four and seven (36%) loads of laundry during winter weeks. The majority (62%) of households dries between one or less (38%) and two and three (24%) loads of laundry during summer weeks.	G



7.11.1 Residential Refrigerators

This section presents details on the refrigerators observed at the surveyed homes. Each surveyed home had at least one refrigerator. Figure 67 summarizes the key findings of refrigeration measures.

Figure 67. Refrigerators Profile

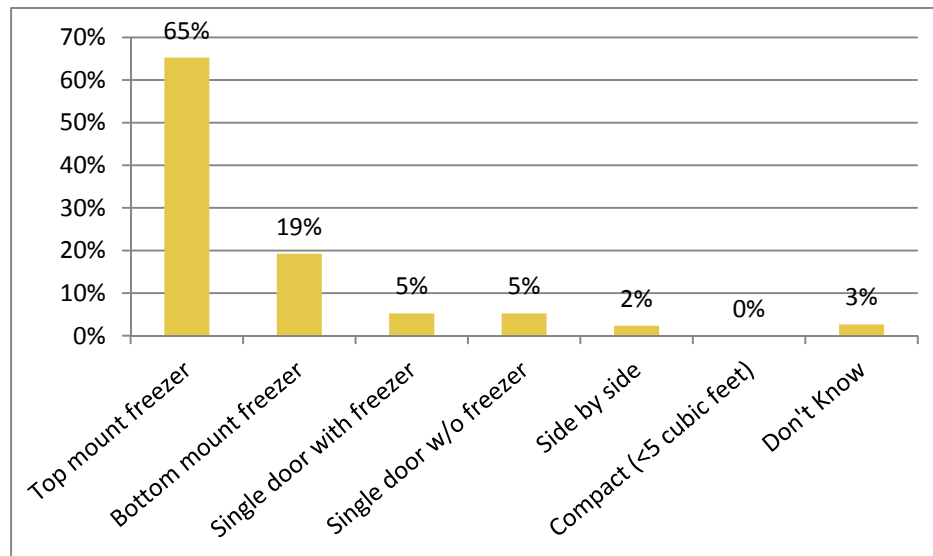
Measure/Characteristic	Key Findings	Source
Refrigerator - Primary	66% of all refrigerators are top-mount, while another 19% are bottom-mount. The average size of primary refrigerators is 16.4 cubic feet, and the average age is 7 years.	M
Refrigerator - Secondary	72% of secondary refrigerators are bottom mount. The average size of secondary refrigerators is 12.43 cu, ft., and the average age is 12 years.	M
Energy Star Refrigerators	11% of all refrigerators surveyed are Energy Star certified. All Energy Star refrigerators are primary refrigerators.	M
Refrigerator Size	Refrigerator size ranges from 4.8 to 22 cubic feet for primary refrigerators and from 5 to 18 cubic feet for secondary refrigerators.	M
Refrigerator Age	The average age of refrigerators was 9 years, ranging from 2 to 17 years.	M

Source: Residential on-site surveys

Figure 68 shows the majority of both primary and secondary refrigerators are top mount freezers representing 65 percent of all refrigerators.



Figure 68. Residential Primary Refrigerator Types



Source: Residential on-site surveys

The average sizes by refrigerator type are shown in Figure 69, while average ages by type are shown in Figure 69. The average size of side-by-side refrigerators is 22 cu. ft., while top mount, bottom mount, and single door without freezer have average sizes of 16.20, 18.60, and 4.80 cu. ft., respectively.

Figure 69. Residential Size of Refrigerators

Refrigerator Type	Primary Refrigerator Average Size (cu .ft.)	Secondary Refrigerator Average Size (cu. ft.)	Source
Side by side	22.00	-	M
Top mount freezer	16.20	17.30	M
Bottom mount freezer	18.60	-	M
Single door w/o freezer	4.80	-	M
Compact (<5 cubic feet)	-	5.00	M
Refrigerator Type Unknown	20.40	15.00	M

Source: Residential on-site surveys

The average age of top mount refrigerator is 9 years, while bottom mount, single door with freezer, and single door without freezer have average ages of 8, 7, and 2 years, respectively.

**Figure 70. Residential Age of Refrigerators**

Refrigerator Type	Primary Refrigerator Average Age (Years)	Secondary Refrigerator Average Age (Years)	Source
Top mount freezer	9	17	M
Bottom mount freezer	8	-	M
Single door with freezer	7	-	M
Single door w/o freezer	2	-	M
Compact (<5 cubic feet)	-	8	M
Refrigerator Type Unknown	-	-	M

Source: Residential on-site surveys



7.11.2 Residential Freezers

Figure 71 summarizes the key findings of the residential freezers surveyed. The online survey found that 70 percent of residential homes surveyed had at least one standalone freezer. One secondary freezer was found in the surveyed sites. Eighteen percent of freezers surveyed were Energy Star certified.

Figure 71. Residential Freezers Profile

Measure/Characteristic	Key Findings	Source
Freezer - Primary	80% of freezers surveyed are chest freezers. The average size of the primary freezers is 12.8 cu. ft., while the average age is 13 years. 93% of primary freezers are located in conditioned space.	M
Freezer - Secondary	Only one secondary freezer was found in the surveyed sites. This was a four year old Upright Frost-Free freezer in an unconditioned space.	M
Energy Star Freezer	18% of freezers surveyed were Energy Star certified.	M
Freezer Location	93% of primary freezers are located in conditioned spaces. The one secondary freezer survey was located in an unconditioned space.	M
Freezer Age	The average age of freezers is 11 years. Ages range from 1-42 years old, with 31% of freezers being under 4 years old.	M

Source: Residential on-site surveys

Figure 72 shows the freezer types by primary and secondary freezers. As the table illustrates, eighteen percent of freezers are Energy Star, all of which are primary freezers.

Figure 72. Residential Freezer Type Distribution

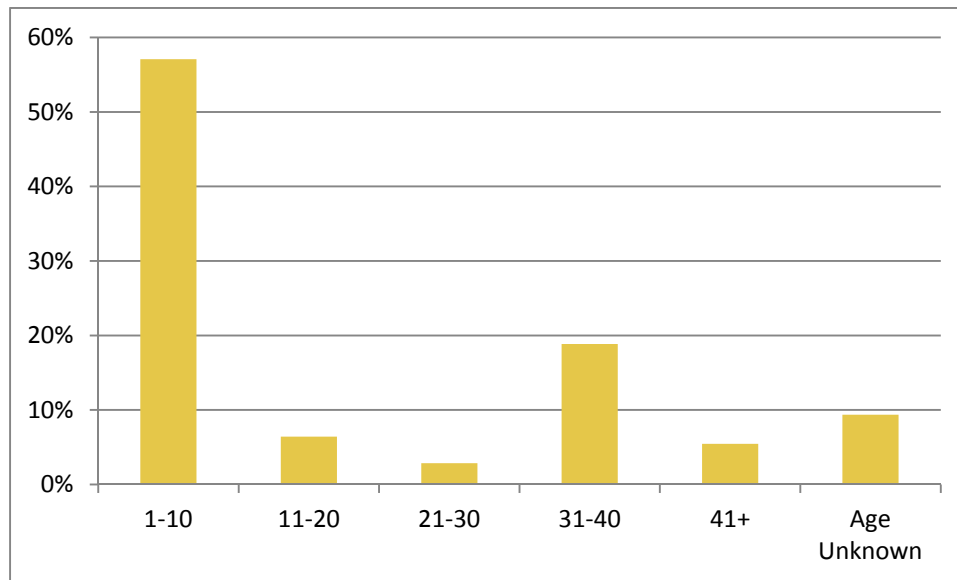
Freezer Type	Primary Freezers	Secondary Freezers	% Energy Star	Source
Chest	81.1%	-	12.3%	M
Upright Frost Free	12.3%	100.0%	5.9%	M
Upright Manual	3.3%	-	-	M
Freezer Type Unknown	3.3%	-	-	M

Source: Residential on-site surveys



Figure 73 illustrates the age range of freezers. Nearly 60 percent of all freezers are under 10 years old.

Figure 73. Residential Freezer Age Distribution



Source: Residential on-site surveys



8. Business, Nonprofit and Institutional Market Characterization

This section describes the BNI sector findings obtained from data collection and analysis activities conducted by the Navigant team. Data were gathered via 30 BNI on-site surveys during the fall of 2012 and winter of 2013. The on-site surveys were used to gather information on building characteristics and baseline saturations of efficient and standard lighting, HVAC, water heating, refrigeration and motors and compressed air. The results for BNI buildings surveyed are present in the following segments:

7. General Building Information
8. Building Envelope
9. Lighting
10. HVAC
11. Refrigeration
12. Motors and Compressed Air

It should be noted that certain results below were derived from a sample size of 30 on-site visits and are used in a qualitative manner. Where possible, Navigant has provided results from additional primary sources.

8.1 BNI General Building Information

Surveyors collected information regarding general building characteristics such as age, size, operating schedules, and more. The following sections present the results for key building characteristics. A summary of general building information is presented in Figure 74

Figure 74. BNI General Buildings Profile

Characteristic	Key Findings	Source
Facility Age	85% of BNI facilities were built post-1970 (weighted by floor space).	I
	The average year of construction was between 1970 and 1999 (weighted by floor space).	I
Building Size	41% of all BNI facilities are 5,000 sq. ft. or less. 14% of facilities were between 5,001 and 10,000 sq. ft. 18% of facilities were between 10,000 and 25,000 sq. ft. 8% of facilities were between 25,001 and more.	C
Business Hours	4% of facilities have weekly hours of 36 hours or less, 22% have hours between 37 and 48, 17% have weekly hours between 49 and 72 hours, 14% have hours between 73 and 96, 8% have hours between 97 and 120, and 34% have hours between 121 and 168, weighted by number of facilities.	I



8.1.1 Facility Age (Source I)

The majority (85%) of facilities were built post-1970. The average year of construction was between 1970 and 1999 (weighted by floor space). The year of construction is related to space heating and space cooling energy use. Shell construction issues such as leaks, cracks, and drafts due to aging or damaged construction materials and shifting structures, can increase the energy used for space conditioning, particularly for older facilities.

8.1.2 Building Size (Source C)

Forty-one percent of all BNI facilities are 5,000 sq. ft. or less. Fourteen percent of facilities were between 5,001 and 10,000 sq. ft. Eighteen percent of facilities were between 10,000 and 25,000 sq. ft. Eight percent of facilities were 25,001 sq. ft. or more.

8.1.3 Business Hours (Source I)

Four percent of facilities have weekly hours of 36 hours or less, 22 percent have hours between 37 and 48, 17 percent have weekly hours between 49 and 72 hours, 14 percent have hours between 73 and 96, 8 percent have hours between 97 and 120, and 34 percent have hours between 121 and 168, weighted by number of facilities.

8.2 BNI Building Envelope

This section provides details of the commercial building shell measures present at the on-site surveyed commercial buildings envelope types. Figure 75

Figure 75 summarizes the key findings of building shell properties. Envelope characteristics and shell tightness have a significant interactive effect with space heating and cooling capacities and runtimes.

Improving the overall shell thermal insulation, including glazing, and reducing infiltration, can create an opportunity to introduce reduced capacity high efficiency mechanical equipment.

**Figure 75. BNI Building Shell Profile**

Measure / Characteristic	Key Findings	Source
Wall Construction Types	Considering all commercial exterior wall area, 20% has concrete block construction, 15% has 2x6 wood frame construction, 14% has 2x6 metal frame construction, and 14% has adiabatic or shared walls.	N
Exterior Wall Insulation Types	43% of all commercial wall area has batt or blanket insulation. 27% of all commercial wall area does not have any insulation.	N
Roof Construction Type	46% of commercial roof area is framed (28% with an attic, 18% without an attic). 31% of commercial roof area is constructed with metal decking.	N
Roof Surface	33% of commercial roof area has a metal surface. 16% of commercial roofs have an asphalt roll/shingle surface.	N
Roof Finish	51% of commercial roof area has a flat finish. 24% of commercial roof area has a reflective finish.	N
Roof Colour	Only 12% of commercial roof area is dark.	N
Floor Types	More than half of commercial floor area is slab-on-grade.	N
Window Panes	99.6% of commercial window area has two panes.	N
Window Glazing Types	Grocery/supermarket and health care/hospital facilities only contain clear window glazing, and most non-food retail centers only have clear window glazing. The majority of industrial facilities and restaurants have tinted window glazing. The majority of 'other commercial' facilities contain reflective window glazing.	N
Window Glazing Features	The majority of commercial windows do not have any glazing features, with the exception of health care/hospital facilities and restaurants which each have about 90% low-E and gas-filled windows.	N
Window Frame Types	Commercial window frames are metal, with the main exception being vinyl windows in health care/hospital facilities.	N
Window Film	99.8% of commercial window area does not have any added window film.	N

Source: BNI on-site surveys



8.2.1 Exterior Wall Construction Types

Figure 76 below describes the findings on commercial exterior wall construction types, broken out by building type. Considering all commercial building wall areas, 20 percent are concrete block construction, 15 percent are 2x6 wood frame construction, 15 percent are 2x6 metal frame construction, and 15 percent are adiabatic or shared walls. A relatively small percentage of commercial building wall area is 2x4 wall construction. The exterior wall construction types vary significantly by building type.

Figure 76. BNI Exterior Wall Construction Types

Exterior Wall Construction Type	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
2x4 Wood Frame	0%	22%	0%	3%	0%	12%	5%	N
2x6 Wood Frame	0%	33%	16%	20%	30%	4%	15%	N
2x4 Metal Frame	0%	0%	0%	1%	0%	0%	0%	N
2x6 Metal Frame	0%	0%	33%	3%	13%	15%	15%	N
8" Solid Concrete	0%	22%	0%	2%	0%	10%	4%	N
10" Solid Concrete	0%	0%	0%	7%	0%	4%	4%	N
12" Solid Concrete	0%	0%	0%	3%	0%	0%	1%	N
Concrete Block	50%	0%	33%	12%	0%	19%	20%	N
Brick	0%	0%	0%	0.6%	0%	0%	0.3%	N
Corrugated Metal	0%	0%	17%	13%	0%	0%	11%	N
Adiabatic (shared wall)	50%	11%	0%	23%	13%	16%	15%	N
Other	0%	0%	0%	2%	0%	0%	1%	N
Unidentified	0%	11%	0%	11%	43%	21%	10%	N
Total	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys



8.2.2 Exterior Wall Insulation Types

Figure 77 shows commercial exterior wall insulation types, broken out by building type. Forty-three percent of all BNI building exterior wall area has batt or blanket insulation. Twenty-seven percent does not have any insulation at all. Exterior wall insulation types are moderately similar across commercial building types.

Figure 77. BNI Exterior Wall Insulation Types

Exterior Wall Insulation Type	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
Batt or Blanket	0%	38%	50%	40%	43%	43%	43%	N
Expanded Polystyrene	0%	25%	26%	8%	0%	10%	13%	N
Loose Fill	0%	25%	0%	2%	0%	0%	2%	N
Rigid Board	0%	0%	0%	0.7%	0%	0%	0.4%	N
Other	50%	0%	0%	5%	0%	0%	3%	N
None	50%	0%	24%	33%	13%	19%	27%	N
Unidentified	0%	13%	0%	12%	43%	28%	13%	N
Total	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys

8.2.3 Roof Construction Types, Surfaces, Finishes, and Colours

Figure 78 summarizes the BNI roof construction types, surfaces, finishes, and colours among various BNI building types. Forty-six percent of BNI roof area is framed, 28 percent has an attic and 18 percent does not have an attic. Thirty-one percent of BNI roof area is constructed using metal decking. All three grocery/supermarket facilities surveyed have a framed roof with an attic. CIBEUS 2000 reports that 31 percent of roof types in Atlantic Provinces are deck type roof construction, 24 percent are framed with attic type construction, 19 percent are metal truss roof construction, 13 percent are wood truss construction, and 12 percent are unknown.

Thirty-three percent of all BNI roof area has a metal surface. Twenty-one percent and 16 percent of BNI roof area has built-up and asphalt roll/shingle roof surface, respectively.

Considering all BNI roof area finishes, fifty-one percent is flat, 24 percent is reflective, and 25 percent is not identified. Sixty-seven percent of industrial/manufacturing facility roof area surveyed contains a reflective finish.

Thirty-six percent of all BNI roof area is a medium colour, and only twelve percent is dark. All three grocery/supermarket facilities surveyed have a dark asphalt roll/shingle roof. Non-food retail BNI buildings have a fairly even distribution of roof colours.



Figure 78. BNI Roof Construction Types, Surfaces, Finishes, and Colours

Roof Criteria	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
Roof Construction Type								
Adiabatic (shared wall)	0%	17%	0%	2%	0%	0%	1%	N
Framed With Attic	100%	33%	33%	26%	0%	26%	28%	N
Framed Without Attic	0%	33%	33%	5%	35%	29%	18%	N
Metal Decking	0%	0%	35%	29%	15%	38%	31%	N
Unidentified	0%	17%	0%	39%	50%	8%	22%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	
Roof Surface								
Asphalt Roll/Shingle	100%	67%	0%	24%	0%	14%	16%	N
Built-up	0%	0%	0%	21%	35%	39%	21%	N
Metal	0%	0%	66%	17%	15%	34%	33%	N
Wood Shingle	0%	0%	0%	0%	0%	6%	2%	N
Unidentified	0%	33%	34%	38%	50%	7%	29%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	
Roof Finish								
Flat	100%	67%	34%	48%	50%	84%	51%	N
Reflective	0%	0%	66%	13%	0%	0%	24%	N
Unidentified	0%	33%	0%	40%	50%	16%	25%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	
Roof Colour								
Light	0%	0%	66%	17%	0%	24%	30%	N
Medium	0%	67%	34%	36%	50%	37%	36%	N
Dark	100%	0%	0%	10%	0%	28%	12%	N
Unidentified	0%	33%	0%	38%	50%	11%	22%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys



8.2.4 Floor

Figure 79 displays the BNI floor types broken down by BNI building type. More than half of BNI floor area is slab-on-grade. 34 percent of health care/hospital facilities' floor area has an unheated basement.

Figure 79. BNI Floor Types

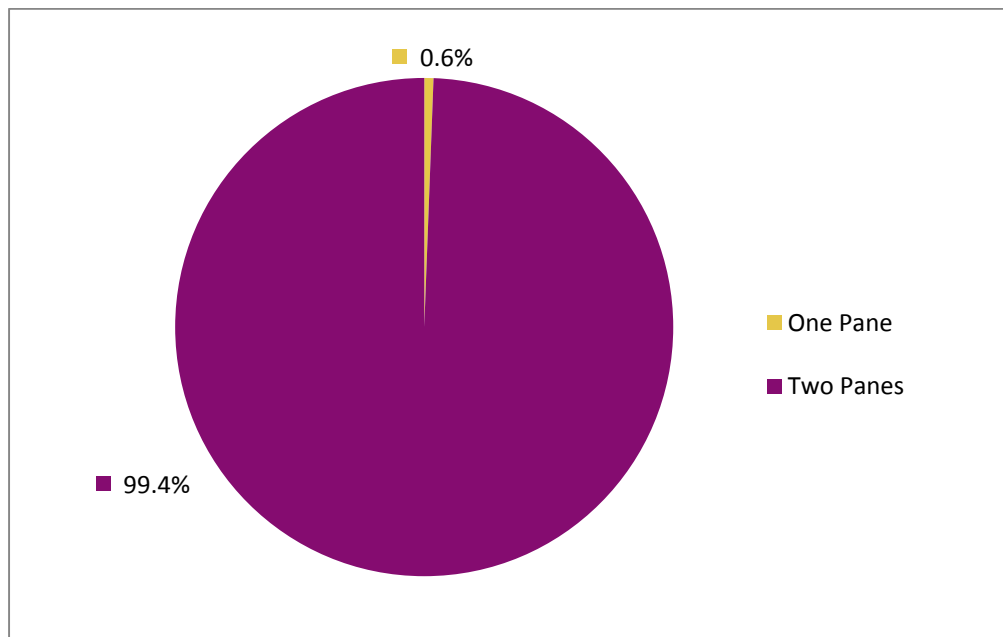
Floor Type	Grocery/ Supermarket,	Health Care/ Hospital	Industrial/ Manufacturing	Other Commercial	Restaurant	Retail (non-food)	Total Commercial	Source
Adiabatic (shared wall)	0%	0%	0%	2%	0%	0%	1%	N
Crawl	0%	0%	0%	3%	0%	0%	1%	N
Slab	50%	17%	50%	59%	50%	50%	53%	N
Unheated Basement	0%	34%	0%	0%	0%	0%	1%	N
Unidentified	50%	50%	50%	36%	50%	50%	44%	N
Total by Category	100%	100%	100%	100%	100%	100%	100%	

Source: BNI on-site surveys

8.2.5 Windows/Fenestration

Figure 80 shows that almost all commercial windows have two panes. Over 99 percent of window area surveyed was two pane.

Figure 80. BNI Window Panes

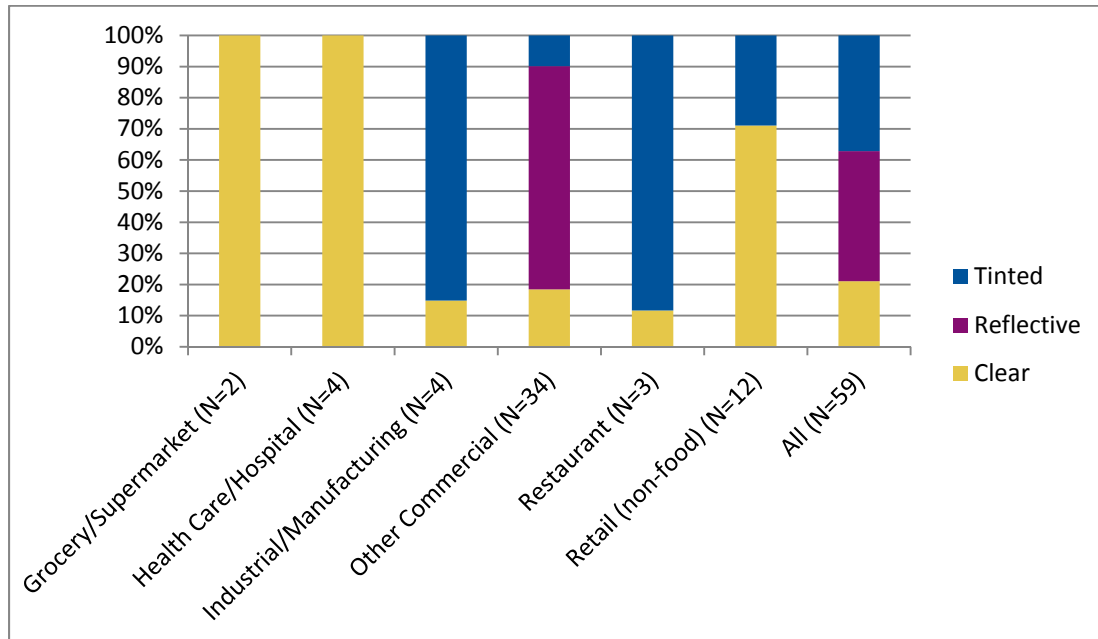


Source: BNI on-site surveys



Figure 81 displays the BNI floor types broken down by building type. Grocery/supermarket and health care/hospital facilities do not contain any treated window glazing. Most non-food retail centers do not have any treated window glazing. A majority of industrial facilities and restaurants have tinted window glazing. The majority of other BNI facilities contain reflective window glazing.

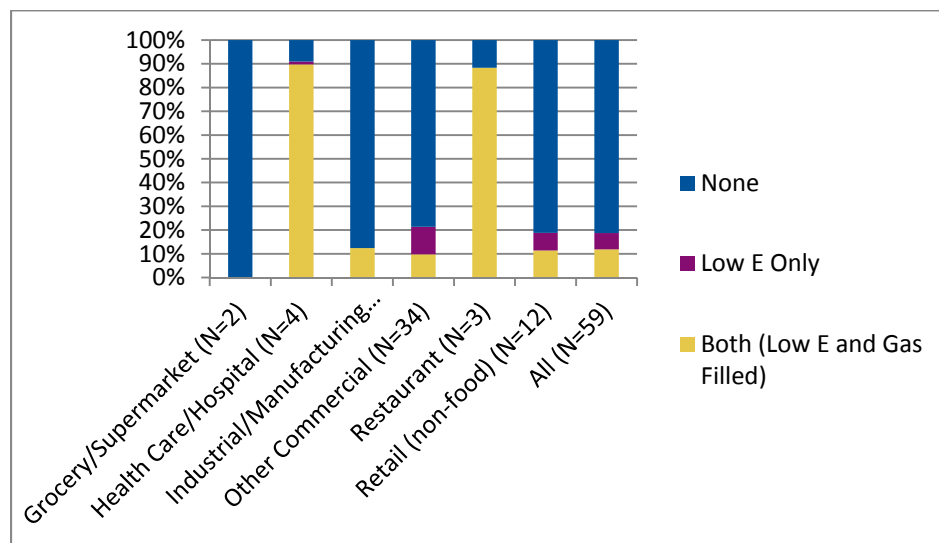
Figure 81. BNI Window Glazing Type



Source: BNI on-site surveys

Figure 82 presents BNI window glazing features by commercial building type. The majority of BNI windows do not have any glazing features, with the exception of health care/hospital facilities and restaurants, which each have about 90 percent low-E and gas-filled windows.

Figure 82. BNI Window Glazing Features

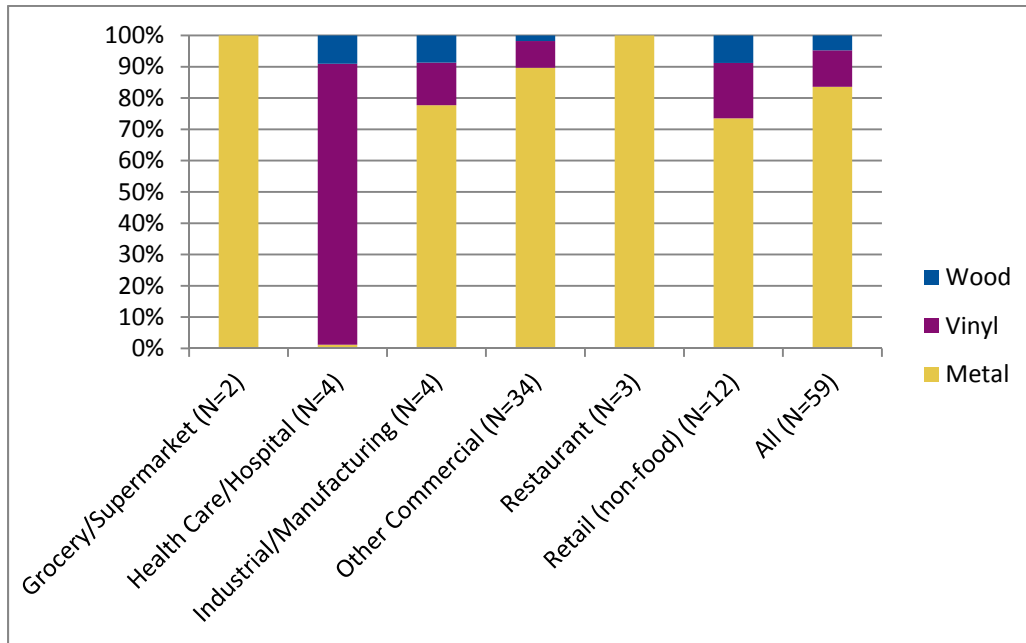


Source: BNI on-site surveys



Figure 83 displays BNI window frame types broken down by building type. Most BNI window frames are metal, with the main exception being vinyl windows in most health care/hospital facilities.

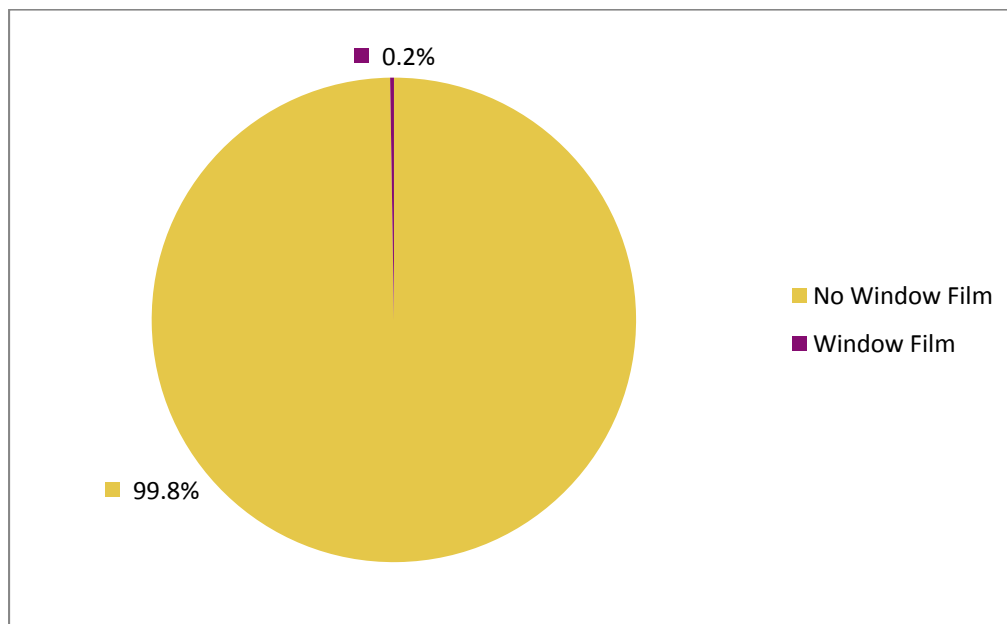
Figure 83. BNI Window Frame Types



Source: BNI on-site surveys

Figure 84 shows that almost all BNI windows do not currently have window film.

Figure 84. BNI Window Film

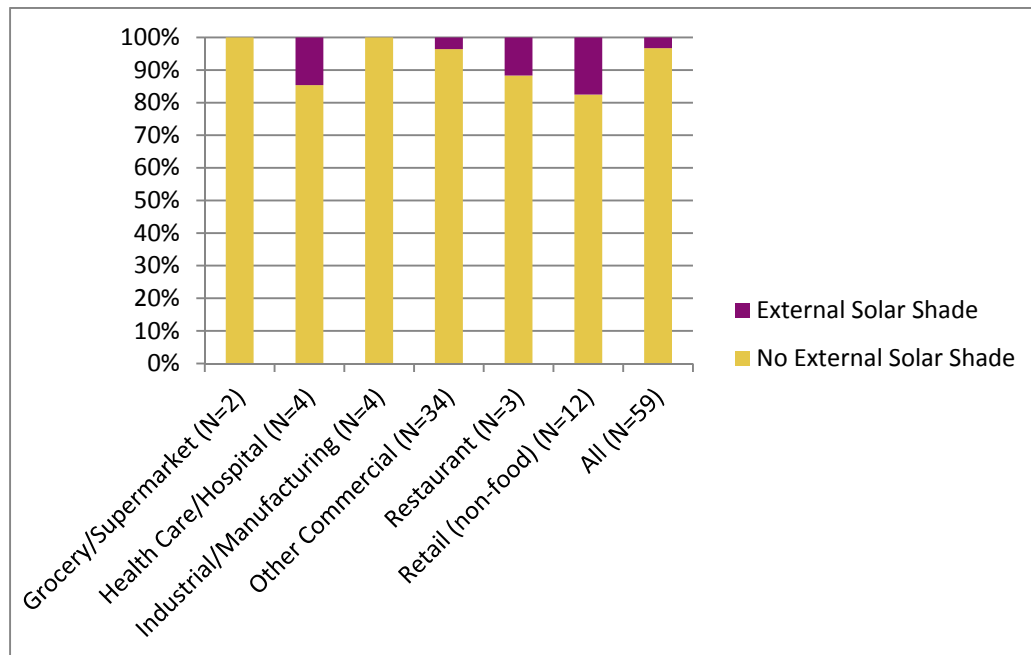


Source: BNI on-site surveys



Almost all BNI windows do not have an exterior solar shade, as shown in Figure 85.

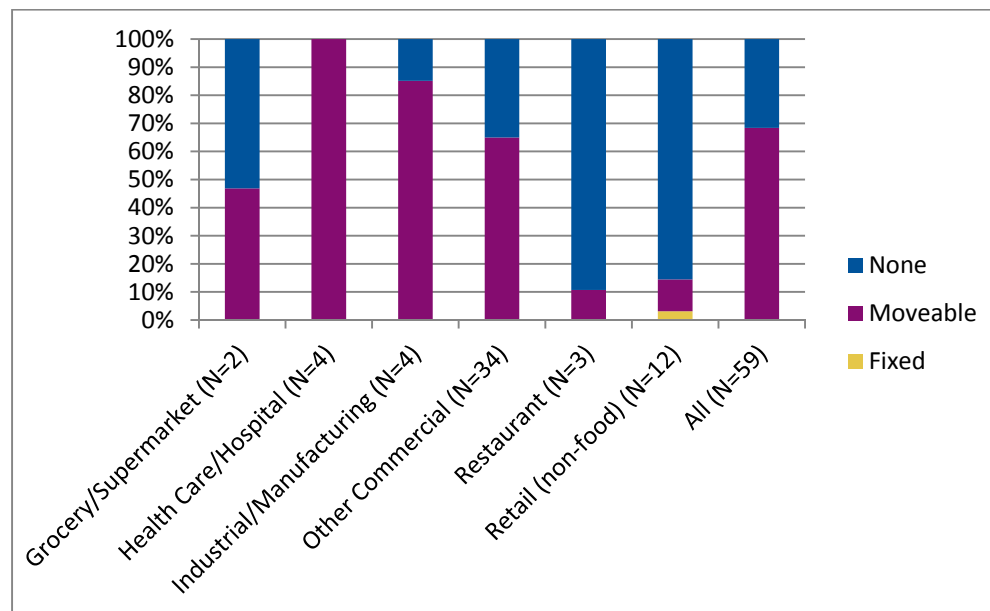
Figure 85. BNI Window Exterior Solar Shade



Source: BNI on-site surveys

Figure 86 shows BNI window interior shade types broken down by building type. About 68 percent of window area has moveable interior shades, with most of the remainder not having any interior shades at all. Of all BNI buildings, only a small percentage of non-food retail facilities have fixed interior shades.

Figure 86. BNI Window Interior Shades



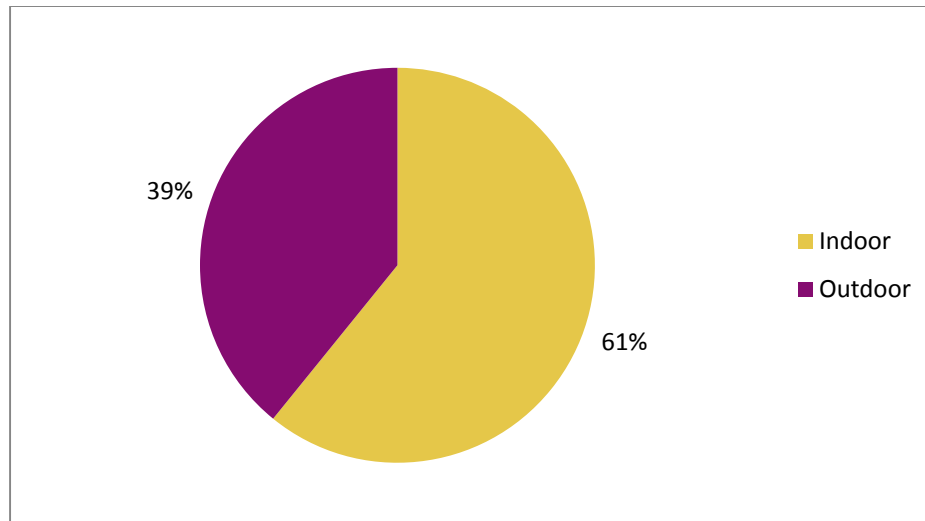
Source: BNI on-site surveys



8.3 BNI Lighting

Figure 87 summarizes the location of the BNI lighting surveyed for ENSC (weighted by wattage). Sixty-one percent of all lighting types were indoor while 39 percent were outdoor.

Figure 87. BNI Lighting Location Distribution



Source: BNI on-site surveys

8.3.1 Indoor Lighting

Figure 88 lists key findings for the BNI indoor lighting profile. Findings include high level results regarding fixture types, wattages, and control types. Reduced indoor lighting power in interior conditioned spaces typically increases the heating energy needed in the winter in occupied spaces.

Figure 88. BNI Indoor Lighting Profile

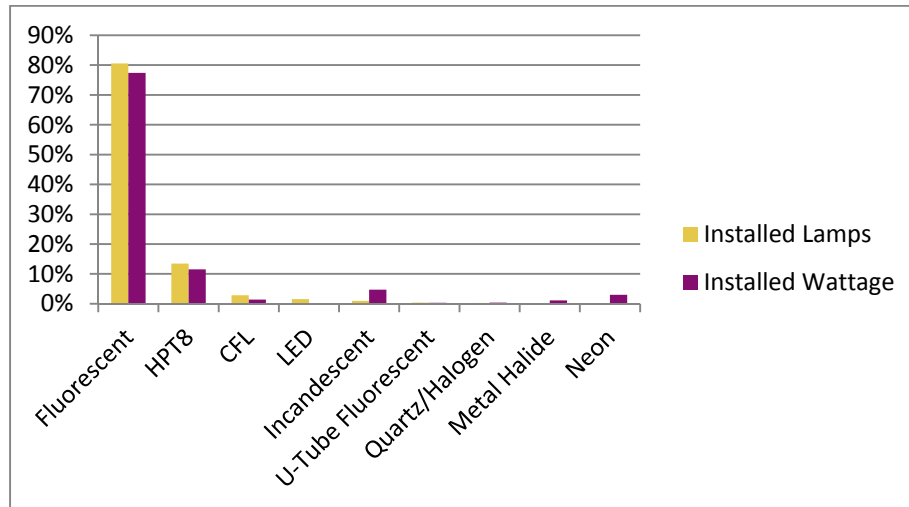
Measure Characteristic	Key Findings	Source
Fixture Types	Fluorescent lights, including both standard and high performance models, make up 94% of installed lamps and 89% of installed wattage. The second most common lamp type is CFLs, which make up 3% of installed lamps and 1% of installed wattage.	N
Wattage	The average wattage of indoor lamps is 36 Watts. The highest average wattage was in industrial facilities, with an average of 42 Watts per lamp, followed by 'Other Commercial' sites at an average of 40 Watts per lamp.	N
Control Type	Only 6% of indoor BNI lighting has controls beyond a standard manual switch. 58% of lighting is controlled by an on/off switch, while another 32% is continuous lighting with no controls.	N

Source: BNI on-site surveys



Figure 89 summarizes the interior lighting lamp type distribution, weighted by installed wattage. Eighty-one percent of all interior lights recorded were standard-output fluorescent lamps, while another 13 percent were high-output fluorescent lamps. Standard fluorescent lamps also represented 77 percent of installed wattage, while high performance HPT8s represented another 12 percent. This illustrates that fluorescents clearly compose the dominant lighting type in ENSC BNI buildings. Exact distribution values for all lighting types are listed in Figure 90.

Figure 89. BNI Installed Lamps vs. Installed Wattage



Source: BNI on-site surveys

Figure 90. BNI Installed Lamps vs. Installed Wattage

Lamp Type	Installed Lamps	Installed Wattage	Source
Fluorescent	81%	77%	N
HPT8	13%	12%	N
CFL	3%	1%	N
LED	2%	0%	N
Incandescent	1%	5%	N
U-Tube Fluorescent	0%	0%	N
Quartz/Halogen	0%	0%	N
Metal Halide	0%	1%	N
Neon	0%	3%	N

Source: BNI on-site surveys



Fluorescent lamps also dominate the market in terms of fixture types, as shown in Figure 91. Almost 60 percent of indoor fixtures in ENSC's BNI market are standard fluorescent, while another 22 percent are high performance T8 fluorescent fixtures. This is in contrast to the 2012 CRA CIBBS telephone survey indicates that there is still significant potential for efficient fluorescent lighting such as HPT8 and T5HO fixtures in Nova Scotia, particularly for T5 fixtures. A majority of participants surveyed did not state 'already installed' as a barrier to installing fluorescent lighting in their commercial buildings. On average across efficient fluorescent types, 15 percent of respondents stated that Fluorescent Lighting was Already Installed at Their Facility, and Other Reasons, were given as primary barriers to implementation.

Figure 91. BNI Distribution of Fixture Type

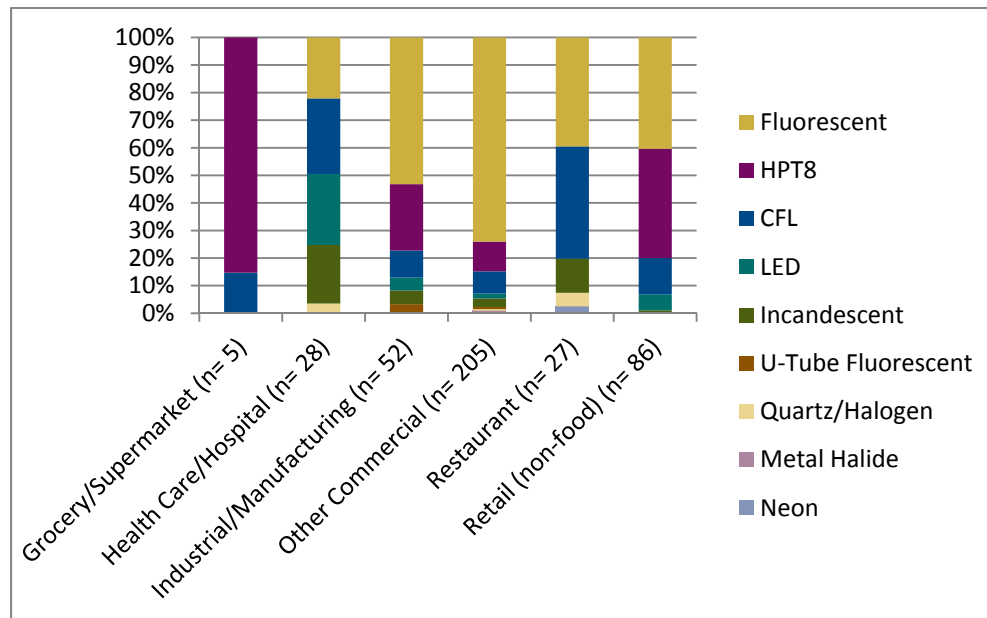
Lamp Type	Fixture Distribution	Source
Fluorescent	57%	N
HPT8	22%	N
CFL	11%	N
LED	4%	N
Incandescent	3%	N
U-Tube Fluorescent	1%	N
Quartz/Halogen	1%	N
Metal Halide	0%	N
Neon	0%	N

Source: BNI on-site surveys

A breakdown of fixture distribution by building type is illustrated in Figure 92. Standard fluorescent fixtures are the most common fixture type in industrial facilities, non-food retail facilities, and 'other commercial' buildings. HPT8s are the most common in grocery stores, while CFLs are most common in health care facilities and restaurants.



Figure 92. BNI Fixture Distribution by Building Type



Source: BNI on-site surveys



8.3.2 Outdoor Lighting

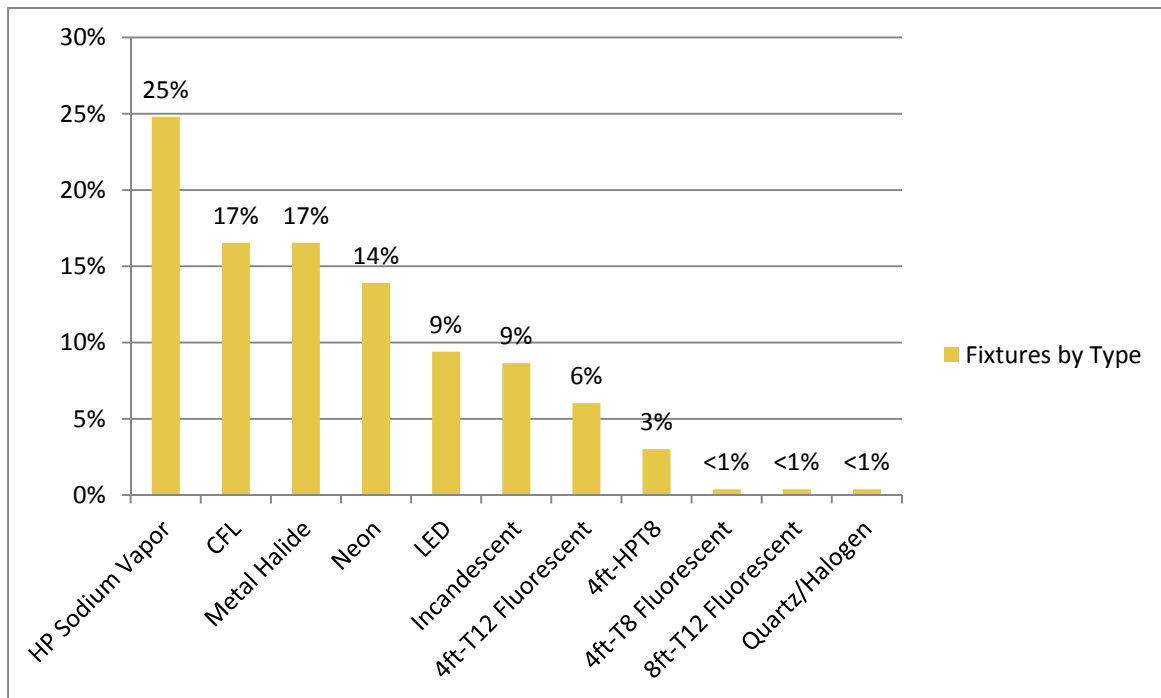
Figure 93 lists key findings for the BNI outdoor lighting profile. Findings include high level results regarding fixture types, wattages, and control types.

Figure 93. BNI Outdoor Lighting Profile

Measure Characteristic	Key Findings	Source
Fixture Types	One-quarter of all outdoor fixtures are High Pressure Sodium Vapor. CFLs and Metal Halides each constituted 17% of the rest of the outdoor lighting fixture types. Neon lights made up another 14% of the distribution. The rest of the lighting types made up less than 10% each.	N
Wattage	Neon lamps are the dominant lamp type by wattage, making up over 85% of the distribution. The average wattage for all outdoor lamp types is 138 watts. Wattages range from 10-100 Watts, depending on the lamp.	N
Control Type	82% of sites have motion sensors, photocells, or time clocks as outdoor lighting controls. Of these control types, 86% are time clocks.	N

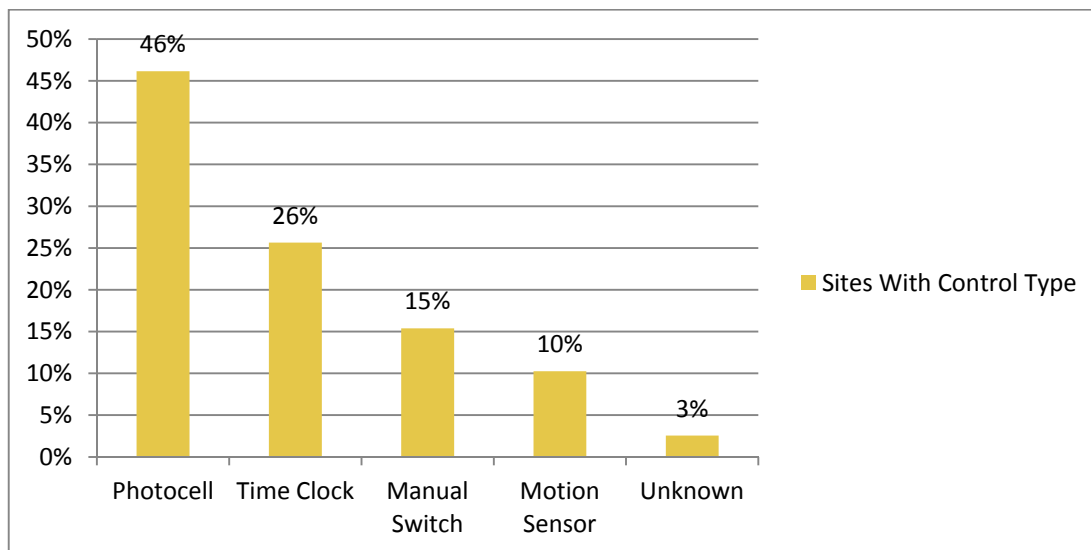
Source: BNI on-site surveys (Source "N")

As shown in Figure 94, high-pressure sodium vapor is the most common exterior fixture type, constituting nearly a quarter of the market share. This is followed by CFLs and metal halides, with nearly 17 percent of the market, respectively.

**Figure 94. BNI Fixture Type Distribution**

Source: BNI on-site surveys

As mentioned above, 82 percent of all sites have some form of automated control systems for their exterior lights, most of which are photocells. Figure 95 shows the control types on exterior lights.

Figure 95. BNI Control Types for Sites with Exterior Lights

Source: BNI on-site surveys

8.4 BNI HVAC and Water Heating

Figure 96 summarizes the key findings of the BNI HVAC survey

**Figure 96. BNI HVAC and Water Heating Profile**

	Measure Characteristic	Key Findings	Source
HVAC	Single-Zone HVAC System Age	The on-site surveyors identified 477 single-zone HVAC systems. Two-thirds (66%) of single-zone HVAC systems are baseboard/radiant systems followed by unit ventilators or heaters (13%).	N
	Primary Heating Fuel Type	Nearly two-thirds (65%) of all single-zone HVAC systems used electricity as a fuel type. Fuel oil and liquid propane gas (LPG) represent 3% each (6% total) of fuel types for single-zone HVAC systems.	N
	Heating System Type	More than half (53%) of all facilities sampled had baseboard heaters. Boilers and electric resistance heaters were in 19% and 10%, respectively, of facilities sampled. Air source heat pumps, furnaces, and radiant heaters comprise the remaining heating systems and were in 8% of surveyed facilities.	N
	Boiler Delivery Systems	The majority (79%) of boilers were hot water boilers. 21% of boilers were a steam delivery system. The mean boiler age was 12.6 years.	N
	Hot Water Circulation Pump Speed Controls	28% of all pumps were 0.15 horsepower (hp). Pumps that were 0.2, 0.25, 0.75, and 3 hp in size represented 20%, 8%, 8%, and 4% of all pumps, respectively.	N
	Cooling System Types	According to the Commercial and Institutional Building Energy Use Survey (CIBEUS) 2000 reported that in Atlantic Canada as a whole, 60% of C&I buildings had mechanical cooling of some kind.	F
		Of the systems that did have a cooling component, 95% were direct expansion while 5% were chillers. The mean size of all cooling units was 2.9 tons with a mean efficiency of 9.8 EER and 13 SEER.	N



Water Heating	Water Heating Equipment Types	88% of all water heaters were standard water heaters (i.e., tank water heaters). 8% of water heaters were instantaneous, or tankless, water heaters, while 5% were boilers. The average age of all water heaters was 6.6 years. The average size water heater was 4.1 kW and 96.5 kBtuh.	N
	Water Heating Fuel Types	The majority of water heaters were fueled by electricity. Five percent of units were fueled by liquid propane gas (LPG), while fuel oil and natural gas represented 2.5% each (5% total) of fuel types for water heaters.	N
	Water Heating Pipe and Tank Insulation	85% of pipes leading into the water heater were not insulated, while 12.5% were insulated. Similarly, 82.5% of tanks were not externally insulated (e.g., blanket wrap), while 12.5% were externally insulated ³⁹ .	N
	Water Heating Recirculation Pump	85% of water heaters did not have recirculation pumps installed, while 10% did have recirculation pumps installed. 5% of water heaters were noted as unknown, or “Don’t Know”, if a recirculation pump was installed.	N

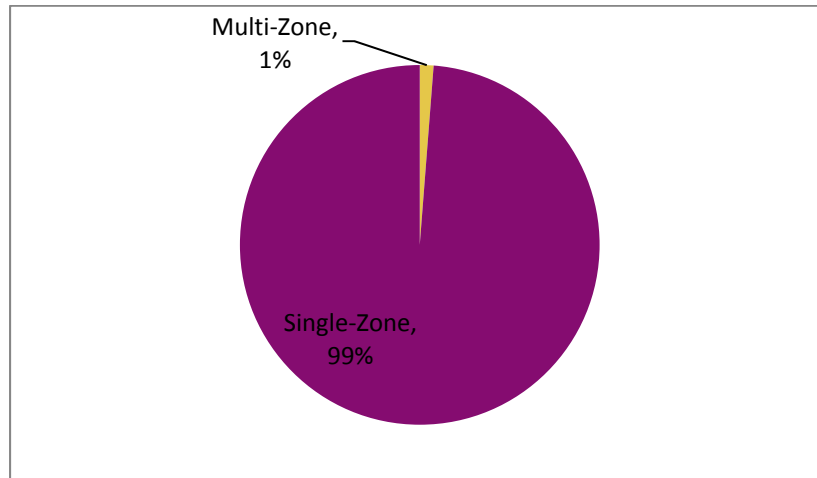
Source: BNI on-site surveys

³⁹ It should be noted that the vast majority of new water heaters installed typically have insulation integral to the tank.



The majority (99%) of HVAC systems are single-zone systems while 1 percent are multi-zone systems, as shown in Figure 97. Single-zone systems are typically considered “simple” systems in the energy code, and multi-zone systems are categorized as “complex” systems. Each system type has different requirements to comply with the energy code, which affects HVAC systems at time of replacement.

Figure 97. BNI Distribution of Single-Zone and Multi-Zone Systems



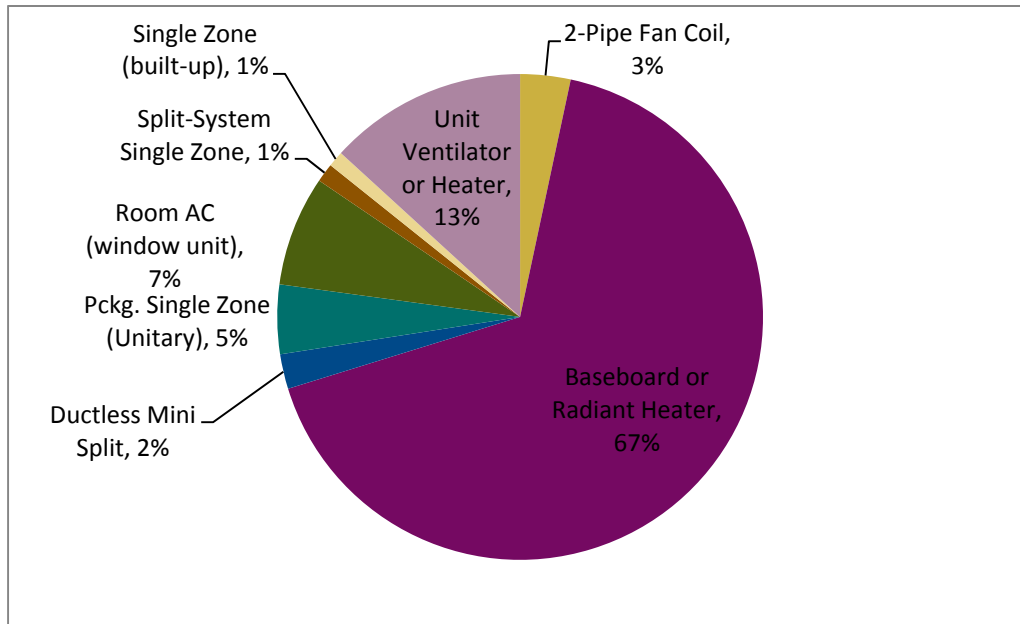
Source: BNI on-site surveys



8.4.1 Single-Zone Distribution Systems

The on-site surveyors identified 477 single-zone HVAC (SZHVAC) distribution systems and gathered all available data for each system.⁴⁰ Figure 98 shows that two-thirds (66%) of single-zone HVAC systems are baseboard/radiant systems followed by unit ventilators or heaters (13%). Room AC, packaged single zone, and ductless mini-split, make up 7 percent, 5 percent, and 2 percent of single-zone systems, respectively.

Figure 98. BNI Distribution of Single-Zone HVAC Systems



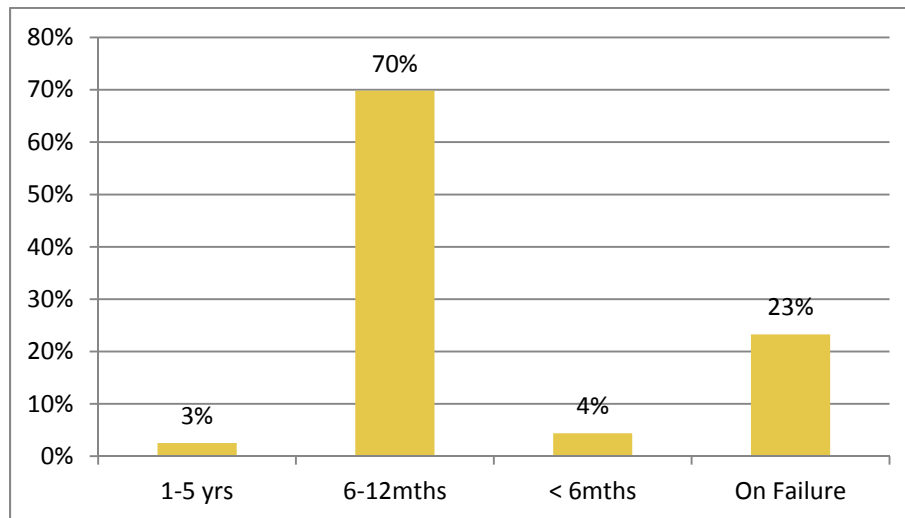
Source: BNI on-site surveys

Figure 99 summarizes the estimated maintenance of single-zone HVAC units. Seventy percent of the facilities surveyed estimated that they conduct maintenance on existing equipment every 6 to 12 months. Twenty-three percent of those surveyed reported that they conduct maintenance on an “as-needed” or “on failure” need. Three percent estimated that they conduct maintenance on their single-zone HVAC system every 1 to 5 years, while 4 percent estimated they conducted maintenance on a period of less than 6 months.

⁴⁰ Complete data was not available for every system.



Figure 99. BNI Single-Zone HVAC Maintenance



Source: BNI on-site surveys

8.4.2 Multi-Zone Systems

Although Navigant included multi-zone HVAC systems in the BNI survey, very few of the facilities sampled contained multi-zone systems. This may be a factor of the relatively small sampled of 30 on-site visits in a very diverse market. HVAC systems that do not serve a dedicated, single zone are classified as multi-zone systems. A total of one multi-zone cooling system was observed. This system was a 10 ton direct expansion unit. Two multi-zone air handling units were observed, as well as one multi-zone electric heating unit. The heating unit was noted as "Other" by the survey team.

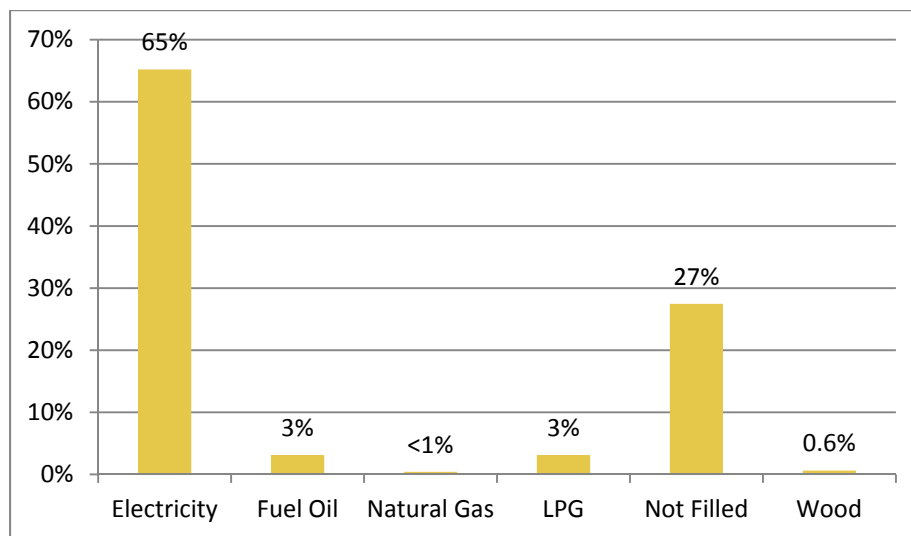


8.5 BNI Heating Systems

8.5.1 Heating Fuel Type

The BNI survey indicated that nearly two-thirds (65%) of all single-zone HVAC systems used electricity as a fuel type, as shown in Figure 100. Fuel oil and liquid propane gas (LPG) represent 3 percent each (6% total) of fuel types for single-zone HVAC systems. The 2012 CRA CIBBS telephone survey recorded that electrically operated air source and ground source heat pumps are not commonly installed. These electrically operated devices are several times more efficient than electric resistance heating devices, and could have a significant impact in Nova Scotia where 65 percent of heating is electric.

Figure 100. BNI Single-Zone System Fuel Type



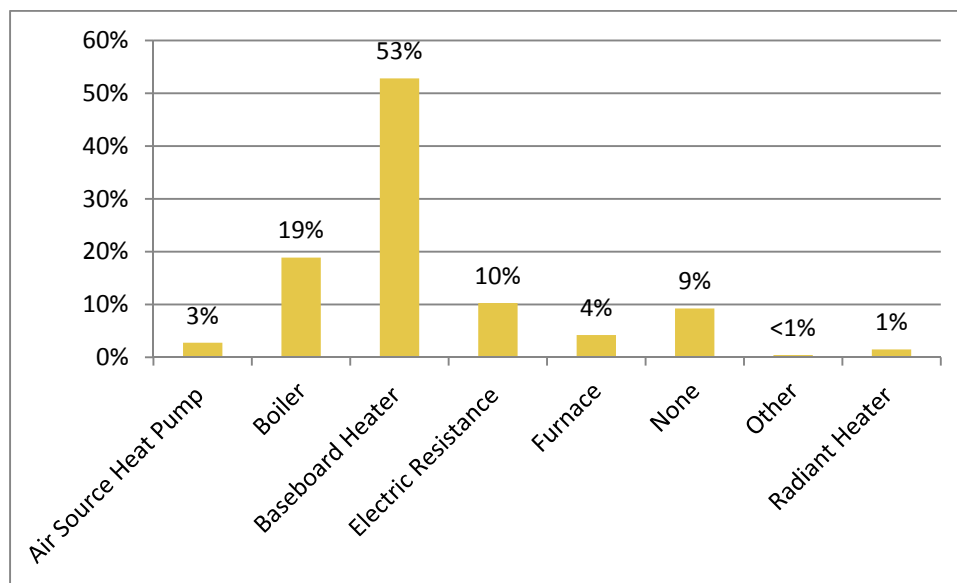
Source: BNI on-site surveys



8.5.2 Heating System Type

The BNI survey indicated that more than half (53%) of all facilities sampled had baseboard heaters, as shown in Figure 101. Boilers and electric resistance heaters comprised 19 percent and 10 percent, respectively. Air source heat pumps, furnaces, and radiant heaters comprise 8 percent of the remaining heating systems. This low penetration of air source and ground source heat pumps, coupled with the 65 percent electrical heating fuel type found by Navigant, suggests there is significant potential in Nova Scotia to reduce energy use and cost using air source and ground source heat pumps as a heating source, instead of electric resistance heating. Nine percent of facilities did not have a single-zone heating system.

Figure 101. BNI Single-Zone Heating System Type



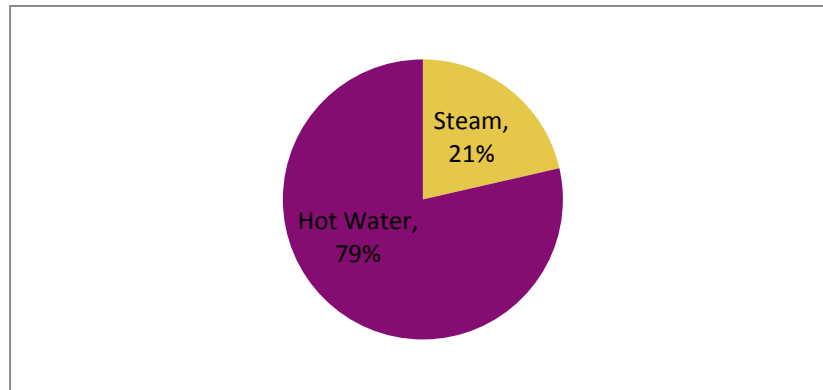
Source: BNI on-site surveys

8.5.3 Boilers

Figure 102 summarizes the distribution of boiler delivery systems. The majority (79%) of boilers were hot water boilers. In cold climates such as Nova Scotia, there may be an opportunity for condensing boilers to operate closer to their peak condensing thermal efficiency due to lower return water temperatures. Twenty-one percent of boilers used a steam delivery system. The mean boiler age was 12.6 years.



Figure 102. BNI Boiler Delivery System by Type

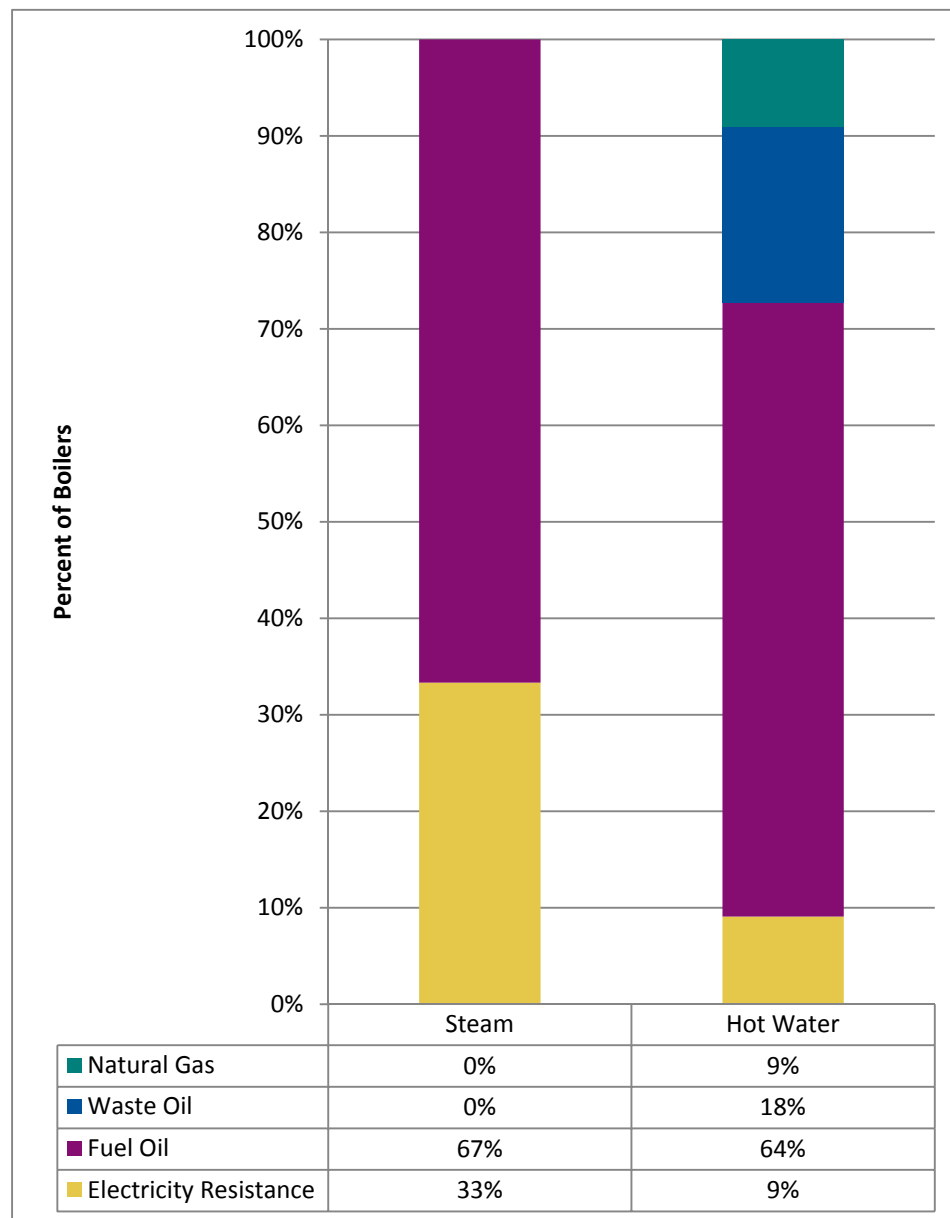


Source: BNI on-site surveys



Figure 103 summarizes the breakdown of boiler fuel types by delivery mechanism. Two-thirds of steam boilers were “fuel oil” type, while one-third were “electricity resistance” type. Hot water boilers were distributed among four fuel types, natural gas, waste oil, fuel oil, and electricity resistance, representing approximate, 9 percent, 18 percent, 64 percent, and 9 percent of fuel types, respectively.

Figure 103. BNI Boiler Fuel Types by Delivery System



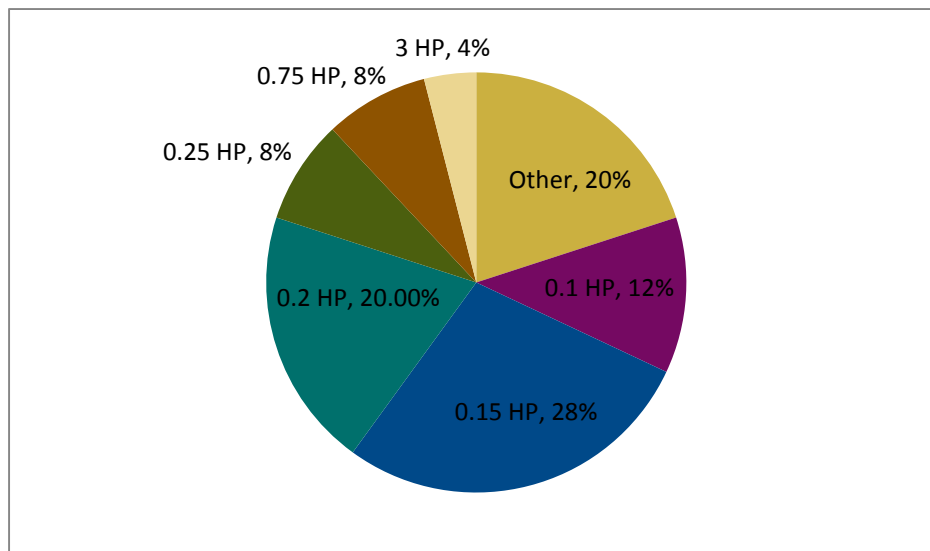
Source: BNI on-site surveys



8.5.4 Hot Water Circulation Pumps

Figure 104 summarizes the distribution of hot water circulation pumps in the facilities surveyed. Twenty-eight percent of all pumps were 0.15 horsepower (hp). Pumps that were 0.2, 0.25, 0.75, and 3 hp in size represented 20 percent, 8 percent, 8 percent, and 4 percent, respectively. Twenty percent of hot water circulation pumps were noted by surveyors as “Don’t Know.”

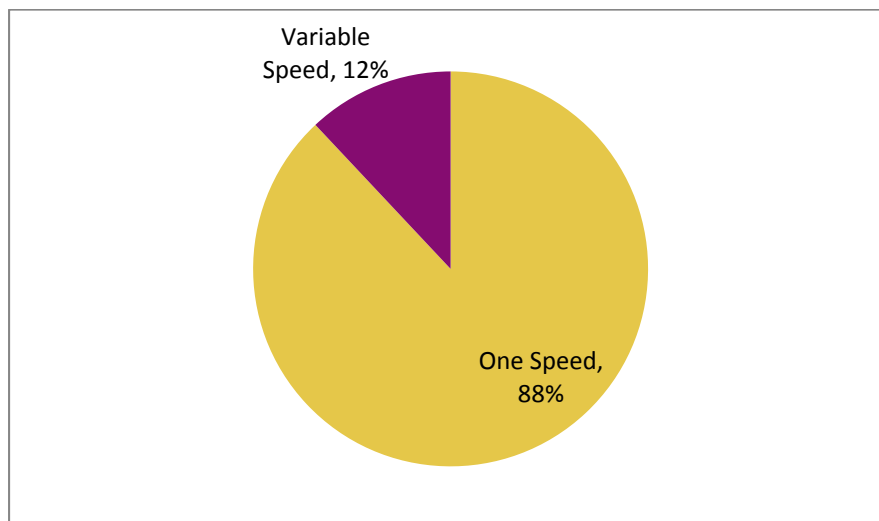
Figure 104. BNI Hot Water Circulation Pump Distribution by Size



Source: BNI on-site surveys

Figure 105 summarizes the control types of hot water circulation pumps. Eighty-eight percent of all hot water pumps were one speed, while 12 percent were variable speed.

Figure 105. BNI Hot Water Circulation Pump Speed Control Type



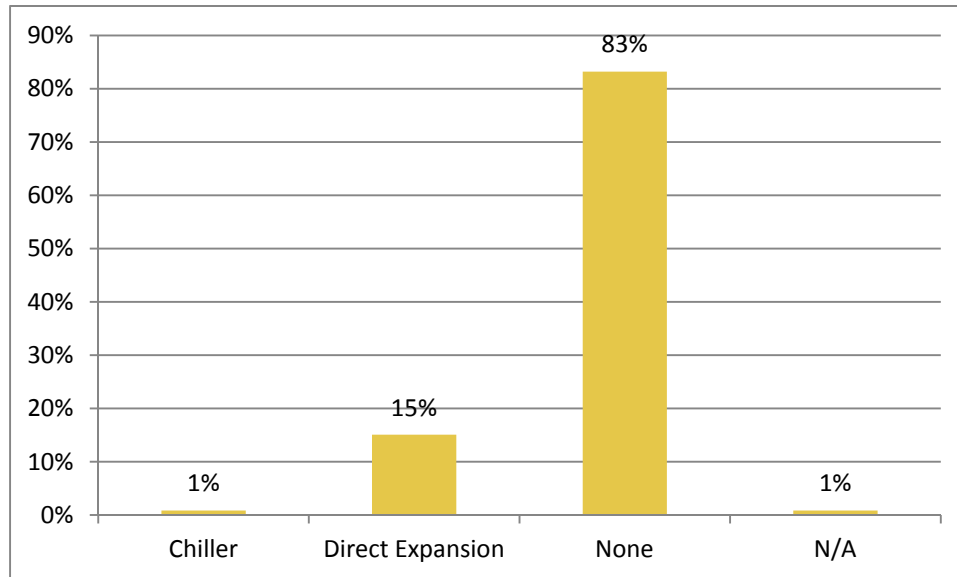
Source: BNI on-site surveys



8.6 BNI Cooling Systems

Figure 106 summarizes the type of cooling units among all single-zone HVAC systems. Eighty-three percent of all single-zone systems do not have a cooling component. Of the systems that did have a cooling component, ninety-five percent were noted by surveyors to be direct expansion while 5 percent were chillers. The mean size of all cooling units was observed to be 2.9 tons with a mean efficiency of 9.8 EER and 13 SEER.

Figure 106. BNI Types of Cooling for Single-Zone HVAC

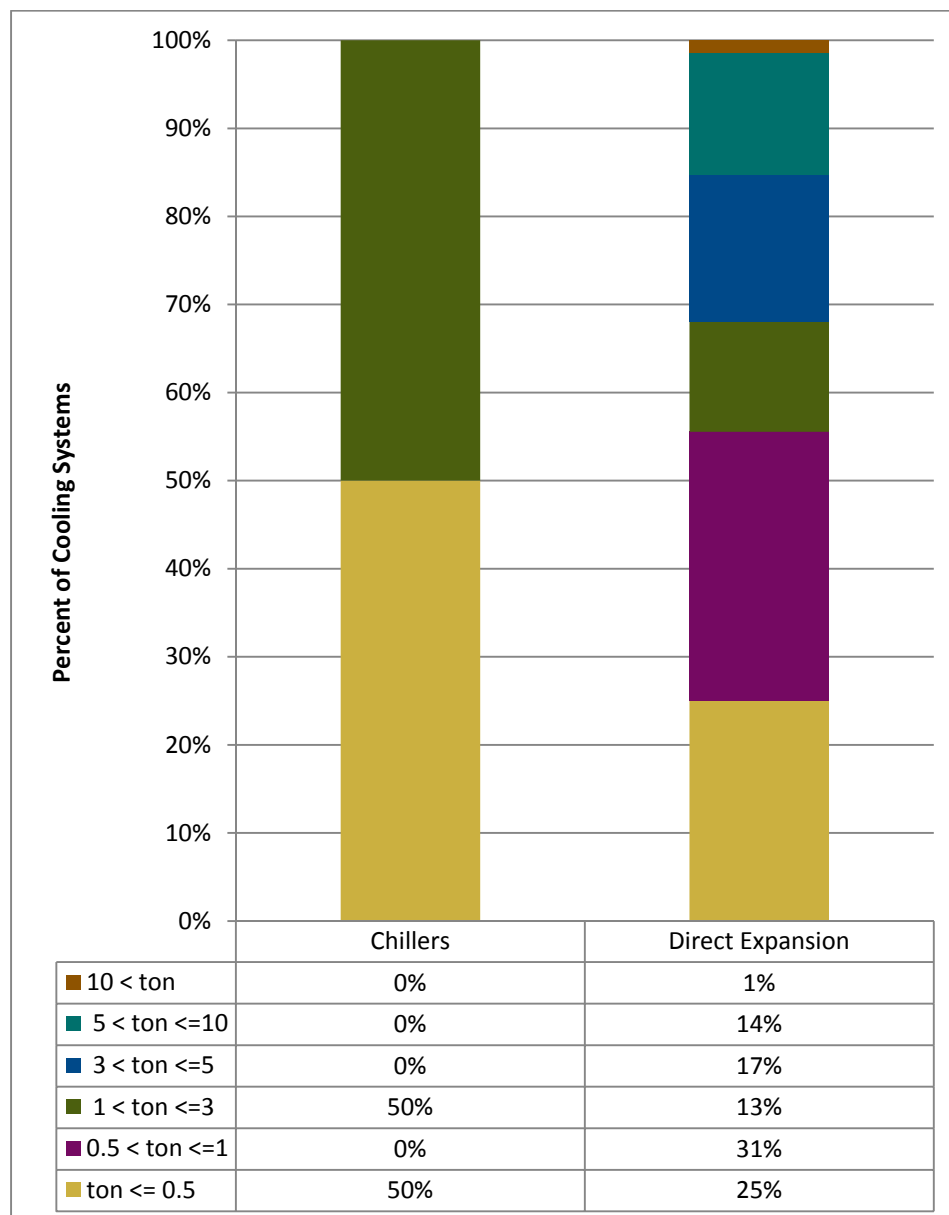


Source: BNI on-site surveys



Figure 107 summarizes the size distribution of all single-zone cooling systems within both the Chiller and Direct Expansion categories. Only two instances of single-zone chillers were recorded by the surveyors, with unit's sizes ranging from less than 0.5 tons to between 1 and 3 tons. Direct expansion cooling systems had a broader range in sizing, with 25 percent of units being less than 0.5 tons. Thirty-one percent of units were greater than 0.5 and less than or equal to 1 tons. Thirteen percent of units were greater than 1 tons but less than or equal to 3 tons. Seventeen percent of direct expansion units were greater than 3 tons but less than or equal to 5 tons. Fourteen percent of units were greater than 5 tons but less than or equal to 10 tons. Only 1 percent of direct expansion units were recorded as being greater than 10 tons. For comparison, CIBEUS 2000 reported that in Atlantic Canada as a whole, 60 percent of C&I buildings had mechanical cooling of some kind.

Figure 107. BNI Distribution of Sizes for Single-Zone Cooling



Source: BNI on-site surveys



Figure 108 summarizes the efficiency (in EER) by system size range for all direct expansion cooling systems surveyed.

Figure 108. BNI Direct Expansion Average Efficiency (EER) by Size Range

System Size Range	Average Efficiency EER	Source
ton ≤ 0.5	11.00	N
0.5 < ton ≤ 1	9.63	N
1 < ton ≤ 3	9.00	N
3 < ton ≤ 5	9.70	N
5 < ton ≤ 10	9.50	N
10 < ton	10.00	N
<i>Source: BNI on-site surveys</i>		

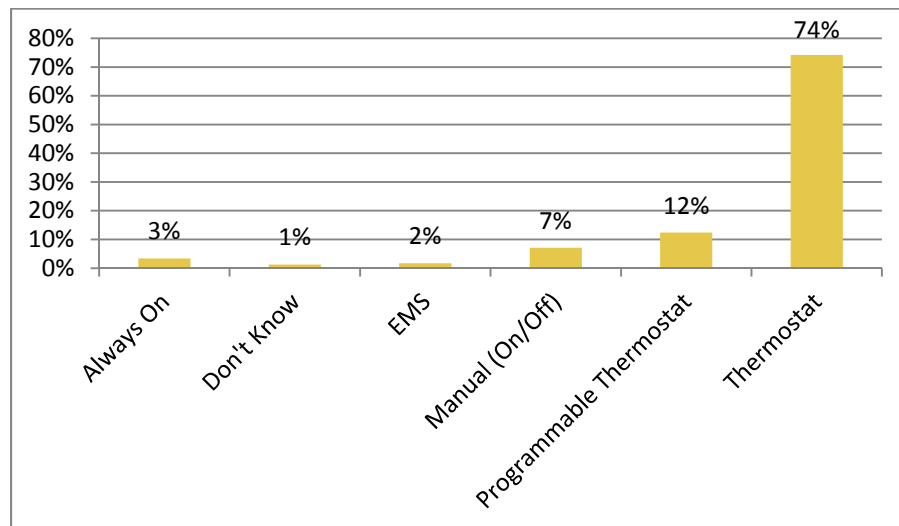
8.6.1 Chillers

Only one chiller was found in the facilities included in the survey. The chiller was an electric fuel type with no variable speed drive (VSD) installed. The chiller had a capacity of 9 tons.

8.7 BNI HVAC Controls

Figure 109 displays the most common control types for HVAC systems in the facilities sampled. Thermostats represent 74 percent of HVAC control types, while programmable thermostats and manual on/off switches represent 12 percent and 7 percent, respectively. Controls that were noted by the surveyor as “Always On” or energy management systems (EMS) represent 3 percent and 2 percent respectively.

Figure 109. BNI HVAC Control Types



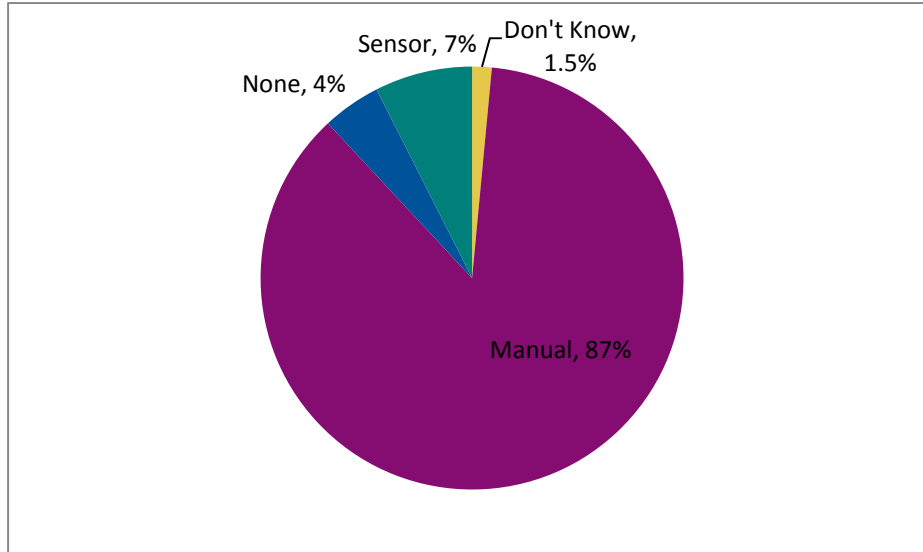
Source: BNI on-site surveys



8.7.1 Exhaust Fans

Eighty-seven percent of exhaust fans are controlled manually, as shown in Figure 110. Seven percent of exhaust fans are controlled by a sensor, while 4 percent were reported as not having a control type (e.g. always on fans). The control type for 1.5 percent of the exhaust fans surveyed was reported as unknown or “Don’t Know”.

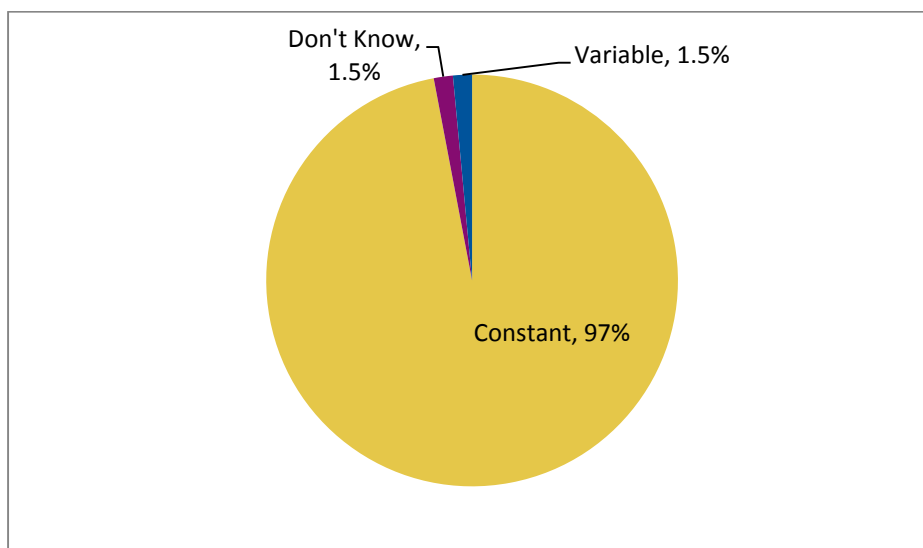
Figure 110. BNI Distribution of Exhaust Fan Control Type



Source: BNI on-site surveys

Figure 111 summarizes the distribution of exhaust fan drive speed types. Ninety-seven percent of exhaust fans were noted to be constant speed type, while 1.5 percent were reported as variable speed fans. Surveyors reported 1.5 percent of fan speed types as unknown or “Don’t Know”.

Figure 111. BNI Distribution of Exhaust Fan Drive Speed Type



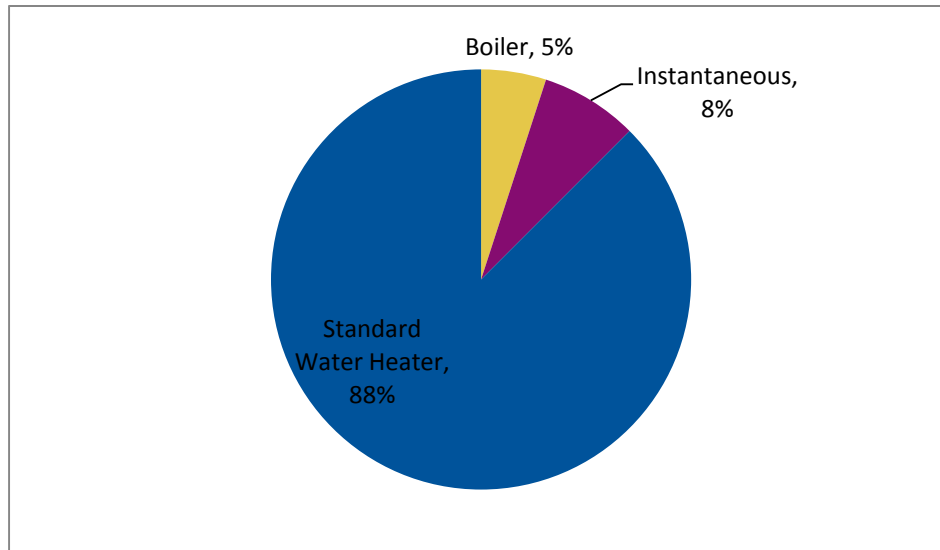
Source: BNI on-site surveys



8.7.2 Water Heating

Figure 112 summarizes the types of water heaters in the facilities surveyed. Eighty-eight percent of all water heaters were standard water heaters (i.e., tank water heaters). Eight percent of water heaters were instantaneous, or tankless, water heaters, while 5 percent were boilers. The average age of all water heaters was 6.6 years. The average size water heater was 4.1 kW and 96.5 kBtuh.

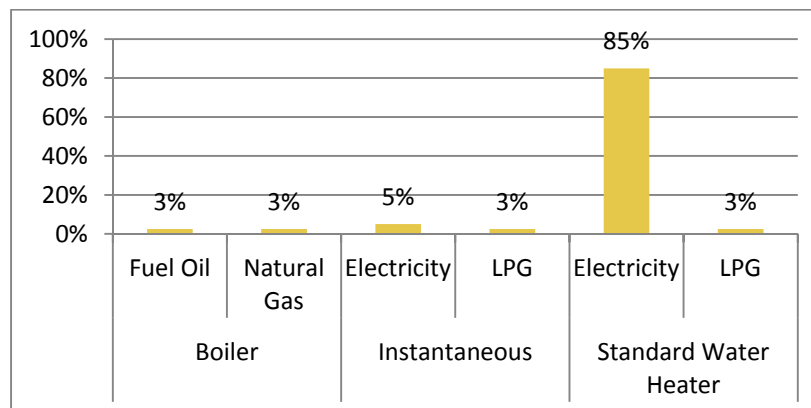
Figure 112. BNI Water Heater Type Distribution



Source: BNI on-site surveys

As shown in Figure 113, the majority (cumulatively 90%) of water heaters were fueled by electricity. Five percent of units were fueled by liquid propane gas (LPG), while fuel oil and natural gas represented 2.5 percent each (5% total) of fuel types for water heaters.

Figure 113. BNI Distribution of Fuel Types Among Water Heaters

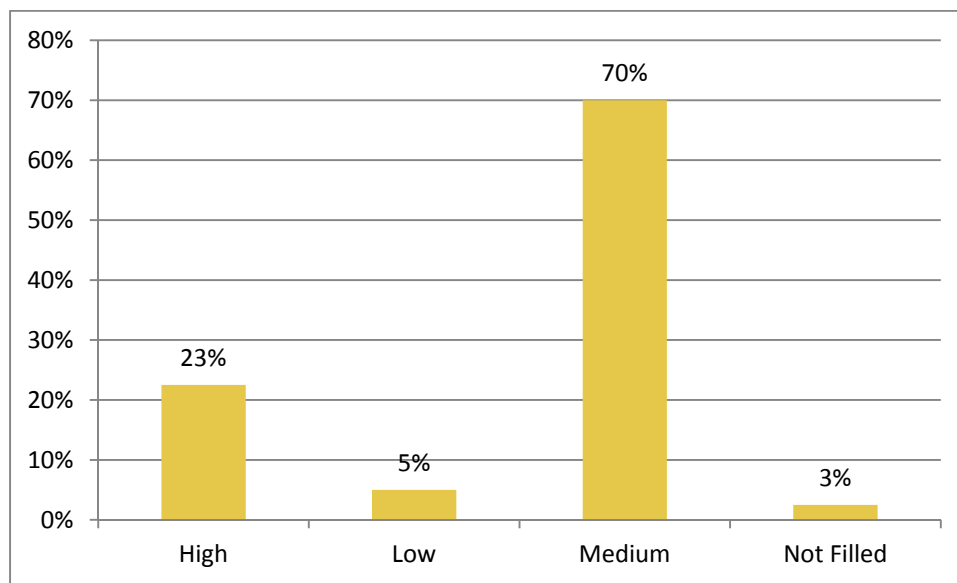


Source: BNI on-site surveys



Figure 114 shows the distribution of temperature set points for water heater observed. Seventy percent of units were set between 43 °C (110 °F) and 60 °C (140 °F) (i.e., medium), while 23 percent of units were above 60 °C (140°F) (i.e., high) and 5 percent of units were set below 110 °F (i.e., low). It should be noted that Health Canada recommends setting water heaters to a temperature of 50 °C (122 °F) to reduce the risk of legionellosis⁴¹.

Figure 114. BNI Distribution of Water Heating Temperature Set Point



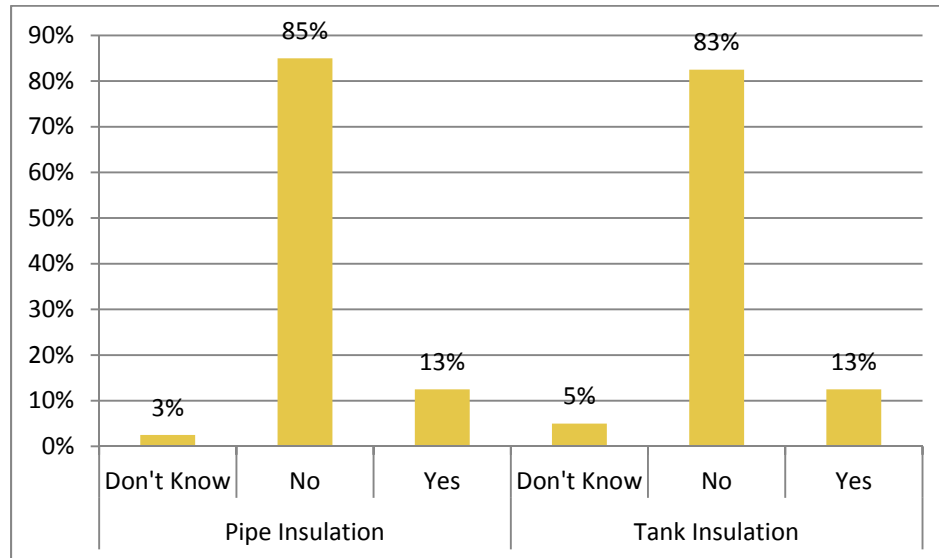
Source: BNI on-site surveys

⁴¹ Legionnaires' Disease and Pontiac Fever, Health Canada, February 2004, updated October 2012, Her Majesty the Queen in Right of Canada, represented by the Minister of Health, 2012, page 2, H13-7/126-2012E-PDF, ISBN: 978-1-100-21309-5. See also: <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/diseases-maladies/legionnaire-eng.php#a5>



Figure 115 summarizes the distribution of water heating insulation either on the tank or on the pipe. Eighty-five percent of pipes leading into the water heater were not insulated, while 13 percent were insulated. Similarly, 83 percent of tanks were not externally insulated (e.g., blanket wrap⁴²), while 13 percent had insulation.

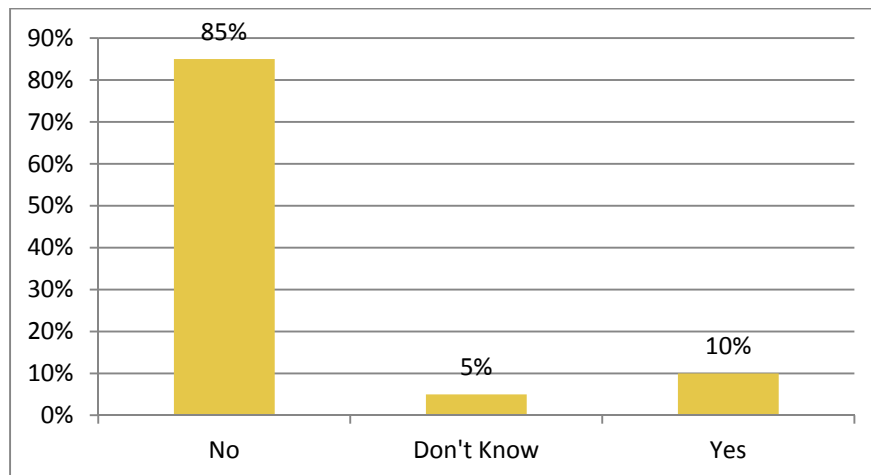
Figure 115. BNI Distribution of Water Heating Insulation



Source: BNI on-site surveys

As shown in Figure 116, 85 percent of water heaters did not have recirculation pumps installed, while 10 percent did have recirculation pumps installed. Five percent of water heaters were noted as unknown, or “Don’t Know”, if a recirculation pump was installed.

Figure 116. BNI Water Heat Recirculation Pump



Source: BNI on-site surveys

⁴² It should be noted that the vast majority of new water heaters installed typically have insulation integral to the tank.



8.8 BNI Refrigeration

Market Characterization – Refrigeration

Figure 117 lists key findings for the BNI refrigeration profile.

Figure 117. BNI Refrigeration Profile

Market Characteristic	Key Findings	Source
Compressors	Compressors were in industrial facilities, restaurants, and ‘other commercial’ facilities. However, insufficient data exists to properly characterize the market in terms of compressors. ⁴³	N
Walk-in space lighting	Nearly 63% of space lighting in BNI walk-ins is fluorescent, while another 25% is incandescent. The rest are unknown. ⁴⁴	N
Walk-in lighting controls	Eighty-eight percent of lighting in BNI walk-ins is controlled via a wall switch. The rest of the control types are unknown.	N
Walk-in motor types	A quarter of the motors in BNI walk-ins are shaded pole, while the rest are unknown. 14% of motors have evaporative fan controls.	N

Source: BNI on-site surveys

Figure 118 provides a list of refrigeration equipment in BNI sites. Of the equipment types in BNI facilities, 55 percent are glass door beverage cases, as illustrated in Figure 119.

Figure 118. BNI Refrigeration Types

Equipment Code	Equipment Description	Size of Default	Source
GD	Glass door beverage cases (e.g. vendor supplied) from 2 to 4 doors	3 doors	N
CD	Closed door storage cases, one to three doors	2 doors	N
UG	Upright glass door freezer cases from one to three doors	2 doors	N
CF	Coffin type glass top freezer cases (usually ice cream) typically 6 or 8 ft.	7 ft.	N
OT	Other: self-contained refrigeration not listed above	1 unit	N
IV	Ice vending machines (hotel-sized icemaker) – Only self-contained units	1 unit	N

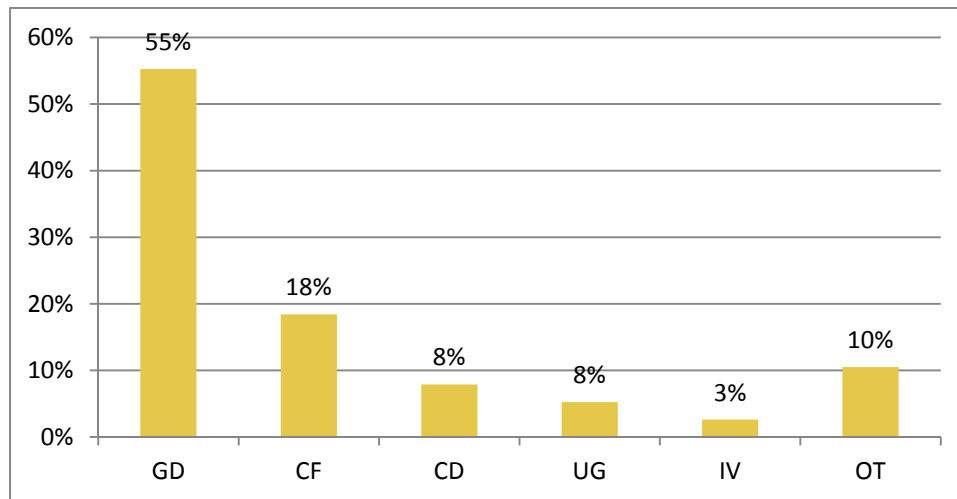
Source: BNI on-site surveys

⁴³ Regardless of the types and capacities of refrigeration compressor in Nova Scotia, significant opportunity exists to implement compressor system controls, such as free cooling refrigeration economizers, and floating head pressure control with liquid pressure amplification (LPA). Refrigeration economizer controls turn off the compressor and evaporator when the outdoor air temperature is at or below the cooler or freezer dry bulb temperature setpoint, making use of cold outdoor air to meet setpoints with lower power circulation fans to ensure proper air mixing. Floating head pressure controls on larger refrigeration racks in grocery stores can likewise be an additional source of annual energy savings.

⁴⁴ There is significant opportunity for LED lighting savings in refrigerated spaces.



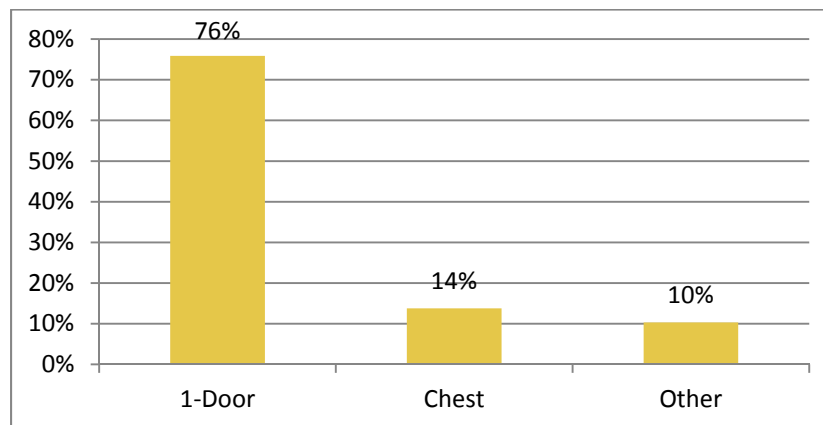
Figure 119. BNI Refrigeration Equipment Types Distribution



Source: BNI on-site surveys

Of all non-BNI refrigeration equipment type on BNI sites, 76 percent are 1-door cases, with another 14 percent being chest-style refrigerators. As shown in Figure 120, the final 10 percent are classified as 'other.'

Figure 120. Non-BNI Type Refrigeration Equipment Types Distribution



Source: BNI on-site surveys



8.9 *BNI Motors and Compressed Air*

8.9.1 Market Characterization – Motors and Compressed Air

Figure 121 provides a summary characterization of motor and compressed air measures for the BNI segments.

Figure 121. BNI Motors and Compressed Air Profile

Measure/Characteristic	Key Findings	Source
Process motor types	The majority (62%) of motors are pump motors and material handling/conveying motors.	N
Motor controls and efficiency	All identified motors are standard efficiency and constant speed. ⁴⁵	N
Air compressor types	The majority (82%) of air compressors are reciprocating two-stage, single acting (RTS) units.	N
Air compressor hours of use	RTS type air compressors are using 73 hp about 49 hours a week. ⁴⁶	N
Air dryer on compressed air systems	The majority (90%) of air compressors do not have an air dryer.	N

⁴⁵ It should be noted that, although no high efficient motors or variable-speed drives were observed in the facilities surveyed, it would be expected that a portion of all motors and motor control types would be considered efficient.

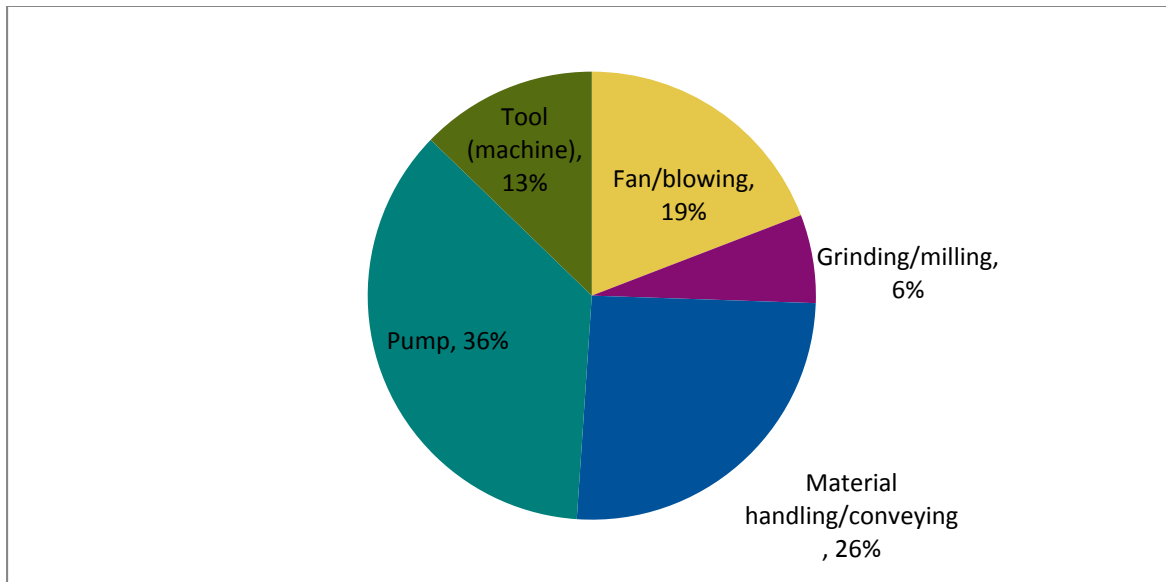
⁴⁶ Compressed air is expensive. End uses can often be served at lower cost using electrically-powered solutions, rather than compressed air. Additionally, separating end uses to allow each compressed air system to operate at its lowest possible air pressure setpoint is another way to reduce costs associated with compressed air use. Navigant recommends investigation of electrically-powered alternatives to compressed air use, and recommends lowering air pressure setpoints for existing systems to the extent possible.



8.9.2 Motors

The majority (62%) of motors in the BNI sample are pump motors and material handling/conveying motors, as shown in Figure 122. Process motors were present in the industrial/manufacturing, retail non-food and 'other commercial' segments of the BNI sample.

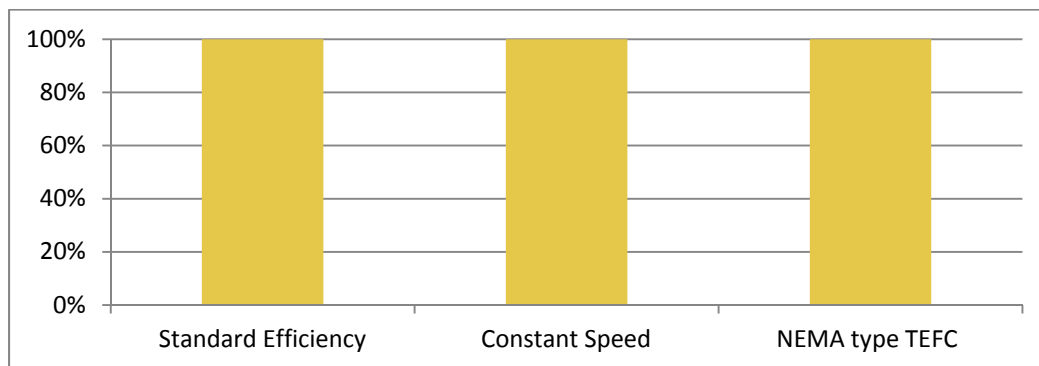
Figure 122. BNI Distribution of Process Motor Types



Source: BNI on-site surveys

Figure 123 shows that all of the motors surveyed are constant speed motors and classified as standard efficiency. All motors have a NEMA type of TEFC (totally enclosed fan cooled). Opportunities exist to increase efficiency levels of motors through both increasing equipment efficiency and adding variable controls.

Figure 123. BNI Motor Controls, Efficiency and NEMA Type



Source: BNI on-site surveys



The rated horsepower for process motor units ranges from 0.1hp to 30hp with a mean horsepower of 3.7hp. The total horsepower by motor type is shown in Figure 124.

Figure 124. BNI Total Motor Horsepower by Type

Motor Type	Number of Motor Units	Total Horsepower (hp)	Source
Fan/blowing	9	40	N
Grinding/milling	3	10.8	N
Material handling/conveying	12	34.5	N
Pump	16	84.5	N
Tool (machine)	1	5.1	N
Total	6	174.8	

Source: BNI on-site surveys

8.9.3 Compressed Air

The majority (82%) of the air compressors surveyed are reciprocating two-stage, single acting (RTS) units, as shown in Figure 125. Only one unit out of all air compressors is a smaller capacity single-stage model while all other units (91%) are two-stage compressors, which are more efficient and often longer lasting than their single-stage counterparts. All air compressor units were located in the industrial/manufacturing and 'other commercial' segments of the BNI sample. Navigant recommends investigation of electrically powered alternatives to compressed air use where possible, and recommends lowering air pressure setpoints for existing systems to the extent possible to control the high cost of compressed air systems. This can sometimes be achieved by separating unlike compressed air end uses onto separate systems.

Figure 125. BNI Distribution of Air Compressor Type

Air Compressor Type	Number of Units	Percent of Total	Source
Reciprocating (Single-stage, Single-acting) (RSS)	1	9%	N
Reciprocating (Single-stage, Double-acting) (RST)	0	0%	N
Reciprocating (Two-stage, Double-acting) (RTD)	1	9%	N
Reciprocating (Two-stage, Single-acting) (RTS)	9	82%	N
Rotary Screw (Two-Stage)	0	0%	N
Centrifugal	0	0%	N
Unknown	0	0%	N

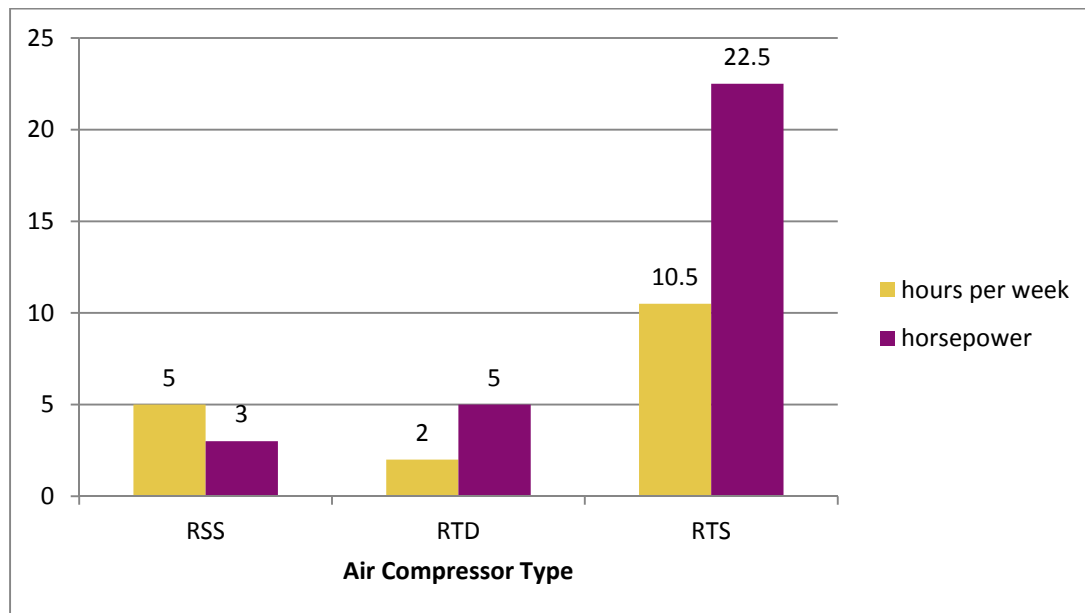


Other	0	0%	N
All	11	100%	

Source: BNI on-site surveys

The air compressors in the 'other commercial' segment are using a total of 30.5hp about 8 hours per week, as shown in Figure 126. Figure 127 shows that air compressors in the industrial/manufacturing segment of the BNI sample are using a total of 50hp about 40 hours per week.

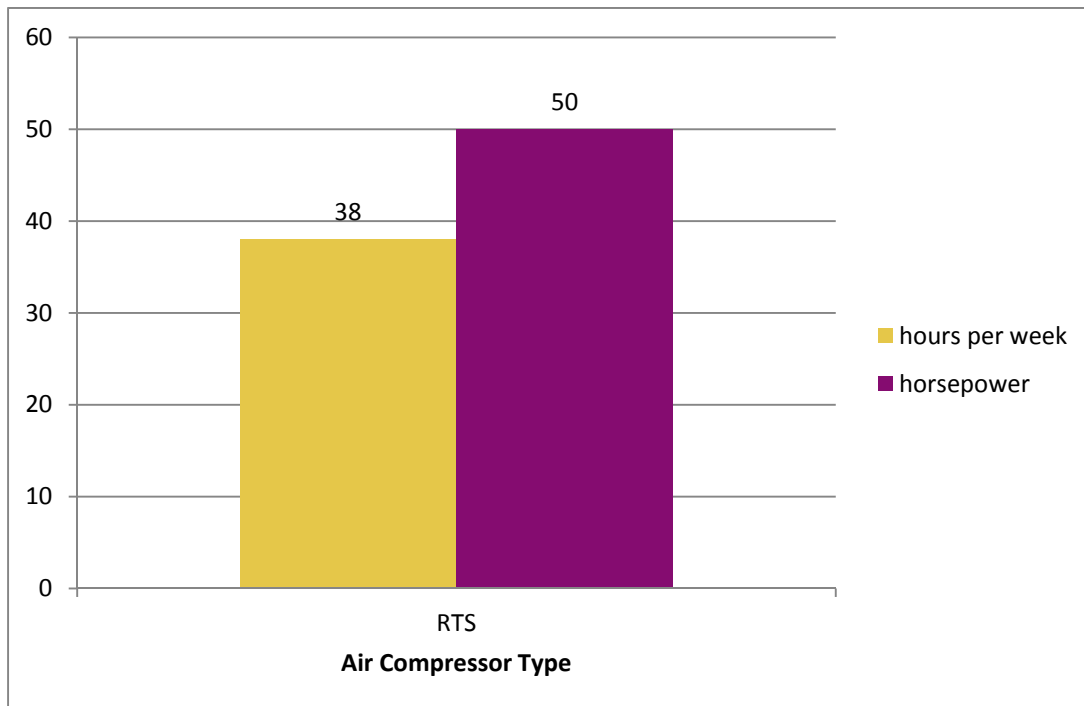
Figure 126. BNI 'Other Commercial' Air Compressor Hours of Weekly Use by Horsepower



Source: BNI on-site surveys



Figure 127. BNI Industrial Air Compressor Hours of Weekly Use by Horsepower



Source: BNI on-site surveys



The majority (90%) of air compressors do not have an air dryer, as shown in Figure 1284. Air dryers maintain higher quality compressed air, typically necessary for industrial purposes, but also consume more energy and typically operate continuously unless an efficient cycling air dryer is employed. Out of all the air compressors, only one RTS unit running at 7.5hp had an air dryer present.

Figure 128. BNI Air Dryer Verification by Air Compressor Type

Air Compressor Type	Number of Units	Air Dryer Present
Reciprocating (Single-stage, Single-acting) (RSS)	1	No
Reciprocating (Two-stage, Double-acting) (RTD)	1	No
Reciprocating (Two-stage, Single-acting) (RTS)	8	No
	1	Yes

Source: BNI on-site surveys (Source "N")



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Appendix B. Residential On-Site Data Collection Tool

Site ID #

2012 Residential On-Site Survey Form For

ENSC
10/23/2012

Customer Information: (Please Print)

Customer			
Customer Acct #			
Phone Number:	()		
Street Address:			
City:		Postal Code:	
Mailing			
City:		Postal Code:	
County:			

Survey Tracking Information:

Performed by, First/ Last Name / Initials

Date:
dd/mm/yyyy

Field Survey
Performed:

__ / __ / __

Completeness and
Quality Check"

__ / __ / __

Data Entry Complete:

__ / __ / __



HOME CHARACTERISTICS - BY INTERVIEW

INTRODUCTION TO SURVEY

Thank you again for participating in the survey. To start, I'm going to ask you a few questions about your home and your home's equipment. After this brief interview, I will walk through your home so that I can inventory your energy using equipment to record all the specific information about the equipment. I will be recording information on the following items: lighting, heating and cooling systems, water heating system, cooking equipment, home electronics, laundry equipment, refrigerators and freezers, fans and miscellaneous equipment. I will have some questions for you about the equipment and how you use it, so it's best if we walk through the survey together.

1. Which of the following best describes the home/residence (based on **surveyor** judgment):

- ☐ Single-family construction
- ☐ Single-family factory manufactured/modular
- ☐ Single-family mobile home
- ☐ Two family residence (duplex)—traditional structure
- ☐ Apartment (3 + families) --- traditional structure
- ☐ Condominium---traditional structure
- ☐ Row House or any "Other": (describe _____)

2. Do the occupants own or rent the residence?

- ☐ Own
- ☐ Rent

3. What year was this residence built?

_____ Year Built Interviewer Estimate? ☐

If estimate, OK to estimate by decade up to 2000, then estimate to year.

4. How many square feet is the above-grade conditioned living space? _____

5. How many square feet of conditioned living space is below-grade? _____

6. Total square footage of home (Add 4 & 5) _____

7. Is this the main, weekend, or seasonal/vacation residence? (CHECK ONLY ONE)

- ☐ Main Residence
- ☐ Weekend Residence
- ☐ Seasonal/Vacation Residence

8. In each season, how many people live in this household?

_____ Summer
_____ Winter

9. How many stories tall is the home? (check one, based on **surveyor** judgment)

- ☐ One Story



- ☐ Split Entry
- ☐ Split Level
- ☐ Two Stories
- ☐ Three or More Stories

For the remainder of the survey,
answer questions based on
YOUR OBSERVATION, whenever possible.
Otherwise, ask the homeowner.

HOME CHARACTERISTICS – BY OBSERVATION

10. Estimate square feet of conditioned floor space: (other than garage, basement, and porch)

_____ sq.ft.

11. Are any of the following areas used as conditioned living space? (ENTER ALL THAT APPLY)

_____ Garage (sq. ft).

_____ Basement (sq. ft).

_____ Porch (sq. ft).

12. Does this residence have an accessible attic?

- ☐ Yes/Vented
- ☐ Yes/Unvented
- ☐ No

13. Does this residence have an accessible crawl space?

- ☐ Yes Access/Vents Open
- ☐ Yes Access/Vents Closed
- ☐ No



LIGHTING

14. Fill out the following information about the indoor and outdoor lighting of the home using the following codes.

Fixture Number	Number of identical fixtures	Room Type	Socket Type	Bulb Type (existing)	No. of bulbs per fixture	Watts per Bulb	Watts per Fixture	Hours of use Code	(1) standard, (2) dimmable, (3) 3-way	Hardwire ? [Yes=1 No=2]	(1) Exposed flood (2) recessed can (99) other	(1) Control (2) Manual, (3) Timer, (4) Photocell, (5) occupancy sensor
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

Lighting Room Codes		Socket Type Codes	Bulb Type Codes		Hours of Use Code	
1. Living Room	8. Office	1. Edison Base	1. Incandescent	8. LED	1. Infrequent Use - < 1hr	5. Security Lighting
2. Kitchen	9. Closet	2. Candelabra	2. T12 Fluorescent	9. No Bulb	2. Low Use - 1 to 2 hrs	6. Dusk-to-Dawn
3. Dining Room	10. Utility Room	3. Pin Base	3. T8 Fluorescent	88. Don't Know	3. Med. Use - 2-5hrs	7. Not Applicable
4. Hall/Entry	11. Basement	4. Nightlight	4. High Performance T8	99. Other	4. High Use - > 5hrs	99. Other
5. Bedroom	12. Exterior	88. Don't know	5. CFL			
6. Bathroom	88. Don't know	99. Other	6. Halogen			
7. Garage	99. Other		7. Xenon			



SPACE HEATING

15. Is the heating system accessible?

- ☐ Yes (note (1) ton = 12,000 btu's)
- ☐ No

16. When was the heating system last serviced or repaired by a qualified HVAC technician?

- ☐ less than 6 months
- ☐ 6 - 12 months
- ☐ 1 to 2 years
- ☐ more than 2 years
- ☐ Never
- ☐ Not Sure

17. If there is a secondary or backup heating system, how often is it used during winter?

- ☐ Don't have one
- ☐ Never or Rarely
- ☐ Often
- ☐ Always

(IF RESIDENCE TYPE: multifamily (4 or more attached units) ASK THE NEXT QUESTION:

18. Does the heating system serve more than one residence?

- ☐ Yes
- ☐ No
- ☐ Not Sure



SPACE HEATING

19. Fill out the following information about the heating system of the home using the following codes:

(Note: Record the make and model number on the supplemental data sheet.)

(a) Type of System (1) Central furnace (2) Central heat pump - air (3) Central heat pump - water (4) Central heat pump - ground (5) Built-in electric room units with indiv. room controls (incl. baseboards) (6) Boiler/Steam/Hot Water (7) Dual fuel heat pump (electric & gas) (8) Wall or floor furnace (9) Portable electric heater (10) Portable kerosene heater (11) Wood burning stove (12) Coal burning stove (13) Fireplace (14) Solar (15) None (16) Electric Thermal Storage (17) Minisplit Heat Pump (18) Other _____	(b) Fuel Type (1) Electricity (2) Natural Gas (3) Propane or Bottled Gas (4) Fuel Oil (5) Wood (6) Kerosene (7) Coal (8) Solar (9) Biomass Pellets (10) Other	(d) Air Handler Location (1) Conditioned space (2) Unconditioned space (3) Unconditioned attic (4) Outdoors (5) No air handler (6) Not sure (e) Location of Majority of Duct Work (1) Conditioned space (2) Unconditioned space (3) Unconditioned attic (4) Outdoors (5) No ducts

	Primary System	Second System	Third System
1. Type of system (a)			
2. Fuel type (b)			
3. Input capacity kW			
3a. Input capacity kBtuh			
4. Output capacity (Btuh/hr)			
5. Make			
6. Model			
7. Year of Manufacture			
8. Fan HP			
9. Fan Watts (if HP unavailable)			
10. Fan Speed (Constant, Variable)			
11. Is fan ECM?			
12. Energy Star? (yes = 1, no = 2)			
13. Air handler location (d)			
14. Duct work location (e)			
15. Duct work insulated (yes = 1, no = 2)			
16. Programmable thermostat (yes = 1, no = 2)			
17. Energy Recovery (yes. no)			



SPACE COOLING

20. Is the cooling system accessible?

- ☐ Yes (note (1) ton = 12,000 btu's)
- ☐ No

21. When was the cooling system last serviced or repaired by an HVAC technician?

- ☐ less than 6 months
- ☐ 6 - 12 months
- ☐ 1 to 2 years
- ☐ More than 2 years
- ☐ Never
- ☐ Not Sure

22. If there is a secondary or backup cooling system, how often is it used during summer?

- ☐ Don't have one
- ☐ Never or Rarely
- ☐ Often
- ☐ Always

(IF RESIDENCE TYPE: multifamily (4 or more attached units) ASK THE NEXT QUESTION

23. Does the air conditioning system serve more than one residence?

- ☐ Yes
- ☐ No
- ☐ Not Sure

SPACE COOLING

24. Fill out the following information about the central air conditioning system using the following codes: *(Note: Record the make and model number on the supplemental data sheet.)*



(a) Type of System (1) Central electric, straight cool/package (2) Central electric, straight cool/split (3) Central heat pump/air-packaged (4) Central heat pump/air-split (5) Central heat pump/water or ground source (6) Central Gas (7) Room air conditioning only (8) Room air conditioning with heat pump (9) Room air conditioning with strip heat (10) Whole house AC with window/wall mounted (11) Minisplit Heat Pump (12) None (13) Other: _____		(c) Air Handler Location (1) Conditioned space (2) Unconditioned space (3) Unconditioned attic (4) Outdoors (5) No air handler (6) Not sure	
		(d) Location of Majority of Duct Work (1) Conditioned space (2) Unconditioned space (3) Unconditioned attic (4) Outdoors (5) No ducts	
	Primary System	Second System	Third System
1. Type of system (a)			
2. Output Capacity (kBtu/hr)			
3. Output Capacity (tons)			
4. Make			
5. Model			
6. Year of Manufacture			
7. Fan HP			
8. Fan Speed (Variable, Constant)			
9. Is Fan ECM?			
10. SEER			
11. EER			
12. Energy Star? (yes=1, no=2)			
13. Air handler location (c)			
14. Duct work location (d)			
15. If in conditioned space, are ducts in need of repair?			
16. Duct work insulated (yes=1, no=2)			
17. Programmable thermostat (yes=1, no=2)			



Water Heating

25. Is the water heating system accessible?

- ☐ Yes
☐ No

26. Where are the hot water lines located?

- ☐ In Slab
☐ Un-Conditioned Area (Crawl space, attic, basement)
☐ Conditioned Area (including finished basement and/or attic)
☐ Other _____

(IF RESIDENCE TYPE: multifamily (4or more attached units) ASK THE NEXT QUESTION:

27. Is there a separate water heater serving only this residence?

- ☐ Yes
☐ No
☐ Not Sure

28. Fill out the following information about the water heating system using the following codes:

(Note: Record the make and model number on the supplemental data sheet.)

(a) System Type		(5) Fuel oil
(1) Electric Resistance		(6) Instantaneous Electric
(2) Heat Pump		(7) Instantaneous Gas
(3) Natural Gas		(8) Solar
(4) Propane or Bottled gas		(9) Fossil Fuel , Unknown
	Unit 1	Unit 2
1. Primary fuel type (a)		
2. Back-up fuel type (a)		
3. Input Rating (kW)		
3a. Input Rating (kBtu/hr)		
4. Capacity in gallons		
5. Tank Insulation R-Value (if labeled)		
8. Location (cond = 1, uncond = 2)		
9. Tank Wrap (yes = 1, no = 2)		
10. Timer (yes = 1, no = 2)		
11. Add-on heat pump (yes = 1, no = 2)		
12. Pipe wrap near the water heater (yes = 1, no = 2)		
13. Heat Recovery from Heat Pump?		
14. Drain Water Heat Recovery?		
15. Tank temperature setting(Lo, Med, Hi)		

BRAND NAME MODEL NUMBER

ENERGY STAR

Primary Heater _____ ☐



Second Heater _____ ☐

WATER HEATING

29. Are there **low-flow showerheads (< 9.5 lpm)** installed in the showers? (Low flow takes 24 seconds or more to fill a gallon jug.)

Number with _____ Number without _____

30. Are there **faucet aerators** installed on the faucets? (Usually < 7.7 lpm) (Low flow takes 30 seconds or more to fill a gallon jug or 15+ seconds to fill ½ gallon.)

Number with _____ Number without _____

Refrigerators

31. Fill out the following information about the refrigerators of the home using the following codes:

(a) Type	(4) Single door with freezer
(1) Side by side	(5) Single door w/o freezer
(2) Top mount freezer	(6) Compact (<5 cubic feet)
(3) Bottom mount freezer	

	Unit 1	Unit 2	Unit 3
1. Type (a)			
2. Size (cubic feet)			
3. Year of manufacture			
4. Make			
5. Model			
6. Ice Maker? (yes = 1, no = 2)			
7. Energy Star Logo (yes = 1, no = 2)			
8. Unit Plugged In? (yes = 1, no = 2)			
9. Location (cond=1, uncond=2)			

Freezers

32. Fill out the following information about the freezers of the home using the following codes:



(a) Type (1) Chest (2) Upright FF (3) Upright Manual (4) None	(b) Seal Condition (1) Complete (2) Cracked (3) Missing Sections	(c) Coil Condition (1) Clean (2) Dirty (3) Inaccessible
	Unit 1	Unit 2
1. Type (a)		
2. Size (cubic feet)		
3. Make		
4. Model		
5. Year of manufacture		
6. Energy Star (yes = 1, no = 2)		
7. Location (cond=1, uncond=2)		

Cooking

33. Is there a range/cooktop in the residence?
- ☐ Yes
☐ No (SKIP TO OVEN)
34. What type of range/cooktop do you primarily use in this home?(CHECK ONLY ONE)
- ☐ Electric Range/Cooktop
☐ Gas Range/Cooktop
☐ Propane Range/Cooktop
☐ Other (Describe: _____)
☐ None [SKIP TO OVEN]
35. IF Q40 = Electric Range/Cooktop, Is the electric range/cooktop Energy Star?
- ☐ Yes
☐ No
36. IF Q40 = Electric Range/Cooktop, Is the electric range/cooktop induction?
- ☐ Yes
☐ No
37. How old is the range/cooktop?
_____ (Age in years) ☐ Estimate?
(If estimate, estimate to increments of 5 years or less)
38. Is there an oven in the residence?
- ☐ Yes
☐ No (SKIP TO DISHWASHER)
39. What type of oven do you primarily use in this residence? (CHECK ONLY ONE)
- ☐ Electric Oven



- ☐ Gas Oven
☐ Propane Oven
☐ Other (*Describe:* _____)
☐ None [SKIP TO DISHWASHER]

40. If [45] Electric Oven, is the electric oven:

- ☐ standard
☐ convection
☐ combination

41. How old is the oven?

_____ (Age in years) ☐ Estimate?
 (If estimate, estimate to increments of 5 years or less)

Dishwashers

42. Is there a dishwasher in this residence?

- ☐ Yes
☐ No

43. How many dish loads are washed per week?

_____ loads per week

44. How often is the energy saver option used during the drying cycle?

- ☐ All the time
☐ Sometimes
☐ Never

45. Is the dishwasher Energy Star?

- ☐ Yes
☐ No
☐ Don't Know

46. How old is the dishwasher?

_____ (Age in years) ☐ Estimate?
 (If estimate, estimate to increments of 5 years or less)

47. If there is a dishwasher, does it have a heat booster?

- ☐ Yes
☐ No
☐ None

BRAND NAME

MODEL NUMBER

DISHWASHER



Laundry

48. Is there a clothes washer in this residence for private use?

- ☐ Yes
☐ No

49. Is the clothes washer Energy Star?

- ☐ Yes
☐ No

50. How old is the clothes washer?

_____ (Age in years) ☐ Estimate?
(If estimate, estimate to increments of 5 years or less)

51. How many loads of laundry are washed per week? _____

52. If there is a clothes washer, what is the orientation?

- ☐ Horizontal (front loading)
☐ Vertical (top loading)
☐ None

Laundry

53. Is there a **clothes dryer** in this residence?

- ☐ Yes
☐ No

54. If there is a clothes dryer, what type of fuel does it use *for heat*?

- ☐ Electric
☐ Natural Gas [SKIP TO HOME ELECTRONICS]
☐ LP Gas [SKIP TO HOME ELECTRONICS]
☐ Other (*Describe:* _____) [SKIP TO HOME ELECTRONICS]
☐ None

55. Is the clothes dryer Energy Star?

- ☐ Yes
☐ No

56. How many loads of laundry are dried with the clothes dryer per week?

57. How old is the clothes dryer?

_____ (Age in years) ☐ Estimate?
(If estimate, estimate to increments of 5 years or less)



BRAND NAME

MODEL NUMBER

CLOTHES WASHER _____

CLOTHES DRYER _____



Home Electronics & Other

TELEVISIONS

	Display (CRT/LCD/ Plasma/LED/O ther)	Format Standard/ Wide	Size (Diag. inches)	Energy Star? (Y/N)	EMS	Avg. Hours of Daily Use
Unit 1						
Unit 2						
Unit 3						
Unit 4						
Unit 5						
Unit 6						

Video Game Systems and DVRs

	Type (DVR OR Video Game System)	EMS	Avg. Hours of Daily Use
Unit 1			
Unit 2			
Unit 3			
Unit 4			
Unit 5			
Unit 6			

Energy Management System	
EMS Type	EMS Code
Manual Power Strip (user turns off PS after each use)	MPS
Always On Power Strip	AOPS
Timer Strip	TM
Occupancy Sensor	OSS
Smart Strip	SMS
Other	OT

Computers & Peripherals

Computers	Type (Desktop OR Laptop)	Screen Size (diag. inch)	IF Desktop, Display: CRT OR LCD	Additional Display: CRT OR LCD	Energy Star? (Y/N)	EMS	Auto power down enabled? (Y/N)	Avg. Hours On per Day
Unit 1								
Unit 2								
Unit 3								
Unit 4								
Unit 5								
Unit 6								



Computer Peripherals	Type (Printer, scanner, external hard drive, modem, router)	Energy Star? (Y/N)	Energy Management System- (MPS, AOPS, TM, OSS, SMS, OT)	Average Hours On per Day
Unit 1				
Unit 2				
Unit 3				
Unit 4				
Unit 5				

PUMPS

Type (pool, spa, fountain, pond, sump, well)	Years Since Installation	Horsepower (HP)	Efficiency Rating? (s) Standard, (h) high, (p) premium	Motor Speed? (s) Single, (d) double, (v) variable	Timer?	Months of Use	Avg. Hours of Daily Use during months of use

FANS

Type (Attic, Whole house, Ceiling, Ventilation)	Years Since Installation	Horsepower (HP)	Energy Star?	Efficiency Rating? (s) Standard, (h) high, (p) premium	Months of Use	Avg. Hours of Daily Use during months of use



MISCELLANEOUS

Type (Water bed heater, humidifiers, dehumidifiers)	Years Since Installation	Energy Star?	Gallons per hour	Months of Use	Avg. Hours of Daily Use during months of use

WALL, ROOF, AND FLOOR INSULATION

58. Fill out the following information about the insulation of the home using the following codes:

(a) Roof Material (T) Tile/Slate/Concrete (A) Asphalt Shingles		(M) Metal or Membrane (W) Wood Shake		(b) Roof Color (D) Dark (L) Light (W) White		(c) Attic Type (N) None (Cathedral Ceiling) (V) Vented Attic (U) Unvented Attic	
Reference #	Roof Material (a)	Roof Color (b)	Attic Type (c)	Insulation Depth (in)	Radiant Barrier?	% Roof Area	
1	T A M W	D L W	N V U		Y N		
2	T A M W	D L W	N V U		Y N		
3	T A M W	D L W	N V U		Y N		
Notes:							



(a) Orientation		(b) Construction	(c) Exterior Finish		(d) Insulation Type
(N) North	(NE) Northeast	(2x4) 2x4 Stick Built	(B) Brick/Block		(B) Batts
(S) South	(NW) Northwest	(2x6) 2x6 Stick Built	(ST) Stucco		(L) Loose Fill
(E) East	(SE) Southeast	(BW) Block Wall	(SI) Siding		(F) Expanded foam
(W) West	(SW) Southwest				(O) Other

Wall Ref #	% of Total Above Grade Wall Area	Construction (b)	Ext. Finish (c)	Rigid Foam Insulation?	Insulation Type (d)
1A		2x4 2x6 BW	B ST SI	Y N	
2A		2x4 2x6 BW	B ST SI	Y N	
3A		2x4 2x6 BW	B ST SI	Y N	

Wall Ref #	% of Total Below Grade Wall Area	Insulation Thickness (in)	Rigid Foam Insulation?	Insulation Type (d)
1B				
2B				
3B				

Wall Ref #	% of Total Floor Area	Insulation Thickness (in)	Insulation Type (d)
1T			
2T			
3T			

Notes:	

WINDOWS

59. Fill out the following information about the windows of the home using the following codes:

(a) Type	(b) Orientation		(c) Shading	(d) Panes	(e) Frame	(f) Tinting
(O) Operable Window	(N) North	(NE) Northeast	(D) Drapes	(1) Single Pane	(A)	(C) Clear
(F) Fixed Window	(S) South	(NW) Northwest	(B) Blinds	(2) Double Pane	Aluminum/metal	(T) Tinted
(B) Bay Window	(E) East	(SE) Southeast	(SS) Solar Screen	(3) Triple Pane	(W) Wood/Vinyl	(L) Low-e
(G) Garden Window	(W) West	(SW) Southwest	(WF) Window Film			
(FD) French Door	(H) Horizontal (skylights only)	(N) None				
(SD) Sliding Door						
(SK) Skylight						

Ref #	Type (a)	Orient (b)	Shade (c)	Panes (d)	Frame (e)	Tint (f)	Total Sq Feet	Overhang (Y/N)	Storm Window (Y/N?)
1				1 2 3	A W	CTL			



2				1 2 3	A W	CTL				
3				1 2 3	A W	CTL				
4				1 2 3	A W	CTL				
5				1 2 3	A W	CTL				
6				1 2 3	A W	CTL				
7				1 2 3	A W	CTL				
8				1 2 3	A W	CTL				
9				1 2 3	A W	CTL				
10				1 2 3	A W	CTL				
11				1 2 3	A W	CTL				
12				1 2 3	A W	CTL				
13				1 2 3	A W	CTL				
14				1 2 3	A W	CTL				
15				1 2 3	A W	CTL				
16				1 2 3	A W	CTL				
17				1 2 3	A W	CTL				
18				1 2 3	A W	CTL				
19				1 2 3	A W	CTL				
20				1 2 3	A W	CTL				
Notes:										



DOORS

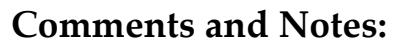
60. Fill out the following information about the doors of the home using the following codes:

(a) Door Type (1) Hollow Wood (2) Solid Wood (3) Sliding Glass (4) French Doors (5) Other (6) Steel		(b) Orientation (1) North (2) South (3) East/West (4) SE (5) SW (6) NE (7) NW (8) unconditioned indoors		(c) Quality of Caulking/ Weather Stripping (1) Good (2) Fair (3) Poor or None		
Reference #	Type (a)	Orientation (b)	Quality (c)	Number of Doors	Total Area	Storm Door?
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						



X. Sketch out the general outline of the residence floor plan and note the dimensions in feet.

A large rectangular grid of dots for sketching a floor plan. The grid consists of 10 columns and 14 rows of dots. In the top-left corner, there is a compass rose with the letters N, S, E, and W indicating the cardinal directions. The dots are arranged in a regular pattern, providing a scale for sketching the residence floor plan.

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Appendix C. Commercial and Industrial On-Site Data Collection Tool

ENSC Commercial and Industrial Baseline Survey

Site ID Number

2012 Commercial and Industrial On-Site Survey Form For ENSC

December 03, 2012

Site Contact Information:

Business Name: _____
 Street Address: _____
 City, Province: _____
 Postal Code: _____
 Business Phone#: () _____
 Contact #1 Name: _____
 Contact Account #: _____
 Title: _____

Survey Tracking Information:

Site Type (Office, Retail, etc.)

Date (dd/mm/yy):

First & last Name & Initials

Field Survey Executed: ____/____/____

Survey Received from Surveyor: ____/____/____

Quality Control Check Complete: ____/____/____

Survey Received for Data Entry: ____/____/____

Data Entry complete: ____/____/____



ENSC Commercial and Industrial Baseline Survey

Self-QC Checklist

- ☐ No blanks !
- ☐ Numbers 1 & 2 match (**SITE AREA = SURVEYED AREA**)
 - ☐ If not, complete the table and give detailed description in comments number 8. Discuss site with Nick.
- ☐ SITE matches meters provided
- ☐ Business hours listed in military time
- ☐ Ensure Q2: "Total SURVEYED floor area" in the Electric Service Meter and Account Numbers Form matches Q50: "Total Enclosed Floor Space" in the Site Information Form. (**SITE AREA = TOTAL ENCLOSED FLOOR SPACE**)
- ☐ Model numbers for HVAC equipment listed
- ☐ HVAC listed for all area IDs that have heating/cooling
- ☐ Area IDs listed for each HVAC system
- ☐ Lighting listed for all area IDs
- ☐ Remember to check for exit signs
- ☐ Cooking equipment only lists electric devices.
- ☐ All remote refrigeration compressors refer to the correct cases and walk-ins
- ☐ All refrigerated areas are served by a compressor



ENSC Commercial and Industrial Baseline Survey

- ☐ If Heating/Cooling for SURVEYED AREA is provided by equipment outside surveyed area, fill out Shared HVAC section

- ☐ If SURVEYED AREA shares utility meters with other areas, fill out shared meters section
- ☐ Review and print Google Maps address to review site area, in particular roof tops



ENSC Commercial Baseline Survey

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17. Heat Rejection (Built-Up) ☐ N/A.....	17
18. Exhaust Fans ☐ N/A.....	18
19. Make-Up Air Units (supply 100% outdoor air) ☐ N/A.....	18
20. Water Heating Equipment ☐ N/A.....	19
21. Outdoor Lighting (Including on-site parking lot and/or ramp).....	20
22. Indoor Lighting	22
23. Office Equipment	24
24. Commercial Cooking/Food Service Equipment ☐ N/A.....	25
25. Refrigeration Equipment – Self Contained	26
Non-Commercial Refrigerator/Freezers ☐ N/A.....	26
Commercial Refrigeration Equipment ☐ N/A.....	26
Self-Contained Refrigeration Equipment Codes	26
26. Remote Refrigeration Equipment ☐ N/A.....	27
27. Miscellaneous Equipment ☐ N/A.....	30
28. Motors/Engines (Process Related) ☐ N/A.....	31
29. Air Compressors ☐ N/A.....	32
30. Electric Process Equipment (Non-Motor) ☐ N/A.....	33
31. Transformers ☐ N/A.....	Error! Bookmark not defined.
32. Swimming Pool/Spa ☐ N/A.....	34
33. On-Site Power Generation ☐ N/A.....	35
34. Thermal Storage ☐ N/A.....	35
35. Electric Energy Storage ☐ N/A.....	35
36. Shared/Central HVAC Systems and Shared Meters/Services	35
Shared HVAC Equipment (Not Located in Surveyed Area) ☐ N/A.....	35
37. Comments and Recommendations	36



ENSC Commercial Baseline Survey

Motor/Fan/Pump Efficiency Conversion Table

Where ever there is a motor efficiency value that is given in Nominal %, use this table to convert that percentage into a "Standard" or "Premium" efficiency label. If the percentage lies between the two values in the table, indicate the motor as "High" efficiency.

Total Enclosed Fan-Cooled (TEFC)						
HP	1200 RPMs		1800 RPMs		3600 RPMS	
	Standard	Premium	Standard	Premium	Standard	Premium
1	80	82.5	82.5	85.5	75.5	77
1.5	85.5	87.5	84	86.5	82.5	84
2	86.5	88.5	84	86.5	84	85.5
3	87.5	89.5	87.5	89.5	85.5	86.5
5	87.5	89.5	87.5	89.5	87.5	88.5
7.5	89.5	91	89.5	91.7	88.5	89.5
10	89.5	91	89.5	91.7	89.5	90.2
15	90.2	91.7	91	92.4	90.2	91
20	90.2	91.7	91	93	90.2	91
25	91.7	93	92.4	93.6	91	91.7
30	91.7	93	92.4	93.6	91	91.7
40	93	94.1	93	94.1	91.7	92.4
50	93	94.1	93	94.5	92.4	93
60	93.6	94.5	93.6	95	93	93.6
75	93.6	94.5	94.1	95.4	93	93.6
100	94.1	95	94.5	95.4	93.6	94.1
125	94.1	95	94.5	95.4	94.5	95
150	95	95.8	95	95.8	94.5	95
200	95	95.8	95	96.2	95	95.4



ENSC Commercial Baseline Survey

Lighting Lookup Table

To truly know if a fixture is HPT8, you must verify the ballast model #, as it's the ballast/lamp combo that determines if it's HPT8. Often time, access to the ballast is not possible. In these cases, please refer to the below table. If you identify the lamp types below, you can assume the fixture is an HPT8 fixture

HP T8 Reference Table of Lamp Types (For reference only)		
Manufacturer	Product Name	Product/Ordering Code
GE	Ecolux High Lumen	F32T8/XL/SPX**/HL/ECO
Maxlite	T8 XL Series	F32T8/*-***XL
OSRAM-Sylvania	Octron XPS Ecologic	FO32/*-***XPS/ECO
Philips	Alto Advantage	F32T8/ADV***/ALTO
Radiant	Triten 50 Ultra	F32T8/Triten O/ULTRA/ENV
SLI Lighting	Terra-Lux High Lumen	F32T8/HL/*-***
TCP	TCP High Lumen	F32T8/850/HL
USHIO	ULTRA 8 High Lumen	F32T8841/HL
Westinghouse	XL Series	F32T8-***-XL-ECOMAX
* Indicates "Wild Card" where a range of product-specific numbers/letters are found, typically indicating lumen output		



ENSC Commercial Baseline Survey

Site # _____

Form 1

1. Electric Service Meter and Account Numbers

Item #	Site's Meter Number/s or Service ID/s:	Site's Account Number/s:
E1	_____	_____
E2	_____	_____
E3	_____	_____
E4	_____	_____
E5	_____	_____
E6	_____	_____
E7	_____	_____
E8	_____	_____
E9	_____	_____
E10	_____	_____

1. What is the total floor area for this SITE (exclude parking garages)? _____ sq ft
2. What is the total SURVEYED floor area? _____ sq ft

If SITE is a large campus, industrial park with multiple buildings, or other site too large to be surveyed entirely, call Nick Beaman (802 526 5107 or 510 926 9008), Stu Slose (802 526 5113 or 201 294 1388) or Tim Guiterman (802 526 5114 or 720 384 5162) immediately to discuss and select areas of the site to be surveyed. Describe the areas surveyed in the table below. Also complete the shared HVAC and shared utilities sections appropriately.

Do not survey less than the SITE AREA unless Nick, Stu or Tim approves.

Item	a. Description of Building or Area in the Site	b. Total Floor Area (ft ²) of Building or Area	c. Floor Area Surveyed (ft ²)	d. Comments
3.				
4.				
5.				
6.				
7.				

8. Describe the SITE with respect to the building/s it is in:



ENSC Commercial Baseline Survey

Site # _____

Form 4

2. Site Activity Information

SITE ACTIVITY CODE: _ _ _ (Use activity codes from the Site Activity Codes table below) (DK if Don't Know)

9. Site Activity Codes:			
COMMERCIAL		INDUSTRIAL	
Office, Large:	060	Chemical:	028
Office, Small:	061	Electronics:	036
Retail (non-food):	059	Food:	020
Warehouse:	050	Motor Freight Transportation:	042
Health Care/Hospital:	080	Rubber/Plastics:	030
Restaurant:	058	Stone/Clay/Glass:	032
School:	082	Other Industrial:	
College/University:	822	Other Describe	130
Grocery/Supermarket	054		
Lodging (Hotel, Motel):	070		
Other Commercial:			
Unassigned buildings	099		
Describe			

10. Describe the current primary activity/product/service of this facility:

3. General Information for Surveyed Business

11. Does the site have an enclosed parking structure?

Yes No

12. What year was the majority of the facility built?

13. Percent of building occupied by this establishment?

_____ %



ENSC Commercial Baseline Survey

Site # _____

Form 4

4. Service Hot Water Use (General and Building-Type Specific) ☐ N/A

*NOTE: If there is water heating equipment on-site, **at least one of the fields** below needs to have a value*

14. Describe Hot Water Uses for facility (list multiple uses if needed) [i.e., lavatory, process, floor-washing, etc.]	
15. How many faucets are in the surveyed area?	
16. What percent of the faucets are low flow/have aerators?	
17. How many shower heads are in the surveyed area?	
18. What percentage of shower heads are low-flow?	

19. Comments:

5. Primary Schedules and Operation
Business Hours

19a. Number of Days OPEN per week: _____

19b. Total hours of operation per week: _____



ENSC Commercial Baseline Survey

Site # _____

Form 6

6. Operation Schedules

Define operation schedules as listed below for all schedule types applicable to the surveyed area.

Draw a line through those schedules that do not apply to the surveyed area.

SCHEDULE TYPE		OUTSIDE OF BUSINESS HOURS*	DURING BUSINESS HOURS
20. Indoor Lighting	% of Equip On	a. ___ %	b. ___ %
21. Office Equipment	% of Equip On	a. ___ %	b. ___ %
22. Cooking Equipment	% of Equip On	a. ___ %	b. ___ %
23. Motors/Air Compressors/Process Equipment	% of Equip On	a. ___ %	b. ___ %
24. Outdoor Lighting** Dusk/Dawn/Light Sensor ☐ (specify typical operating hours)	Hour (1-24) that lights....	a....come on:** hr ___	b. ...go off:** hr ___

* For operation outside of business hours, get estimates from the site contact. Do not use a value of zero (0) unless ALL equipment is really off when the business is closed.

** Outdoor lighting operation is independent from business hours, so hours of operation need to be specified. NOTE: If all outdoor lighting is photocell controlled, the on/off hours can be left blank.

End Use Type	How Often do you perform maintenance?	
25. Compressed Air	<6mths 6-12mths 1-5 yrs 5+ yrs N/A DK Never On Failure	
26. Process Fans/Pumps/Drives	<6mths 6-12mths 1-5 yrs 5+ yrs N/A DK Never On Failure	
27. Process Heating/Drying	<6mths 6-12mths 1-5 yrs 5+ yrs N/A DK Never On Failure	
28. Boiler/Chiller/HVAC	<6mths 6-12mths 1-5 yrs 5+ yrs N/A DK Never On Failure	
29. Duct System	<6mths 6-12mths 1-5 yrs 5+ yrs N/A DK Never On Failure	
30. Refrigeration	<6mths 6-12mths 1-5 yrs 5+ yrs N/A DK Never On Failure	
31. Lighting	<6mths 6-12mths 1-5 yrs 5+ yrs N/A DK Never On Failure	



ENSC Commercial Baseline Survey

Site # _____

Form 7

7. Site Information (Survey Area Only)

32. Number of Floors	33. Total SURVEYED Floor Space, ft ²

Primary Function Areas & Area ID # Assignments: *(Identify no more than six primary function areas)*

Item #	Primary Function Description	a. Area ID # (use item #s 1-33)	b. % of Total Surveyed Floor Area	c. % of Area Cooled	d. % of Area Heated	e. Floor Area, ft ² (Ref only)
34.	Apartments	1	%	%	%	
35.	Classroom	2	%	%	%	
36.	Clean Room	3	%	%	%	
37.	Common or Support Areas /	4	%	%	%	
38.	Conference Rooms	5	%	%	%	
39.	Kitchen / Cooking Area	6	%	%	%	
40.	Computer Room / Data Processing	7	%	%	%	
41.	Dining	8	%	%	%	
42.	Health Facility	9	%	%	%	
43.	Health, Examination Room	10	%	%	%	
44.	Health, Patient Room	11	%	%	%	
45.	Laundry Rooms	12	%	%	%	
46.	Loading Dock	13	%	%	%	
47.	Lobby / Reception Area	14	%	%	%	
48.	Lodging	15	%	%	%	
49.	Manufacturing	16	%	%	%	
50.	Mechanical / Electrical Room	17	%	%	%	
51.	Office, Private	18	%	%	%	
52.	Office, Cubicle or Open Offices	19	%	%	%	
53.	Operating Room, Critical Care	20	%	%	%	
54.	Patio Area	21	%	%	%	
55.	Pool/Spa Area	22	%	%	%	
56.	Public Assembly	23	%	%	%	
57.	Public Assembly, Gymnasium	24	%	%	%	
58.	Public Assembly, Library	25	%	%	%	
59.	Retail	26	%	%	%	
60.	Stairs / Hallways / Corridors	27	%	%	%	
61.	Vacant	28	%	%	%	
62.	Warehouse / Storage (Non-	29	%	%	%	
63.	Warehouse Refrigerated	30	%	%	%	
64.	Garage	31	%	%	%	
65.	Other #1 (describe)	32	%	%	%	
66.	Other #2 (describe)	33	%	%	%	
			100%	--	--	

Within 5%



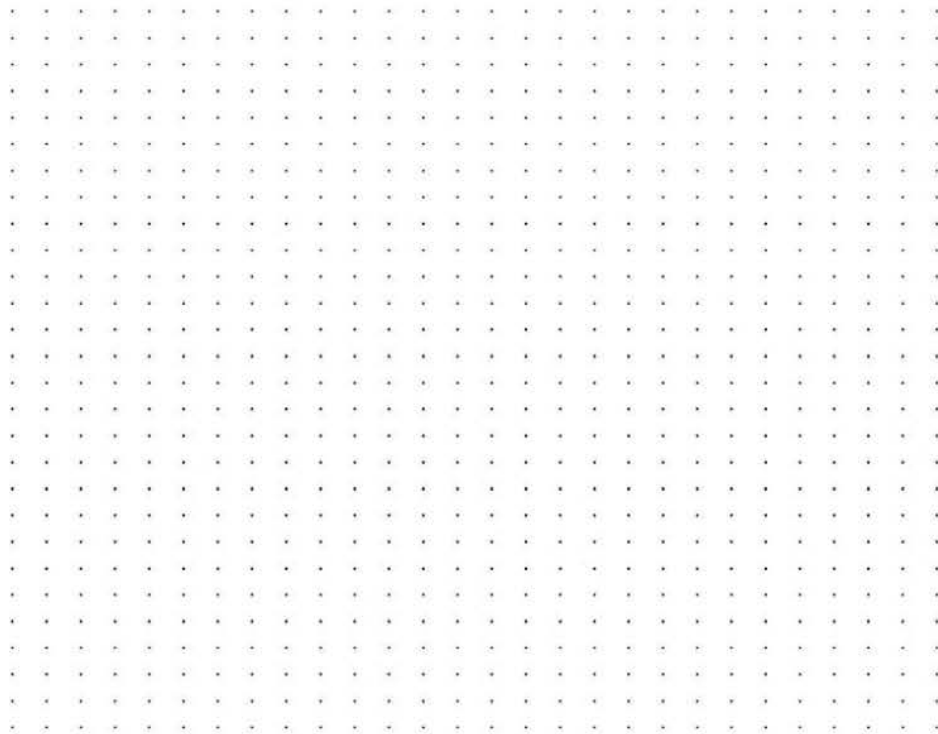
ENSC Commercial Baseline Survey

Site # _____

Form 8

8. Floor Plan (Ask Customer for Fire Exit Map)

Sketch the floor plan of all the buildings at the Site and identify the Survey Area and the Shared Service Area. Indicate on the drawing the boundaries of different space usage areas and meters. Include building dimensions and mark the orientation. Indicate ceiling height and building height. Sketch elevation. Indicate any significant shading provided by adjacent trees or buildings. Attach site plan and floor plan if available. Use multiple drawings if necessary. (No Need to measure, rough estimates are fine by walking)



67. Describe area included in the survey, and any details that should be mentioned that will help us understand the survey:



ENSC Commercial Baseline Survey

Site # _____

Form 9

9. Building Specifications

Exterior Walls (between conditioned space and outdoors)

			W1	W2	W3
68. Wall construction type	From Wall Type table				
69. Insulation material type	From Insulation Type table				
70. Insulation R-value (or inches if known)					
71. Wall Color	D = Dark M = Medium L = Light		D M L	D M L	D M L
Wall Types	Wall Types (Cont.)	Insulation Types (R/in)			
WFF 2 X 4 Wood Frame	WC8 8" Solid Concrete	BAT Batt or Blanket	3.3		
WFM 2 X 4 Metal Frame	WC10 10" Solid Concrete	LSF Loose fill	2.7		
WSF 2 X 6 Wood Frame	WC12 12" Solid Concrete	XPE Expanded perlite	2.8		
WSM 2 X 6 Metal Frame	WBLO Concrete Block	XPS Expanded polystyrene	3.8-5.0		
WAIR Air	WBRI Brick	RDG Rigid board	2.8-4.0		
WC4 4" Solid Concrete	WGLS Glass Curtain	N None	0		
WC6 6" Solid Concrete	WADB Adiabatic or Below Grade or Interior wall	OTH1 Other1 _____			
WCM Corrugated Metal	Other	OTH2 Other2 _____			

Roof/Ceiling

		R1	R2
72. Roof or Top Floor Area (ft2)			
73. Roof construction type	RFAT = Framed With Attic RMET = Metal Decking RFNO = Framed Without Attic RCON = Concrete Decking RADB = Adiabatic (Occ. space above not part of SURVEYED area)	RFAT RMET RFNO RCON RADB	RFAT RMET RFNO RCON RADB
74. Roof Surface	B = Built-up W = Wood Shingle M = Metal C = Clay/Cement Tile A = Asphalt Roll/shingle U = Membrane	B W M C A U	B W M C A U
75. Roof Finish	R = Reflective F = Flat	R F	R F
76. Roof Color	D = Dark M = Medium L = Light	D M L	D M L
77. Roof Insulation R-value			
78. Ceiling Insulation R-value			

Floor

		F1	F2
79. Bottom Floor Area (ft2)			
80. Floor construction type	S = Slab C = Crawl U = Unheated Basement O = Open (Garage) A = Adiabatic	S C U O A	S C U O A
81. Insulation R-value (-99)			

82. Comments:



ENSC Commercial Baseline Survey

Site # _____

Form 10

10. Building Specifications (cont'd)

Windows/Fenestration

Note: Baseline windows are 2-pane, clear glaze

		G1	G2	G3
83. Layers of glazing				
84. Type of glazing	C = Clear T = Tinted R = Reflective O = Opaque	C T R O	C T R O	C T R O
85. Glazing features	N = None L = Low E G = Gas Filled B = Both	N L G B	N L G B	N L G B
86. Window frame type	V = Vinyl M = Metal W = Wood O = Other _____	V M W O	V M W O	V M W O
87.				
88.				
89. Window Film	Y = Yes N = No DK = Don't Know	Y N DK	Y N DK	Y N DK
90. External Solar Shade	Y = Yes N = No DK = Don't Know	Y N DK	Y N DK	Y N DK
91. Interior shading	F = Fixed M = Moveable N = None DK = Don't Know	F M N DK	F M N DK	F M N DK

Wall (at facility boundary) Construction

	N	E	S	W
92. Total Wall Area, ft2 (inc. windows)				
93. External Wall Type W1 (%)	%	%	%	%
94. External Wall Type W2 (%)	%	%	%	%
95. External Wall Type W3 (%)	%	%	%	%
Sum of Exterior Walls	100%	100%	100%	100%
96. Window G1 (% of wall area)	%	%	%	%
97. Window G2 (% of wall area)	%	%	%	%
98. Window G3 (% of wall area)	%	%	%	%
99. Door D1 – metal insulated (ft2)				
100. Door D2 – metal, no insulation (ft2)				
101. Door D3 – wood (ft2)				
102. Door D4 – glass (ft2)				
103. Door D5 – vinyl (ft2)				



ENSC Commercial Baseline Survey

Site # _____

Form 11

11. HVAC – Single Zone SystemsN/A ☐

Seq #	Seq # ____	Seq # ____	Seq # ____
Distribution System:			
104. System type: SZ = Single Zone (built-up) PSZ = Pkg. Single Zone (Unitary) SSZ = Split-System Single Zone PTU = Pkg. Term. Unit (wall mounted) UV = Unit Ventilator or Heater 2PFC = 2-Pipe Fan Coil 4PFC = 4-Pipe Fan Coil WLHP = Water Loop/Source Heat Pump BR = Baseboard or Radiant Heater DMS = Ductless Mini Split RAC = Room AC (window unit) <i>Note: Do not include perimeter units in areas served by an air handler.</i>	SZ PSZ SSZ PTU UV 2PFC 4PFC WLHP BR DMS RAC	SZ PSZ SSZ PTU UV 2PFC 4PFC WLHP BR DMS RAC	SZ PSZ SSZ PTU UV 2PFC 4PFC WLHP BR DMS RAC
105. Heating and cooling? H = Heating only C = Cooling only B = Both	H C B	H C B	H C B
106. Number of units: REQUIRED			
107. Duct Insulation (unconditioned space only)	Y N N/A DK	Y N N/A DK	Y N N/A DK
108. On/Off control: M = Manual (On/Off) A = Always On T = Thermostat E = EMS P = Programmable Thermostat O = Occupancy Sensor DK = Don't Know	M A T E P O DK	M A T E P O DK	M A T E P O DK
109. Equipment manufacturer			
110. Model number			
111. Quantity of Indoor Fans			
112. Indoor/Supply fan (hp/fan)			
113. Motor Eff.: S=Std. H=Hi Eff P=Premium DK=Don't Know	S H P DK	S H P DK	S H P DK
114. Economizer in use?	Y N DK	Y N DK	Y N DK
115. CO2 Sensors in use?	Y N N/A DK	Y N N/A DK	Y N N/A DK
116. Energy Recovery?	Y N N/A DK	Y N N/A DK	Y N N/A DK
117. Return fan motor (hp/fan)			
118. Motor Eff.: S=Std. H=HiEff P=Premium			
119. Quantity of Return Fans			
120. Serves Area REQUIRED or A for all areas			



ENSC Commercial Baseline Survey

Site # _____

Form 11a

HVAC – Single Zone Systems (cont'd)

Seq # (match to Form 9a)	Seq # ____	Seq # ____	Seq # ____
Cooling Equipment:			
121. Type: N = None C = Chiller D = Direct Expan. E = Evap. Cooler <i>If Cooling Type = C(chiller), skip to Heating Equipment.</i>	N C D E	N C D E	N C D E
122. Number of Compressors			
123. Capacity output (nominal tons) <i>Do not Average NA for Evap Coolers</i>			
124. Efficiency: EER			
125. Or SEER			
126. Evaporative Precooling?	Y N DK	Y N DK	Y N DK
127. Variable Speed Drive	Y N DK	Y N DK	Y N DK
Heating Equipment:			
128. Type: N = None F = Furnace ASHP = Air Source Heat Pump GSHP = Ground Source Heat Pump RH = Radiant Heater ER = Electric Resistance B = Boiler BB = Baseboard Heater OT = Other	N F ASHP GSHP RH ER B BB OT	N F ASHP GSHP RH ER B BB OT	N F ASHP GSHP RH ER B BB OT
<i>If Heating Type = B(boiler) stop and move to Boiler page.</i>			
129. Fuel: E = Electricity G = Natural Gas F = Fuel Oil L = LPG (liquefied propane gas) W = Wood	E G F L W	E G F L W	E G F L W
130. Input Rating in kW – electrical units only			
131. Input Rating in kBtuh – gas units only			
132. Efficiency: % (or for HP enter COP)			
133. HP only:HSPF (Heating Season Performance Factor)			

134. Comments (Indicate deck temperature setpoints/reset schedules, or any other significant details such as high pressure air distribution, CFM.):



ENSC Commercial Baseline Survey

Site #

Form 11a



ENSC Commercial Baseline Survey

Site # _____

Form 12

12. HVAC – Multiple Zone SystemsN/A ☐

Seq #	Seq # ____	Seq # ____	Seq # ____
<i>Distribution Systems</i>			
135. Type: DD = Dual Duct MZ = Multi Zone CV = Constant Volume Reheat VAV = Variable Air Volume OT = Other _____ DF = Dual Fan Dual Duct	DD MZ CV VAV OT DF	DD MZ CV VAV OT DF	DD MZ CV VAV OT DF
136. Age (years)			
137. Number of air handlers REQUIRED			
138. On/Off Control: M = Manual (On/Off) A = Always On T = Time Clock E = EMS	M A T E	M A T E	M A T E
139. Supply Fans: (hp/supply fan)			
140. Motor Eff.: S=Std. H=HiEff P=Premium	S H P DK	S H P DK	S H P DK
141. Quantity of supply fans			
142. Supply fan type and control: (VAV only) IA = inlet guide vanes, DF = discharge damper, VA = vane axial fan w/ variable pitch VS = variable speed drive DK = Don't Know	IA DF VA VS DK	IA DF VA VS DK	IA DF VA VS DK
143. Quantity of return fans			
144. Return fans: (hp/return fan)			
145. Motor Eff.: S=Std. H=HiEff P=Premium	S H P DK	S H P DK	S H P DK
146. Return fan type and control: (VAV only) IA = inlet guide vanes, DF = discharge damper, VA = vane axial fan w/ variable pitch VS = variable speed drive DK = Don't Know	IA DF VA VS DK	IA DF VA VS	IA DF VA VS DK
147. Outside air economizer present?	Y N DK	Y N DK	Y N DK
148. Outside air economizer enabled/in use? (Y/N) ask building operator	Y N DK	Y N DK	Y N DK
149. CO2 Sensors in use? (Y/N)	Y N DK	Y N DK	Y N DK
150. Energy Recovery?	Y N DK	Y N DK	Y N DK
151. Serves Area ID # (Required) or A for All			



ENSC Commercial Baseline Survey

Site # _____

Form 12a

HVAC – Multiple Zone Systems (cont'd)**N/A ☐**

Seq # (match to Form 10a)	Seq # ____	Seq # ____	Seq # ____
Cooling Equipment:			
152. Type: N = None C = Chiller D = Direct Expan. E = Evap. Cool <i>If Cooling Type = C(chiller), skip to heating equipment.</i>	N C D E	N C D E	N C D E
153. Number of Units REQUIRED			
154. Number of Compressors			
155. Capacity output (nominal tons) <i>Do not Average NA for Evap Coolers</i>			
156. Efficiency: EER			
157. Variable Speed Drive	Y N DK	Y N DK	Y N DK
Heating Equipment			
158. Type: F = Furnace B = Boiler P = Purch. Steam OT = Other _____ ER = Electric Resistance <i>If Heating Type = B(boiler) stop.</i>	F B P OT ER	F B P OT ER	F B P OT ER
159. Fuel: E = Electricity G = Natural Gas F = Fuel Oil L = LPG S = Solar W = Wood	E G F L S W	E G F L S W	E G F L S W
160. Number of units REQUIRED			
161. Input Rating in kW – electrical units only			
162. Input Rating in kBtuh – gas units only			
163. Efficiency (%)	%	%	%

164. Comments (Indicate deck temperature setpoints/reset schedules, or any other significant details such as high pressure air distribution.):



ENSC Commercial Baseline Survey

Site # _____

Form 18

13. Boilers☐ N/A

Seq #	Boiler # _____	Boiler # _____	Boiler # _____
165. Type: W = Water S = Steam OT = Other _____	W S OT	W S OT	W S OT
166. If steam, enter steam pressure (PSIG setpoint)			
167. If water, enter water temperature setpoint			
168. Primary fuel type: E = Electricity Resistance G = Natural Gas W = Wood C = Coal/Coke WO = Waste Oil D = Diesel S = Gasoline L = LPG F = Fuel Oil O = Other _____	E G W C WO D S L F O	E G W C WO D S L F O	E G W C WO D S L F O
169. Secondary fuel (use codes from Primary Fuel Type)			
170. Average Age (years)			
171. Number of units <i>REQUIRED</i>			
172. Number of units in backup mode			
173. Input Capacity (kBtu/hr/unit)			
174. Efficiency: (%)			
175. Does this boiler utilize a stack economizer?	Y N DK	Y N DK	Y N DK
176. Does this boiler utilize a stack Recuperator?	Y N DK	Y N DK	Y N DK
177. Does this boiler utilize Blow Down Heat Recovery?	Y N DK	Y N DK	Y N DK
178. Does this boiler have O2 trim control?	Y N DK	Y N DK	Y N DK
179. Does the outlet pipe have insulation?	Y N DK	Y N DK	Y N DK
% of Boiler output to each end use: (NOTE: Total must sum to 100%)			
180. Space Heat	%	%	%
181. Water Heat	%	%	%
182. Pool Heat	%	%	%
183. Process	%	%	%
184. Use outside SURVEYED area	%	%	%
185. Is HW temp reset used? (Y / N)	Y N DK	Y N DK	Y N DK
186. Serves Area ID			



ENSC Commercial Baseline Survey

Site # _____

Form 18

14. Hot Water Circulation Pumps☐ N/A

Seq #	Seq #__	Seq #__	Seq #__
187. Number of units REQUIRED			
188. Number of units in backup mode			
189. Pump motor power (hp)			
190. Motor Eff.: S=Std. H=Hi Eff P=Premium DK= Don't Know	S H P DK	S H P DK	S H P DK
191. Motor Type: O = One Speed T = Two Speed V = Variable DK= Don't Know	O T V DK	O T V DK	O T V DK
192. Time clock: Y= Yes N=No DK= Don't Know	Y N DK	Y N DK	Y N DK
193. Serves Area ID # (Required) or A for All			



ENSC Commercial Baseline Survey

Site # _____

Form 18

15. Chillers☐ N/A

Seq #	Chiller #	Chiller #	Chiller #
194. Type:			
CENT = Centrifugal REC = Reciprocating	CENT REC	CENT REC	CENT REC
SABS = Absorption steam SCRW = Screw Compressor	SABS SCRW	SABS SCRW	SABS SCRW
GABS = Absorption, direct fired gas OT = Other _____	GABS OT	GABS OT	GABS OT
195. If absorption, one or two stage	1 2	1 2	1 2
196. If direct-fired, kBtuh input			
197. Fuel type:	E G S	E G S	E G S
E = Elect G = Natural Gas S = Steam			
198. Number of units <i>REQUIRED</i>			
199. Number of units in backup mode			
200. Equipment manufacturer			
201. Model number			
202. Chilled water leaving temperature			
203. – Variable-Speed Drive? (Y/N)	Y N DK	Y N DK	Y N DK
204. Capacity (nominal tons/unit)			
205. Full Load Efficiency in kW/ton			
206. Part Load Value (IPLV) in kW/Ton			
207. Chilled water reset used? (Y/N)	Y N DK	Y N DK	Y N DK
208. Chilled sequencing control used? (Y/N)	Y N DK	Y N DK	Y N DK
209. Water-side economizer in use? (Y/N)	Y N DK	Y N DK	Y N DK
210. Does the outflow from the chiller have pipe insulation? (Y/N)	Y N DK	Y N DK	Y N DK
% of chiller output to each end use:			
(NOTE: Total must sum to 100%)			
211. Space Cooling	%	%	%
212. Process	%	%	%
213. Use outside SURVEYED area	%	%	%



ENSC Commercial Baseline Survey

Site # _____

Form 18

16. Circulation Pumps for Chillers☐ N/A

Seq #	Seq # ____	Seq # ____	Seq # ____
214. Use type: CHW = Chilled Water SCHW = Secondary Chilled Water CHHW = Chilled/Hot Water (2-pipe system) CW = Condenser	CHW SCHW CHHW CW	CHW SCHW CHHW CW	CHW SCHW CHHW CW
215. Number of units REQUIRED			
216. Number of units in backup mode			
217. Pump power (hp)			
218. Motor Eff.: S=Std. H=HiEff P=Prem DK=Don't Know	S H P DK	S H P DK	S H P DK
219. Motor type: O = 1-Speed T = 2-Speed V = Vari.	O T V	O T V	O T V
220. Serves Area ID # (Required) or A for All			

17. Heat Rejection (Built-Up)☐ N/A

Seq #	Seq # ____	Seq # ____	Seq # ____
221. Type: AC = Air Cooled EC = Evaporative Condense spray over tubes ACP = Air Cooled w/pre-cooler WCT = Water Cooling Tower	AC EC ACP WCT	AC EC ACP WCT	AC EC ACP WCT
222. Number of fans REQUIRED			
223. Fan power (hp)			
Motor Eff.: S=Std. H=HiEff P=Prem DK=Don't Know	S H P DK	S H P DK	S H P DK
224. Fan Control: O = One Speed T = Two Speed V = Variable DK =Don't Know	O T V DK	O T V DK	O T V DK
225. Cooling Tower Optimization F =Fan staging T =tower staging R =Reset Temperature W =Wet-bulb +Approach control N = None DK =Don't Know	F T R W N DK	F T R W N DK	F T R W N DK
226. Serves chiller # (Required) or A for All			



ENSC Commercial Baseline Survey

Site # _____

Form 18

18. Exhaust Fans☐ N/A

Seq #	Seq # ____	Seq # ____	Seq # ____
227. Number of units			
228. Motor Model Number			
229. Fan power: hp/unit (if estimated < 1HP, enter "small")			
230. Hours of Use per week			
231. Motor Eff: Std., High Eff, Prem. Don't Know	S H P DK	S H P DK	S H P DK
232. Controls: Timer, Sensor, Manual, None			
233. Sensor type:	T S M N	T S M N	T S M N
234. Drive Speed: Constant or Variable or Don't Know	C V DK	C V DK	C V DK
235. Schedule: C = Continuous W = With air handler O = Other	C W O	C W O	C W O
236. Serves Area ID (Required) or A for All OR if parking indicate "Parking" and continue:			
237. Capacity (total parking spots)			
238. ENCLOSED PARKING Floor Area (ft ²)			
239. Height between decks (ft)			
240.			
241.			
242.			
243.			
244.			
245. Notes: Please indicate any additional features that would impact energy use. I.e. duct work, filters, dampers, or additional notes on peak time(s)-of-use.			

19. Make-Up Air Units (supply 100% outdoor air)☐ N/A

Seq #	Seq # ____	Seq # ____	Seq # ____
246. Number of units REQUIRED			
247. Fan power (HP / unit)			
248. Motor Eff: Std., High Eff, Prem. Don't Know	S H P DK	S H P DK	S H P DK
249. Fan Control: C=constant V=Variable or Don't Know	C V DK	C V DK	C V DK
250. Schedule: C = Continuous W = With air handler O = Other	C W O	C W O	C W O
251. Hours on per week			
252. Serves Area ID # (Required) or A for All			



ENSC Commercial Baseline Survey

Site # _____

Form 20

20. Water Heating Equipment☐ N/A

	Seq # ____	Seq # ____	Seq # ____
253. Equipment type: Std = Standard Water Heater I = Instantaneous (Tankless) PS = Purchased Steam AHP = Heat Pump Water Heater – Air Source GHP = Heat Pump Water Heater – Ground Source PHW = Purchased Hot Water B = Boiler DK = Don't Know	Std I PS AHP GHP PHW B DK	Std I PS AHP GHP PHW B DK	Std I PS AHP GHP PHW B DK
254. Fuel type: (If not boiler) E = Electricity G = Natural Gas F = Fuel Oil L = LPG W = Wood S = Solar SG = Solar w/gas backup H = Heat Recovery K = Other _____	E G F L W S SG H O	E G F L W S SG H O	E G F L W S SG H O
255. Average Age (years)			
256. If boiler, enter boiler # (from Form 13)			
257. Number of units (if not boiler) REQUIRED			
258. Equipment manufacturer			
259. Model number			
260. Rated Input Capacity in kW (if not boiler) – for electrical units			
261. Rated Input Capacity in kBtuh (if not boiler) – for gas units			
262. Tank capacity/volume (Gallons) (Imperial or US [circle one])			
263. Efficiency: Energy Factor			
264. Efficiency: Thermal Efficiency			
265. Water temperature setting °F High= H Med.= M Low= L			
266. Are hot water pipes insulated?	Y N DK	Y N DK	Y N DK
267. Is tank externally insulated (ex, blanket wrap)	Y N DK	Y N DK	Y N DK
268. Does system use a recirculation pump?(Y/N)	Y N DK	Y N DK	Y N DK
269.			
270. Pump operation, average number of hours per week – Also fill out pump information on Pumps Forms			
271. Serves Area ID # (Required) or A for All			



ENSC Commercial Baseline Survey

Site # _____

Form 21

21. Outdoor Lighting (Including on-site parking lot and/or ramp)

	Seq #	Seq #	Seq #	Seq #	Seq #	Seq #	Seq #
272. Control type: S = Manual on/off-switch EM = EMS TC = Timeclock PC = Photocell PT = Photocell/Timeclock MS = Motion Sensor	S EM TC PC PT MS	S EM TC PC PT MS	S EM TC PC PT MS	S EM TC PC PT MS	S EM TC PC PT MS	S EM TC PC PT MS	S EM TC PC PT MS
273. Total number of fixtures							
274. IF NEON, Total length							
275. Number of lamps per fixture							
276. IF NEON, Number of lamps							
277. Watts per lamp							
278. IF NEON, Watts per lamp							
279. Hours per week							
Lamp Type & Lamp-Specific Details:							
280. LED = LEDs	LED	LED	LED	LED	LED	LED	LED
281. E = Electrodes/Induction	E	E	E	E	E	E	E
282. Q = Quartz/Halogen	Q	Q	Q	Q	Q	Q	Q
283. I = Incandescent	I	I	I	I	I	I	I
284. <i>Medium screw base</i> less than 100W?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
285. <i>F = Fluorescent Tube</i>	F	F	F	F	F	F	F
286. <i>UT = Fluorescent U-tube</i>	UT	UT	UT	UT	UT	UT	UT
287. <i>HO = High-output Fluorescent</i>	HO	HO	HO	HO	HO	HO	HO
288. <i>HPTS = High Performance TS (25-28 watts)</i>	HPTS	HPTS	HPTS	HPTS	HPTS	HPTS	HPTS
289. <i>Fluorescent tubes: Length in ft. (e.g. 1.5 2 4 8)</i>							
290. <i>Diameter (T5 TS T10 T12)</i>							
291. CF = Compact Fluorescent	CF	CF	CF	CF	CF	CF	CF
292. CIR = Circline Fluorescent	CIR	CIR	CIR	CIR	CIR	CIR	CIR
293. <i>CF/CIR Base type: P=Pin-base S=Screw-base DK=Don't Know</i>	P S DK	P S DK	P S DK	P S DK	P S DK	P S DK	P S DK
294. MV = Mercury Vapor	MV	MV	MV	MV	MV	MV	MV
295. MH = Metal Halide	MH	MH	MH	MH	MH	MH	MH
296. H = High Pressure Sodium Vapor	H	H	H	H	H	H	H
297. L = Low Pressure Sodium Vapor	L	L	L	L	L	L	L
298. N = Neon	N	N	N	N	N	N	N
299. Field notes: (comments and/or additional ballast info)							



<i>ENSC Commercial Baseline Survey</i>		<i>Site #</i>				<i>Form 21</i>	



ENSC Commercial Baseline Survey

Site #

Form 22

22. Indoor Lighting

	Seq #	Seq #	Seq #	Seq #	Seq #	Seq #	Seq #
300. Use Type: A = Area T = Task X = Exit D = Display/Advertising O = Other	A T X D O	A T X D O	A T X D O	A T X D O	A T X D O	A T X D O	A T X D O
301. Specular (S) or White (W) reflector? Or None	S W N	S W N	S W N	S W N	S W N	S W N	S W N
302. Control type: S = Manual on/off switch DM = Dimmer MS = Motion/Occupancy sensor DL = Daylighting controls TC = Timeclock/EMS N = None/continuous	S DM MS DL TC N	S DM MS DL TC N	S DM MS DL TC N	S DM MS DL TC N	S DM MS DL TC N	S DM MS DL TC N	S DM MS DL TC N
303. High Bay Fixture? (>20 ft high)	HB/NA	HB/NA	HB/NA	HB/NA	HB/NA	HB/NA	HB/NA
304. Total number of fixtures							
305. IF NEON, Total length of fixtures							
306. Number of lamps per fixture							
307. IF NEON, Number of lamps							
308. Watts per lamp							
309. IF NEON, Watts per lamp							
310. Hours per week							
311. Area ID (REQUIRED)							
Lamp Type & Lamp-Specific Details:							
312. LED = LEDs	LED	LED	LED	LED	LED	LED	LED
313. ER = Self/battery powered exit signs	ER	ER	ER	ER	ER	ER	ER
314. Q = Quartz/Halogen	Q	Q	Q	Q	Q	Q	Q
315. E = Electrodeless/Induction	E	E	E	E	E	E	E
316. I = Incandescent	I	I	I	I	I	I	I
317. 2x = 2x Incandescent	2x	2x	2x	2x	2x	2x	2x
318. Medium screw base less than 100W?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
319. F = Fluorescent Tube	F	F	F	F	F	F	F
320. UT = Fluorescent U-tube	UT	UT	UT	UT	UT	UT	UT
321. HO = High Output Fluorescent	HO	HO	HO	HO	HO	HO	HO
322. HPT8 = High Performance T8 (25-28 watts)	HP	HP	HP	HP	HP	HP	HP
For Fluorescent tubes:							
323. Length in ft. (e.g. 1.5 2 4 8)							
324. Diameter (T5 T8 T10 T12)							
325. CF = Compact Fluorescent	CF	CF	CF	CF	CF	CF	CF
326. CIR = Circline Fluorescent	CIR	CIR	CIR	CIR	CIR	CIR	CIR
327. CCF = Cold Cathode Fluorescent	CCF	CCF	CCF	CCF	CCF	CCF	CCF
328. CF/CIR Base type: P=Pin S=Screw-base	P S	P S	P S	P S	P S	P S	P S
329. MV = Mercury Vapor	MV	MV	MV	MV	MV	MV	MV
330. MH = Metal Halide	MH	MH	MH	MH	MH	MH	MH
331. H = High Pressure Sodium Vapor	H	H	H	H	H	H	H
332. L = Low Pressure Sodium Vapor	L	L	L	L	L	L	L
333. IND = Induction	IND	IND	IND	IND	IND	IND	IND
334. N = Neon	N	N	N	N	N	N	N
For ballasted lamp types:							
335. Ballast type: M = Magnetic E = Electronic P = PulseStart DK = Don't Know	M E P DK	M E P DK	M E P DK	M E P DK	M E P DK	M E P DK	M E P DK
336. Field notes: (comments and/or additional							

22

☐ QC



<i>ENSC Commercial Baseline Survey</i>	<i>Site #</i>	<i>Form 22</i>
ballast info)		



ENSC Commercial Baseline Survey

Site # _____

Form 25

23. Office Equipment

Item #	Equipment Code	Equipment Description	High Efficiency (including ESTAR) OR No HE	b. Power Management System? Y/N	c. Total # of units
337.	PCD	Personal Computer – Desktop	HE Std	Y N DK	
338.	LCD	LCD Computer monitor	HE Std	Y N DK	
339.	CRT	CRT Computer Monitor	HE Std	Y N DK	
340.	PCL	Personal Computer – Laptop	HE Std	Y N DK	
341.	JET	Printer – Ink Jet	HE Std	Y N DK	
342.	LSR	Printer – Laser	HE Std	Y N DK	
343.	UPS	Uninterruptible Power Supply	HE Std	Y N DK	
344.	SC	Small Copier	HE Std	Y N DK	
345.	MC	Medium Copier	HE Std	Y N DK	
346.	LC	Large Copier	HE Std	Y N DK	
347.	MON	Additional Monitor	HE Std	Y N DK	
348.	MAIN	Computer – Mainframe	HE Std	Y N DK	
349.	PMAIN	Printer – Mainframe	HE Std	Y N DK	
350.	SERV	Servers	HE Std	Y N DK	
351.	OT	Other (describe)	HE Std	Y N DK	
352.	PS	Power Supply	HE Std	Y N DK	

Additional Information for Servers ONLY (Up to 3. If more, choose the 3 largest) (Enter -99 if not known)				
				N/A ☐
353.	Server Description* (Circle One)	Total IT Load (kVA)	If kVA unknown, Total SF of Server Room (estimated)	Is server space cooled?
354.	Blade Rack			Y N
355.	Blade Rack			Y N
356.	Blade Rack			Y N



ENSC Commercial Baseline Survey

Site # _____

Form 25

24. Commercial Cooking/Food Service EquipmentN/A ☐

Item #	Equip Code	Equipment Description	High Efficiency (including Estar) OR No HE	Total # of Electric Units	Total # of Non-Electric Units	Relevant Equipment Specifications
357.	BR	Broiler, Conventional	HE Std			
358.	BI	Broiler, Infrared	HE Std			
359.	DW	Dishwasher	HE Std			
360.	DB	Dishwasher Booster Heater	HE Std			
361.	FS	Fryer, Any-type w/solid-state control	HE Std			
362.	FC	Fryer, Counter-type	HE Std			
363.	FF	Fryer, Floor-type	HE Std			
364.	FI	Fryer, Induction (1 vat reference)	HE Std			
365.	GR	Griddle, Standard	HE Std			
366.	GE	Griddle, Efficient	HE Std			
367.	IN	Induction Cooktop (2 burner ref)	HE Std			
368.	OV	Oven (in Range or standalone)	HE Std			
369.	CBO	Oven, Combination	HE Std			
370.	CO	Oven, Convection	HE Std			
371.	FO	Oven, Finishing/Toaster	HE Std			
372.	FB	Oven, Flash Bake	HE Std			
373.	MW	Oven, Microwave	HE Std			
374.	PF	Proofers/Holding Cabinet	HE Std			
375.	RL	Range, Large (6 burners)	HE Std			
376.	RM	Range, Medium (4 burners)	HE Std			
377.	RS	Range, Small (2 burners)	HE Std			
378.	ST	Steamer, pressurized/non-pressurized	HE Std			
379.	SV	Steamer, Vacuum-type	HE Std			
380.	SN	Pre-rinse spray nozzles	HE Std			
381.	OT	(describe)	HE Std			
382.	OT		HE Std			



ENSC Commercial Baseline Survey

Site # _____

Form 25

25. Refrigeration Equipment – Self Contained

Non-Commercial Refrigerator/Freezers

N/A ☐

Item #	Equip Code	Equipment Description	a. avg. size (ft ³)	b. Total # of Units	c. Average Age (years)	d. Energy Star (Y/N)	e. Area ID#
383.	1D	Single-door					
384.	2D	Two-door					
385.	CH	Chest					
386.	OT	(describe)					
387.							

Commercial Refrigeration Equipment

N/A ☐

Item #	Equip Code	b. Length feet or	c. # of Doors	Total # of units	Area ID#
388.					
389.					
390.					
391.					
392.					
393.					
394.					
395.					
396.					
397.					
398.					
399.					
400.					
401.					

Self-Contained Refrigeration Equipment Codes

Equip Code	Equipment Description	Size of Default	Default Amps@	
			120V	208V
GD	Glass door beverage cases (e.g. vendor supplied) from 2 to 4 doors	3 doors	9	5
OU	Open upright display cases (pizza, juice, etc.) usually 4,5,6 ft lengths	5 ft	15	9
IC	Island cases (cheese, sometimes produce or juice) from 8 to 16 ft long	12 ft	16	9
SC	Service cases (bakery, sometimes deli) from 4 to 8 ft long	6 ft	7	4
CD	Closed door storage cases, one to three doors	2 doors	7	4
UG	Upright glass door freezer cases from one to three doors	2 doors	10	6
CF	Coffin type glass top freezer cases (usually ice cream) typically 6 or 8 ft	7 ft	8	5
IB	Ice storage boxes	1 unit	8	5
OT	Other: self-contained refrigeration not listed above	1 unit	12	7
IV	Ice vending machines (hotel-sized icemaker) – Only self-contained units	1 unit	17	10



ENSC Commercial Baseline Survey

Site # _____

Form 26a

26. Remote Refrigeration EquipmentN/A ☐

402. Display Cases: Item #	Ref area #	Ref area #	Ref area #	Ref area #	Ref area #
403. Type/Suction Temperature: IC= Ice Cream/Frozen Juices (-35 °F / -37 °C) FF = Frozen Food/Meat/Bakery (-25 °F/ -32 °C) MD = Fresh Meat/Deli-Meat (+10 °F/ -12 °C) DP = Dairy/Produce/Beverage (+20 °F/ -7 °C)	IC FF MD DP	IC FF MD DP	IC FF MD DP	IC FF MD DP	IC FF MD DP
404. Defrost control type (<i>req'd for all</i>): E = Electric G = Hot Gas T = Timed-off N = None	E G T N	E G T N	E G T N	E G T N	E G T N
405. Smart Demand Controls?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
406. Anti-sweat heater control?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
407. Case Lighting N=None F=Fluor. L=LED	N F L	N F L	N F L	N F L	N F L
408. Case Evap Motor Type SP = shaded pole PSC =Permanent split capacitor 409. ECM =Electronically Commutated	SP PSC ECM	SP PSC ECM	SP PSC ECM	SP PSC ECM	SP PSC ECM
410. Case Type SD = Single Deck ML= Multi-Deck IS = Island CF = Coffin 411. DW = Double wide islands DK = Don't Know	SD ML IS CF DW DK	SD ML IS CF DW DK	SD ML IS CF DW DK	SD ML IS CF DW DK	SD ML IS CF DW DK
412. Total length of Case (ft.)					
413. Night Covers?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
414. Glass-door cases: # of doors					
415. Are doors High Efficiency?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
416. Are door gaskets in disrepair?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
417. In Area ID # REQUIRED or A for all areas					



ENSC Commercial Baseline Survey

Site # _____

Form 26a

418. Walk-Ins/Prep Areas: Item #	Ref area # _____	Ref area # _____	Ref area # _____	Ref area # _____	Ref area # _____
419. Type/Suction Temp. Range: F = Freezer (0 to -10 °F / -17 to -23 °C) C = Cooler (30 to 40 °F / -1 to 4 °C) P = Prep Area (50 to 55 °F / 10 to 13 °C)	F C P	F C P	F C P	F C P	F C P
420. Floor Area (ft ²)					
421. Ceiling Height (ft)					
422. Defrost control type: E = Electric G = Hot Gas T = Timed-off N = None DK = Don't Know	E G T N DK	E G T N DK	E G T N DK	E G T N DK	E G T N DK
423. Space Lighting F=Fluor. L=LED I=Incand. D=Induction DK = Don't Know	F L I D DK	F L I D DK	F L I D DK	F L I D DK	F L I D DK
424. Light Controls O=Occu. Sensor W=Wall Switch DK = Don't Know	O W DK	O W DK	O W DK	O W DK	O W DK
425. Walk-in Evap Motors Type SP = shaded pole PSC = Permanent split capacitor ECM = Electronically Commutated					
426. # of Walk-in Evap Motors					
427. Evap Fan Control?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
428. Door installed?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
429. Walk-in Evap Motors - % ECM	%	%	%	%	%
430. If no door, are there strip curtains?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
431. If strip curtains are installed, are they in disrepair? (in need of replacement?)	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK



ENSC Commercial Baseline Survey

Site # _____

Form 26a

432. Compressors	Item #	Comp #	Comp #	Comp #	Comp #	Comp #
433. Type: C = Conventional S = Two-stage multiplex T = Twins M = Multiplex O = Other _____ DK = Don't Know		C S T M O DK	C S T M O DK	C S T M O DK	C S T M O DK	C S T M O DK
434. Compressor Total hp						
435. Number of compressors <i>REQUIRED</i>						
436. Unloader or VSD compressors?		U V DK	U V DK	U V DK	U V DK	U V DK
437. High-efficiency (scroll) compressors?		Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
438. Floating Head Pressure Control?		Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
439. Heat recovery type: N = None S = Space heating/Reheat W = Water heating O = Other _____ DK = Don't Know		N S W O DK	N S W O DK	N S W O DK	N S W O DK	N S W O DK

Condensers	cond #	cond #	cond #	cond #	cond #
440. Type: A = Air-cooled W = Water-cooled P = Air-cooled w/precooler C = Close-approach / oversized DK = Don't Know	A W P C DK	A W P C DK	A W P C DK	A W P C DK	A W P C DK
441. Total fan horsepower (all types)					
442. - Motor Eff.: S=Std. H=HiEff P=Premium DK = Don't Know	S H P DK	S H P DK	S H P DK	S H P DK	S H P DK
443. - VSD fan?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
444. Pump motor hp (water-cooled units only)					
445. - Motor S=Std. H=HiEff P=Premium DK=Don't Know	S H P DK	S H P DK	S H P DK	S H P DK	S H P DK
446. - VSD pump?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK



ENSC Commercial Baseline Survey

Site # _____

Form 27

27. Miscellaneous Equipment N/A ☐

Item #	a. Equip Code	b. Equipment Description (Required only if Equip Code = OT)	c. Fuel Type	d.kW / kBtuh	e. Efficiency Measure (ES/Occ sensors/vending controls) Y/N/DK	f. Avg hrs per week*	g. Total # of units	h. Area ID
447.			E G O					
448.			E G O					
449.			E G O					
450.			E G O					
451.			E G O					
452.			E G O					
453.			E G O					
454.			E G O					
455.			E G O					
456.			E G O					
457.			E G O					
458.			E G O					
459.			E G O					
460.			E G O					
461.			E G O					
462.			E G O					
463.			E G O					
464.			E G O					
465.			E G O					
466.			E G O					

* "Avg hrs per week" must be completed only if equipment operation differs drastically from that shown on Form 6.

ID	Equipment Type	Default kW (kBtuh)	ID	Equipment Type	Default kW (kBtuh)	ID	Equipment Type	Default kW (kBtuh)
	Building Equipment			Electronics			Shop Equipment	
			E1			S1	Forklifts	7.5 (50)
			E2			S2	Hand Truck/Pallet Lifts	2.5 (15)
			E3	Television CRT	0.28	S3	Non-Forklift Elec. Vehicles	10
B4	Battery Charger	3.2	E4	Large Flat Panel TVs	0.5	S4	Other Electric Transport	10
			E5			S5		
				Service/Retail		S6		
			R1			S7		
			R2			S8	Shop Equipment	0.7
			R3			S9		
			R4			S10	Welder	30 (120)
			R5					
	Medical/Hospital		R6				Laundry	
M1	Autoclave	1.2	R7			L1	Clothes Dryer, Residl.	1.4 (15)
M2	CAT Scan Machine	75	R8			L2	Clothes Washer, Residl.	0.9
			R9	Industrial Compactor	2.8	L3	Clothes Dryer, Commcl.	5 (28)
			R10	Vending Machine, Hot Food	0.8	L4	Clothes Washer, Commcl.	8.5
			R11	Vending Machine, Refrig.	0.9	L5	Dry Cleaning Unit	14
			R12	Vending Machine, Non-Refrig.	0.4	L6		
			R13	Water Vending Machine	0.6	L7		
							Space Comfort	
						C1	Air Cleaner	0.5
						C2	Ceiling or Portable Fan	0.2
						C3	Dehumidifier	0.6
						C4	Humidifier	0.5
M13	X-Ray Machine	4.6				C5	Portable Heater	1.4 (10)



ENSC Commercial Baseline Survey

Site # _____

Form 28

28. Motors/Engines (Process Related)N/A ☐

Item #	a. Description	b. Service Type	c. Control Type	d. Size (hp)	e. # of Units	f. NEMA Type	g. Nom. Eff. %**	i. Duty Type	k. Avg run hrs per week*	l. Area ID #	m. Power Recovery? (Y/N/DK)	n. Direct Drive? (Y/N/DK)
467.												
468.												
469.												
470.												
471.												
472.												
473.												
474.												
475.												
476.												
477.												
478.												
479.												
480.												
481.												
482.												
483.												
484.												
485.												
486.												

* "Avg run hrs per week" estimate is required for each motor item.

** Enter Nominal Efficiency as a % or if not available, use: S=Standard H=High-efficiency P=Premium-efficiency

Motor Codes

Service Type	Control Type	NEMA Type	Drive Type	Duty Type
P : Pump F : Fan/Blower M : Material Handling/conveyor T : Machine Tool G : Grinding/milling E : Escalator PE : Passenger Elevator FE : Freight Elevator S : Separation O : Other _____	T : Throttled/Dampened M : Mechanical VSD E : Electronic VSD C : Constant Speed W : Two Speed	ODP =Open Drip Proof TEFC = Totally Enclosed Fan-Cooled OT = _____	AC : AC DCS : DC w/ SCR DCM : DC w/ MGS EG : Nat gas driven FG : Fossil driven SD : Steam driven	C : Constant V : Variable I : Intermittent



ENSC Commercial Baseline Survey

Site # _____

Form 29

29. Air Compressors N/A ☐
487. Leak maintenance program ☐488. Air compressor replacement ☐489. No Loss Drains ☐

Item #	a. System Number (if mult AC Systems)	b. Description	c. Comp Type	d. Appl Type	e. Control Type	f. Size (hp)	g. # of Units	h. Nom. Eff. %**	k. Avg run hrs per week*	l. Air Dryer Y/N/D K	m. Storage Capacity (gallons)	n. Operating Pressure	o. Area ID #
490.													
491.													
492.													
493.													
494.													
495.													
496.													
497.													
498.													
499.													

* "Avg run hrs per week" estimate is required for each air compressor item

** Enter Nominal Efficiency as a % or if not available, use: S=Standard H=High-efficiency P=Premium-efficiency

Air Compressor Codes

System Number	Compressor Type	Application Types	Control Type	Drive Type
If multiple Air Compressor systems exist, indicate the system Number.	RTD: Reciprocating (Two-stage, Double-acting) RST: Reciprocating (Single-stage, Double-acting) RTS: Reciprocating (Two-stage, Single-acting) RSS: Reciprocating (Single-stage, Single-acting) ST: Rotary Screw (Two-stage) C: Centrifugal O: Other _____	C-Cleaning T-Drives tools H-HVAC Pneumatic O-Other _____	S-Start/Stop L-Load/Unload V-VSD Throttling T-Throttling O-Other _____	AC DCS : DC w/ SCR DCM : DC w/ MGS EG : Nat gas driven FG : Fossil driven SD : Steam driven



ENSC Commercial Baseline Survey

Site # _____

Form 30

30. Electric Process Equipment (Non-Motor)N/A ☐

Item #	a. Process Equip Code	b. Product Produced	c. Boiler #	d. # of units	e. Avg Unit Capacity kW	g. Avg hrs per week*	h. Control s? Y/N/DK	i. Power Recover y? Y/N/DK
500.								
501.								
502.								
503.								
504.								
505.								
506.								
507.								
508.								
509.								

* "Avg hrs per week" estimate is required for each process equipment item

Process Equipment Codes

Heat Processing:		Pulping:		Drying/Curing/Baking:	
Direct Fired Gas Heating	DFGH	Batch Digesters	DIGST	Ovens	OVENDCB
Direct Fired Oil Heating	DFOH	Stock Refiners	STKREF	Microwave	MICRODCB
Blanchers	BLNCH	Paper Preparation:		Infrared	IR
Microwave	MICROHP	Pulpers	PULP	Electric Resistance	ELRES
Sterilizers	STER	Refiners	REFNR	Steam from Process Boiler	STM
Pasteurizers	PAST	Stock Mixers	STKMXR	Ultraviolet	UV
Induction Heating	INDCTHTG	Separation and Distillation:		Kiln	KILN
Induction Melting	INDCTMLT	Thermal Distillation Column	THRMDC	Radio Frequency	RFDCB
Radio Frequency	RFHP	Freeze Concentration	FRZCON	Electron Beam	EBDCB
Indirect Resistance	INDIRES	Vacuum Condensation	VACCON	Refrigeration/Freezing:	
Direct Resistance	DIRRES	Membrane Separation	MEMSEP	Forced Air Cooling	FORAIR
Encased Resistance	ENCRES	Pressure Swing Absorption	PSA	Blast Freezing	BLSTFRZ
Plasma Processing	PLSMHP	Vacuum Concentration	VACCNTR	Hydrocooling	HYDRCL
Electric Arc Furnace	ELARCFRN	Ultra Filtration	ULTRAFLT	Belt Freezing	BLTFRZ
Ion Nitriding	IONNIT	Reverse Osmosis	REVOS	Plate Freezing	PLTFRZ
Laser Hardening	LASER	Evaporators	EVAP	Vacuum Cooling	VACCL
Cupola	CUPOLA	Solid-Liquid Extraction:		Immersion Freezing	IMMFRZ
Dehydration:		Single Stage Extractors	SSEXT	Mixing and Emulsification:	
Convection Dryer	CONVDR	Multi-Stage, Static Bed Extractors	MLTEXT	Pressure Homogenizers	PRSHOM
Infrared Dryer	IRDR	Continuous Moving-Bed Extractors	CONBED	Ultrasonic Emulsification Devices	ULTRAEMD
Electric Resistance Drying	ELRES DH	Plastic Molding:		Fiber Preparation:	
Microwave Dryer	MICRODH	Injection Molding	INJMLD	Dye Tanks	DYE
Material Preparation:		Extrusion Molding	EXTMLD	Crystallization:	
Arc Welding	ARCWLD	Blow Molding	BLWMLD	Oil Winterization	OILWNTR
Laser Cutting	LASERCT	Rotational Molding	ROTMLD	Freeze Concentration	FRZCONC
Water Jet Cutting	WTRJET	Compression Molding	COMPMLD	Ice Crystallization	ICECRYS
Electron Beam Welding	EBWMP	Thermoforming	THRMFRM	Lactose Crystallization	LACCRYS
Laser Welding	LASERWLD	Washing and Drying:		Fat Crystallization	FATCRYS
Plasma Cutting	PLSMMP	Rotary Kilns	ROTKLN	Screening and Separation:	
Filtration:		Cascade Dryer	CASC DR	Froth Floatation Baths	FRTH
Pressure Filters	PRESFLT	Fluidized Bed Dryer	FBD	Exploration and Drilling:	
Vacuum Filters	VACFLTR	Suspension Dryer	SUSPDR	Engine Driven Boring Equipment	ENGBOR
Finishing:		OTHER		Emission Reduction Equipment:	
Ovens	OVENF			Standard Thermal Oxidizer	STHOX
Electroplating	ELPLT			Recuperative Thermal Oxidizer	RTHOX
Hot Dip Galvanizing	HDG			Stack Economizer	STAKEC



ENSC Commercial Baseline Survey

Site # _____

Form 31

31. Swimming Pool/Spa ☐ N/A

	Seq #__	Seq #__	Seq #__
510. Type: S = Swimming Pool H = Hot Tub O = Other	S H O	S H O	S H O
511. What is the size of the pool (sq. ft.)? (or DK=Don't Know)			
512. Fuel Type: N = Not Heated E = Electricity G = Natural Gas L = LPG S = Solar SG = Solar w/Gas DK = Don't Know	N E G L S SG DK	N E G L S SG DK	N E G L S SG DK
513. Heater Capacity in kW – electric units only			
514. Heater Capacity in kBtu/h – gas units only			
515. Pump Size (hp)			
516. Pump Type (Single Speed, Dual Speed, VSD, DK)	SS DS VSD DK	SS DS VSD DK	SS DS VSD DK
517. When does the pool pump turn on? (1-24)			
518. When does the pool pump turn off? (1-24)			
519. Total number of hours the pump is on			
520. Timer?	Y N DK	Y N DK	Y N DK



ENSC Commercial Baseline Survey

Site # _____

Form 31

32. On-Site Power Generation ☐ N/A*(Cogeneration, self-generation, includes renewable, excludes emergency generators)*

	Seq #	Seq #
521. Type: I = Internal Combustion Engine G = Gas Turbine C = Combined Cycle O = Other (e.g., solar PV, fuel cell, small wind) DK = Don't Know	I G C O DK	I G C O DK
522. What is the plant generation capacity? (kW)		
523. Fuel Type: G = Natural Gas F = Fuel Oil S = Solar W = Wind O = Other _____ DK = Don't Know	G F S W O DK	G F S W O DK
524. Average operating hours per day		
525. Number of operating days per year		
526. Use of waste heat: S = Space heat W = Water heat P = Pool heat O = Other _____ DK = Don't Know	S W P O DK	S W P O DK
527. Average heat output (kBtu/hr)		
528. What fraction of the waste heat is utilized?	%	%

33. Thermal Storage ☐ N/A

	Seq #	Seq #
529. Storage type C = Chilled Water I = Ice O = Other _____ DK = Don't Know	C I O DK	C I O DK
530. Thermal storage capacity (Ton-Hour)		

34. Electric Energy Storage ☐ N/A

	Seq #	Seq #
531. Storage type: Chemical, Mechanical, Other _____ DK = Don't Know	C I O DK	C I O DK
532. Storage Capacity (kWh)		
533. Peak Capacity (kW)		

35. Shared/Central HVAC Systems and Shared Meters/Services**Shared HVAC Equipment (Not Located in Surveyed Area)**☐ N/A

Complete this table when the SURVEYED area is receiving heating or cooling from a central system which is not part of the SURVEYED area (i.e. the heating/cooling equipment is connected to a different utility service [account & meter] than survey area).

	Seq #	Seq #	Seq #
534. Equipment Type: C = Chiller B = Boiler O = Other _____ DK = Don't Know	C B O DK	C B O DK	C B O DK
535. Equipment Fuel Type: E = Electricity G = Natural Gas F = Fuel Oil L = LPG DK = Don't Know	E G F L DK	E G F L DK	E G F L DK
536. Total Capacity			
537. Units for Capacity: T = tons B = kBtu/h W = kW H = horsepower (hp) DK = Don't Know	T B W H DK	T B W H DK	T B W H DK
538. Efficiency			

35

☐ QC

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Request IR-08:

**Please refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Evidence, Page 13, lines
20-21, E1 states:**

**“EfficiencyOne would have to achieve 181 GWh/year in energy savings for each year from
now until 2040, in order for ratepayers to fully achieve the Mid-Level DSM benefits”**

**a. If this is the case, why is E1 proposing a “preferred plan” with an expected 141 GWh
first year energy savings?**

Response IR-08:

a) Please refer to EfficiencyOne’s response to CA IR-03.

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Request IR-09:

Please refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Evidence, Page 13, lines 23-26, E1 states that DSM should be subsidized by HST savings, it is in the best interest of ratepayers and would provide a return on investment to ratepayers of approximately 480%

a. Please provide any and all workpapers with working formulae related to this estimate of 480% return on investment.

b. Please show how this return is allocated by rate class.

Response IR-09:

a) Each dollar invested in DSM returns \$4.80 in lifetime benefits. 4.8 is the average PAC for the plan¹, which is the ratio of lifetime benefits to program administrator cost. Lifetime benefits are expressed as the net present value of the avoided costs, including energy, capacity, transmission and distribution, over the life of the program measures, using utility weighted average cost of capital (WACC).

b) Please refer to EfficiencyOne's 2020-2022 DSM Resource Plan, Appendix F, HST Tables, filed electronically for the working papers for the allocation by rate class.

¹ M09096 2020-2022 DSM Resource Plan Application, Appendix A, Table 1

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Request IR-10:

Referring to Efficiency One 2020-2022 DSM Plan Application Table 6, pg. 25-26, and Table 7, pg. 28, which outline the proposed DSM programs and potential barriers to participation. Affordability seems to be a major barrier that E1 is trying to address in both the Residential and BNI sides. Has NSP done any comparative analysis on between the savings from the affordability improvements of the programs in the preferred plan and the estimated increase in electricity rates due to the preferred plan, by rate class and in aggregate? If so, please provide this analysis and all related workpapers with formulae intact.

Response IR-10:

Based on the clarification received from the SBA on this IR, the following is EfficiencyOne's response.

The only analysis of rate and bill impacts of both the Preferred Plan and Alternate Scenario were conducted through EfficiencyOne's forward looking rate and bill impact analysis filed as Appendix B of the EfficiencyOne's application.

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Request IR-11:

Referring to E1’s response to NSP IR-40(c), E1’s ’s statement, “Attachment 1 to Appendix A of the Application, provides the Total Resource Cost screening tests for demand reduction measures, which are relatively high, providing an indication of their affordability.” Please provide additional detail and explanation supporting the concept that a higher TRC value indicated affordability.

Response IR-11:

The Total Resource Cost (TRC) test, at a measure level, provides a numerical result reflecting the ratio of Total Resource Benefits as divided by Total Resource Costs. Total Resource Benefits are calculated as the Net Present Value of future utility avoided costs, and other fuel and water impacts if applicable. TRCs’ reflect the costs of adopting the measure, regardless of any incentives provided by EfficiencyOne, as the TRC test considers incentives as transfer payments between the utility and the participant and therefore excludes them.

The results of the TRC test provide the return on investment of a measure, for both the utility and participant in aggregate. In this way, the TRC provides one key indication of measure affordability, the return on investment for these parties. If the focus is narrowed to solely participant affordability, this assumes that this return is shared between the utility and the participant.

EfficiencyOne acknowledges that upfront costs also have a role to play in any determination of affordability, the provision of financial incentives is intended to overcome this and other barriers. These other aspects of affordability are the reason EfficiencyOne suggests that the TRC test result provides an indication, as opposed to a full determination, of affordability.

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Request IR-12:

Referring to E1's use of the ProCESS tool,

- a. Please describe the methodology and list key inputs and assumptions used within the ProCess software to determine the avoided cost values.**
- b. Please include a table of inputs used by EfficiencyOne in the ProCESS tool and the rationale behind each of these assumptions.**

Response IR-12:

- a) Avoided costs are inputs to the model, not determined by it. Please refer to EfficiencyOne's response to SBA IR-13 for an explanation of how avoided costs are determined.
- b) Please refer to EfficiencyOne's response to NS Power IR-31 Attachment 2¹ for the ProCESS model input file. Below is a summary of key input file fields.

Sheet	Field	Rationale
Measures	Measure life	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators.
Measures	NTG (net to gross)	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators.
Measures	Incremental costs	Incremental costs are based on costs collected by E1 when available since this data is the most relevant to Nova Scotians. If E1 does not have internal cost data, sources from other jurisdictions are used, e.g. TRMs, cost studies, and other research

¹ M09096, 2020-2022 DSM Plan - E1 Responses to NS Power IR Requests 1-69, Exhibit E-3, March 29, 2019.

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		that contains such cost information. For more information on incremental costs, please see E1 (SBA) RIR-49
Measures	Variable Admin Cost	Variable Admin Cost are the unitary admin costs per measure, based on the measure savings and per-kWh administrative costs (i.e. Variable Admin Cost per Savings). For more information, please see E1 (SBA) RIR-45
Measures	Variable Admin Cost per Savings	Variable Admin Cost per Savings are based on 2017 actual administrative costs per kWh of energy savings and are therefore the most current, appropriate values to use for anticipated future costs . For more information, please see E1 (SBA) RIR-45
Measures	RUL (2020, 2021, 2022)	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators.
Measures	Incentives (2020, 2021, 2022)	Incentives are based on currently offered or anticipated future incentives. Please see E1 (IG) RIR-24, part a, for more details on incentive levels.
Measures	Direct Install Costs (2020, 2021, 2022)	Direct Install costs are based on currently offered or anticipated future direct install costs. For more information, please see E1 (SBA) RIR-46
Measures	Full retrofit costs (2020, 2021, 2022)	Full retrofit costs are only used for retirement measures to determine the TRC measure cost based on deferred replacement methodology. For ROB/NEW measures, this variable is not considered. For true retrofit (non-early retirement) measures, full retrofit cost will equal incremental measure cost.
Measures	Participation (2020, 2021, 2022)	Participation is determined by E1 staff and is estimated based on historical and forward-looking trends and achieving strategic objectives, e.g. diversification, delivering programs to underserved groups, etc.
Measures	Max achievable Potential (2020, 2021, 2022)	Maximum achievable estimates from the E1's 2018 Potential Study update for applicable measures. These values were used to inform program design.
Measures	Baseline energy consumption (2020, 2021, 2022)	This field is optional and was not used in E1's plan model
Measures	Energy Efficient consumption (kWh) (2020, 2021, 2022)	This field is optional and was not used in E1's plan model
Measures	Energy Savings (kWh) (2020, 2021, 2022)	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators. For more

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		information on how energy savings were determined, please see E1 (IG) RIR-24, part c.
Measures	Non-Coinc. Demand Savings (kW) (2020, 2021, 2022)	This field is optional and was not used in E1's plan model
Measures	Coinc. Demand Savings (kW) (2020, 2021, 2022)	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators. For more information on how energy savings were determined, please see E1 (IG) RIR-24, part c.
Measures	Baseline Gas Consumption (MJ) (2020, 2021, 2022)	This field is optional and was not used in E1's plan model
Measures	Efficient Gas Consumption (MJ)(2020, 2021, 2022)	This field is optional and was not used in E1's plan model
Measures	Gas Savings (MJ) (2020, 2021, 2022)	Assumed values for measures are based on estimates of gas impacts as developed by EfficiencyOne, reflecting methodologies consistent with evaluated results for energy and demand savings where possible. For more detail, Please refer to EfficiencyOne's response to Synapse IR-09
Measures	Water Savings (m3) (2020, 2021, 2022)	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators. Please refer to E1 (Synapse) RIR-08 for more information.
Measures	Water Savings (billing units) (2020, 2021, 2022)	This field is optional and was not used in E1's plan model
Measures	Post-RUL Baseline Energy Consumption (kWh) (2020, 2021, 2022)	This field is optional and was not used in E1's plan model

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Measures	Post-RUL Efficient Energy Consumption (kWh) (2020, 2021, 2022)	This field is optional and was not used in E1's plan model
Measures	Post-RUL Energy Savings (kWh) (2020, 2021, 2022)	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators.
Measures	Post-RUL Coinc. Demand Savings (kW) (2020, 2021, 2022)	Assumed values for measures currently offered by Efficiency Nova Scotia are based on evaluated and verified program results since this represents the best available information that has been reviewed by the NSUARB and stakeholders. If an evaluated value or methodology is not available (i.e. new measures) values are based on similar existing measures, engineering estimates, or methodologies from other DSM administrators.
Measures	Post-RUL Gas Savings (MJ) (2020, 2021, 2022)	Assumed values for measures are based on estimates of gas impacts as developed by EfficiencyOne, reflecting methodologies consistent with evaluated results for energy and demand savings where possible. For more detail, Please refer to EfficiencyOne's response to Synapse IR-09. Please note that since EfficiencyOne did not model any measures with gas savings, these values are not distinct from the values discussed in row 21 of this attachment.
NominalAvoidedCosts	Energy and demand avoided costs	Energy and capacity avoided costs are based on the 2014 IRP, which is the most current set of avoided costs available. Please see E1 (SBA) RIR-13 for an explanation of how avoided costs are determined.
NominalAvoidedCosts	Gas Savings(MJ)	Gas Savings avoided costs are based on nominal retail rates as opposed to an IRP process output since there is no IRP for gas. Prices are assumed to increase by 2% each year to account for inflation.
NominalAvoidedCosts	Water Savings (m3)	Water Savings avoided costs are based on nominal retail rates as opposed to an IRP process output since there is no IRP for water. Prices are assumed to increase by 2% each year to account for inflation.
NominalRetailRates	Water Savings (m3)	Water costs are based on nominal retail rates. Prices are assumed to increase by 2% each year to account for inflation.
NominalRetailRates	Energy Savings (kWh) and Coinc. Demand Savings (kW)	Energy and demand costs are based on nominal retail rates. Prices are assumed to increase by 2% each year to account for inflation.
NominalRetailRates	Gas Savings (MJ)	Gas costs are based on nominal retail rates. Prices are assumed to increase by 2% each year to account for inflation.
OTProgCosts	Other costs	These costs are enabling strategies, and are assumed to be \$3.5M, \$4.0M, and \$4.0M in 2020, 2021, and 2022 respectively
DiscountRates	discount rate for each cost test	All cost test use NSPI's current weighted average cost of capital (WACC), which is consistent with past practise in NS. Please refer to E1 (HG) RIR-05 for more information.

EfficiencyOne – EfficiencyOne Application for approval of a Supply Agreement for Electricity Efficiency and Conservation Activities between E1 and Nova Scotia Power Inc. (DSM 2020-2022) M09096 (E-ENS-R-19)
E1 Responses to Small Business Advocate (SBA)

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LineLossFactors	LineLossFactors	Instead of using a provincial average, E1 weighted line losses by sector based on historical program participation by rate class and line losses by rate class. The latter of which was provided by Nova Scotia Power.
Misc	Forecast Start Period	Period starts in 2020, which is when the plan begins
Misc	Present Value Year	Present value year is 2020, which is when the plan begins
Misc	Inflation Rate	Inflation Rate is not used in the model since all costs are treated as nominal in the year they are stated
Misc	Reserve Margin Coinc. Demand Savings (kW)	This field is optional and was not used in E1's plan model
Misc	Max Economic Lifetime (years)	This field can be used to artificially limit a measure to a given lifetime. This field is set to 100 years, i.e. it is not limiting measure life
Misc	CO2 Density (lbs/impact) Avoided LBMP (kWh)	This field is optional and was not used in E1's plan model
Misc	Avoided Cost of Carbon (\$/MWh Saved)	This field is optional and was not used in E1's plan model

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Request IR-13:

Referring to calculation of the avoided cost values,

- a. How are the annual energy and capacity related avoided costs determined? Provide applicable workpapers with formulae intact.**
- b. Please also include the individual component (i.e. T&D, Generation, etc.) avoided cost values used by E1 in the preferred plan.**

Response IR-13:

- a) In the development of the 2020-2022 DSM Resource Plan, EfficiencyOne used avoided costs of energy, capacity, transmission and distribution, as well as water and wastewater discharge rates as a proxy for avoided costs related to water impacts.

The Nova Scotia Utility and Review Board directed NS Power “to update avoided costs as required by E1 for use in preparation of the 2020-2022 DSM Resource Plan”¹. EfficiencyOne requested that NS Power confirm the appropriate avoided costs for use in the 2020-2022 DSM Resource Plan development. On October 16, 2018, NS Power provided confirmation that the 2014 Integrated Resource Plan avoided costs of energy and capacity represent the appropriate avoided cost streams to use.

Transmission and distribution (T&D) avoided costs are also determined by NS Power. A summary of the method used to develop these avoided costs was provided to the DSM Advisory Group (DSMAG) members by NS Power on October 24, 2018. This presentation is provided in NS Power’s Evidence in this matter.²

¹ M08604 Board Order from 2019 DSM Plan

² M09096, NS Power Evidence, Filed April 12, 2019, at Appendix B, page 16.

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The only non-energy impacts modelled by EfficiencyOne relate to water impacts. EfficiencyOne used Halifax Water combined water and wastewater discharge rates as a proxy for avoided costs (rates effective April 1, 2016).³ These rates were inflated by 2% per year, to reflect future expectations with respect to inflation.⁴

b) Please refer to Attachment 1 of this IR response for the individual component avoided cost values used by EfficiencyOne. Also, please note EfficiencyOne's response to NS Power IR-39 part b)⁵:

Please note that EfficiencyOne has inadvertently underestimated capacity-related avoided costs in its modelling for the Business, Not-for-Profit and Institutional (BNI) sector only. Updated avoided costs of transmission and distribution of \$14.88/kW (real dollars) were used for the Residential sector. The previous avoided costs of transmission and distribution of \$11.89/kW (real dollars) were used for the BNI sector, as well as an older version of extrapolation in outer years of the analysis (from the Generation Utilization and Optimization Potential Analysis). This underestimate is immaterial and conservative – its effects are estimated to underreport total benefits within the BNI sector by less than 0.6%.

Individual component values (i.e., having separate T&D and Generation avoided costs) are shown separated in Attachment 1. Please note that these items are not additional to the row labelled "Coinc. Demand Savings (kW)", rather they reflect a break-out of those values. Please also note that T&D avoided costs are inflated on an annual basis from their year of

³ <https://www.halifax.ca/home-property/halifax-water/accounts-billing/rates-charges-water-wastewater-stormwater>

⁴ <https://www.bankofcanada.ca/core-functions/monetary-policy/inflation/>

⁵ M09096, 2020-2022 DSM Plan - E1 Responses to NS Power IR Requests 1-69, Exhibit E-3, March 29, 2019.

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- 1 production, which EfficiencyOne asserts as appropriate on the basis on the methodology
- 2 used to develop them.

Sector	Avoided Cost Savings Types	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Residential	Water Savings (m3)	\$0.00419	\$0.00427	\$0.00436	\$0.00445	\$0.00454	\$0.00463	\$0.00472	\$0.00481	\$0.00491	\$0.00501	\$0.00511	\$0.00521
Residential	Gas Savings (MJ)	\$0.02027	\$0.02068	\$0.02109	\$0.02152	\$0.02195	\$0.02238	\$0.02283	\$0.02329	\$0.02375	\$0.02423	\$0.02471	\$0.02521
Residential	Energy Savings (kWh)	\$0.05962	\$0.06211	\$0.08376	\$0.08451	\$0.08578	\$0.08676	\$0.08876	\$0.09266	\$0.09846	\$0.10221	\$0.10813	\$0.11294
Residential	Coinc. Demand Savings (kW)	\$211.24	\$194.32	\$206.58	\$223.29	\$217.32	\$232.25	\$219.58	\$216.15	\$212.84	\$213.51	\$212.31	\$208.56
Residential	Avoided Costs of Capacity (kW)	\$195.76	\$178.53	\$190.48	\$206.86	\$200.57	\$215.16	\$202.15	\$198.37	\$194.70	\$195.01	\$193.44	\$189.31
Residential	Avoided Costs of Transmission and Distribution (kW)	\$15.48	\$15.79	\$16.11	\$16.43	\$16.76	\$17.09	\$17.43	\$17.78	\$18.14	\$18.50	\$18.87	\$19.25
BNI	Water Savings (m3)	\$0.00419	\$0.00427	\$0.00436	\$0.00445	\$0.00454	\$0.00463	\$0.00472	\$0.00481	\$0.00491	\$0.00501	\$0.00511	\$0.00521
BNI	Gas Savings (MJ)	\$0.01369	\$0.01397	\$0.01424	\$0.01453	\$0.01482	\$0.01512	\$0.01542	\$0.01573	\$0.01604	\$0.01636	\$0.01669	\$0.01702
BNI	Energy Savings (kWh)	\$0.05962	\$0.06211	\$0.08376	\$0.08451	\$0.08578	\$0.08676	\$0.08876	\$0.09266	\$0.09846	\$0.10221	\$0.10813	\$0.11294
BNI	Coinc. Demand Savings (kW)	\$208.48	\$191.46	\$203.63	\$220.24	\$214.17	\$229.00	\$216.22	\$212.68	\$209.26	\$209.81	\$208.49	\$204.62
BNI	Avoided Costs of Capacity (kW)	\$195.76	\$178.53	\$190.48	\$206.86	\$200.57	\$215.16	\$202.15	\$198.37	\$194.70	\$195.01	\$193.44	\$189.31
BNI	Avoided Costs of Transmission and Distribution (kW)	\$12.72	\$12.94	\$13.16	\$13.38	\$13.61	\$13.84	\$14.07	\$14.31	\$14.56	\$14.80	\$15.05	\$15.31

Sector	Avoided Cost Savings Types	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Residential	Water Savings (m3)	\$0.00532	\$0.00542	\$0.00553	\$0.00564	\$0.00575	\$0.00587	\$0.00599	\$0.00611	\$0.00623	\$0.00635	\$0.00648	\$0.00661
Residential	Gas Savings (MJ)	\$0.02571	\$0.02623	\$0.02675	\$0.02729	\$0.02783	\$0.02839	\$0.02896	\$0.02954	\$0.03013	\$0.03073	\$0.03134	\$0.03197
Residential	Energy Savings (kWh)	\$0.11974	\$0.11258	\$0.13018	\$0.14273	\$0.14965	\$0.15542	\$0.16339	\$0.16869	\$0.17206	\$0.17550	\$0.17901	\$0.18259
Residential	Coinc. Demand Savings (kW)	\$207.54	\$212.69	\$212.43	\$216.74	\$213.34	\$217.88	\$218.72	\$195.74	\$196.19	\$196.65	\$197.12	\$197.60
Residential	Avoided Costs of Capacity (kW)	\$187.91	\$192.67	\$192.00	\$195.91	\$192.09	\$196.20	\$196.61	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19
Residential	Avoided Costs of Transmission and Distribution (kW)	\$19.63	\$20.03	\$20.43	\$20.83	\$21.25	\$21.68	\$22.11	\$22.55	\$23.00	\$23.46	\$23.93	\$24.41
BNI	Water Savings (m3)	\$0.00532	\$0.00542	\$0.00553	\$0.00564	\$0.00575	\$0.00587	\$0.00599	\$0.00611	\$0.00623	\$0.00635	\$0.00648	\$0.00661
BNI	Gas Savings (MJ)	\$0.01736	\$0.01771	\$0.01807	\$0.01843	\$0.01880	\$0.01917	\$0.01956	\$0.01995	\$0.02035	\$0.02075	\$0.02117	\$0.02159
BNI	Energy Savings (kWh)	\$0.11974	\$0.11258	\$0.13018	\$0.14273	\$0.14965	\$0.15542	\$0.16339	\$0.16869	\$0.17770	\$0.18719	\$0.19719	\$0.20114
BNI	Coinc. Demand Savings (kW)	\$203.48	\$208.50	\$208.11	\$212.29	\$208.74	\$213.14	\$213.84	\$190.71	\$187.72	\$184.80	\$181.95	\$185.59
BNI	Avoided Costs of Capacity (kW)	\$187.91	\$192.67	\$192.00	\$195.91	\$192.09	\$196.20	\$196.61	\$173.19	\$169.90	\$166.68	\$163.52	\$169.79
BNI	Avoided Costs of Transmission and Distribution (kW)	\$15.57	\$15.84	\$16.10	\$16.38	\$16.66	\$16.94	\$17.23	\$17.52	\$17.82	\$18.12	\$18.43	\$18.80

Sector	Avoided Cost Savings Types	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
Residential	Water Savings (m3)	\$0.00674	\$0.00688	\$0.00701	\$0.00715	\$0.00730	\$0.00744	\$0.00759	\$0.00774	\$0.00790	\$0.00806	\$0.00822	\$0.01
Residential	Gas Savings (MJ)	\$0.03261	\$0.03326	\$0.03393	\$0.03461	\$0.03530	\$0.03600	\$0.03672	\$0.03746	\$0.03821	\$0.03897	\$0.03975	\$0.04
Residential	Energy Savings (kWh)	\$0.18624	\$0.18997	\$0.19377	\$0.19764	\$0.20159	\$0.20563	\$0.20974	\$0.21393	\$0.21821	\$0.22258	\$0.22703	\$0.23
Residential	Coinc. Demand Savings (kW)	\$198.09	\$198.58	\$199.09	\$199.61	\$200.14	\$200.68	\$201.23	\$201.79	\$202.36	\$202.94	\$203.54	\$204.15
Residential	Avoided Costs of Capacity (kW)	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19
Residential	Avoided Costs of Transmission and Distribution (kW)	\$24.90	\$25.40	\$25.90	\$26.42	\$26.95	\$27.49	\$28.04	\$28.60	\$29.17	\$29.76	\$30.35	\$30.96
BNI	Water Savings (m3)	\$0.00674	\$0.00688	\$0.00701	\$0.00715	\$0.00730	\$0.00744	\$0.00759	\$0.00774	\$0.00790	\$0.00806	\$0.00822	\$0.00838
BNI	Gas Savings (MJ)	\$0.02202	\$0.02246	\$0.02291	\$0.02337	\$0.02384	\$0.02431	\$0.02480	\$0.02530	\$0.02580	\$0.02632	\$0.02684	\$0.02738
BNI	Energy Savings (kWh)	\$0.20516	\$0.20926	\$0.21345	\$0.21772	\$0.22207	\$0.22651	\$0.23104	\$0.23566	\$0.24038	\$0.24518	\$0.25009	\$0.25509
BNI	Coinc. Demand Savings (kW)	\$189.30	\$193.09	\$196.95	\$200.89	\$204.91	\$209.00	\$213.18	\$217.45	\$221.80	\$226.23	\$230.76	\$235.37
BNI	Avoided Costs of Capacity (kW)	\$170.13	\$173.53	\$177.00	\$180.54	\$184.15	\$187.84	\$191.59	\$195.42	\$199.33	\$203.32	\$207.39	\$211.53
BNI	Avoided Costs of Transmission and Distribution (kW)	\$19.17	\$19.56	\$19.95	\$20.35	\$20.75	\$21.17	\$21.59	\$22.02	\$22.46	\$22.91	\$23.37	\$23.84

Sector	Avoided Cost Savings Types	2056	2057	2058	2059	2060
Residential	Water Savings (m3)	\$0.01	\$0.01	\$0.01	\$0.01	\$0.01
Residential	Gas Savings (MJ)	\$0.04	\$0.04	\$0.04	\$0.04	\$0.04
Residential	Energy Savings (kWh)	\$0.24	\$0.24	\$0.25	\$0.25	\$0.26
Residential	Coinc. Demand Savings (kW)	\$204.76	\$205.40	\$206.04	\$206.70	\$207.37
Residential	Avoided Costs of Capacity (kW)	\$173.19	\$173.19	\$173.19	\$173.19	\$173.19
Residential	Avoided Costs of Transmission and Distribution (kW)	\$31.58	\$32.21	\$32.85	\$33.51	\$34.18
BNI	Water Savings (m3)	\$0.00855	\$0.00872	\$0.00889	\$0.00907	\$0.00925
BNI	Gas Savings (MJ)	\$0.02793	\$0.02849	\$0.02906	\$0.02964	\$0.03023
BNI	Energy Savings (kWh)	\$0.26019	\$0.26539	\$0.27070	\$0.27612	\$0.28164
BNI	Coinc. Demand Savings (kW)	\$240.08	\$244.88	\$249.78	\$254.78	\$259.87
BNI	Avoided Costs of Capacity (kW)	\$215.76	\$220.08	\$224.48	\$228.97	\$233.55
BNI	Avoided Costs of Transmission and Distribution (kW)	\$24.32	\$24.80	\$25.30	\$25.81	\$26.32

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Request IR-14:

**Referring to E1's response to NSP IR-65 on the decay rates applied to customer classes in
Appendix B of Efficiency One 2020-2022 DSM Plan Application.**

**a. Please provide the names of the tabs within the RBIA model where the decay rate
calculations may be found. If the calculation of this rate is done in a separate
workpaper, please provide said workpaper, with formulae attached.**

Response IR-14:

a) The decay rates can be found in the RBIA model in the following tabs:

R-Inputs

SG-Inputs

G-Inputs

LG-Inputs

SI-Inputs

MI-Inputs

LI-Inputs

M-Inputs

The calculations are done directly in the RBIA model in each of the tabs listed above, on a
row labelled in Column C as "Ratio of New to Annual Participants".

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Request IR-15:

Referring to E1's response to NSP IR-67 on the scaling down of DSM measures to create the alternative plan.

a. Please identify which measures are not scaled down proportionally by the 0.89 factor between the Preferred and Alternate Cases?

b. Please the factor by which they were scaled and the rationale behind that scaling.

Response IR-15:

a) All Measures in the Affordable Multi-family Housing and Non-profit Organizations program component, First Nations Home Energy Efficiency program component, and demand reduction in the Home Energy Assessment, Green Heat, Small Business Energy Solution, and Business Energy Rebates program components were scaled down at different rates. These measures are listed below with their respective reduction in the alternate plan.

Program Component	Measure Name	Reduction
Affordable MultiFamily Renter	Custom Energy Efficiency	50%
First Nations Home Retrofits	Clothes Dryers	67%
First Nations Home Retrofits	Clothes Washers	67%
First Nations Home Retrofits	Dehumidifier replacement (Low income only)	67%
First Nations Home Retrofits	Drain Water Heat Recovery	67%
First Nations Home Retrofits	Freezer replacement (Low income only)	67%
First Nations Home Retrofits	Heat Pump Water Heater	67%
First Nations Home Retrofits	Programmable thermostats	67%
First Nations Home Retrofits	Refrigerator replacement (Low income only)	67%
First Nations Home Retrofits	Whole Home First Nations Retrofit	67%
ETS Business Energy Rebates	Large Commercial/Industrial ETS System	50%
ETS Business Energy Rebates	Medium Commercial ETS System	50%
ETS Business Energy Rebates	Small Commercial ETS Sytem	50%
ETS Green Heat	Residential ETS System (Central)	50%

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Program Component	Measure Name	Reduction
ETS Green Heat	Residential ETS System (Room)	50%
ETS Green Heat	Residential DHW Timer	50%
ETS Home Energy Assessment	Residential ETS System (Central)	50%
ETS Home Energy Assessment	Residential ETS System (Room)	50%
ETS Small Business Energy Solutions	Medium Commercial ETS System	50%
ETS Small Business Energy Solutions	Small Commercial ETS System	50%

b) The Affordable Multi-Family Housing and First Nations program components were reduced to a greater level than the other program components in the Alternate Scenario because they have a higher unit cost and as a result generate fewer energy savings. EfficiencyOne made the decision to increase the investment in both of these slightly as compared to the level of investment from the 2019 pilots but not at the same level of the Preferred Plan. In addition to new program components directed at the underserved markets, EfficiencyOne has also included in the Alternate Scenario, demand reduction specifically for Electric Thermal Storage at a similar level of investment as the 2019 pilot.

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Request IR-16:

**Regarding the Rate and Bill Impact Analysis (RBIA) for Preferred Plan included in
Appendix B of EfficiencyOne 2020-2022 DSM Plan Filing:**

- a. What is the present value of the benefits to the participants of the 2020-2022 DSM plan on 2020.**
- b. What is the impact of proposed 2020-2022 Preferred DSM Plan by considering avoided costs and lost revenue of both participants and non-participants?**
- c. What are the assumptions used for estimating avoided costs related with energy and demand?**
- d. How do DSM measures or programs selected at later date impact the RBIA analysis?**

Response IR-16:

- a) The present value of lifetime bill savings (net of DSM program costs and DSM rate effects) for Participants is \$559 million.
 - b) Lost revenues are caused by participants and recovered through rates for all customers. The analyses filed by EfficiencyOne considers the total amount of avoided costs and the total amount of lost revenues.
 - c) Please see Sections 3.5 and 3.7 of Appendix B to EfficiencyOne's DSM Plan Application.
- Avoided Costs are calculated at the portfolio level. For each year of the Plan, total portfolio lifetime energy savings are divided by total portfolio first-year energy savings to determine

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the portfolio-level weighted-average measure life (which is 14 years for each year of both the Preferred and Alternate Plans). First-year energy and demand savings resulting from each year of DSM program delivery are assumed to occur annually for the duration of the weighted-average measure life (i.e. 2020 measures last 14 years, 2021 measures last 14 years, and 2020 measures last 14 years). In each year, the total amount of energy and demand savings are multiplied by the respective avoided cost rates presented in Section 3.5. The total energy and demand savings in each year include persistent savings from previous years of DSM programming delivered within the three-year plan, such that avoided costs in 2020 are only driven by 2020 programming, avoided costs in 2021 are driven by 2020 and 2021 programming, avoided costs in 2022-2033 are driven by all three years of programming, avoided costs in 2034 are driven by 2021 and 2022 programming (since 2020 measures have expired), and avoided costs in 2034 are only driven by 2022 programming (since 2021 measures have expired). This pattern is illustrated on the 'Avoided Costs' tab of each model, in columns L:N, in rows 15 to 30 for energy and 52 to 67 for demand. The annual summations and conversion from units of energy and demand to dollars is done in columns AG:AH of the same tabs.

- d) The model does not consider what types of DSM measures are installed, only the costs, savings, and participation associated with these measures. Any impacts would be driven by changes in these parameters – if measures in the Plan are replaced with measures that have the same costs, savings and participation, there would be no impact to the modelled results. Holding all else equal, measures with higher or lower costs would generally push rates up or down, measures with marginally higher or lower savings would generally have little effect on rates as the avoided costs and lost revenues roughly cancel out, both of which are impacted by changes in savings by approximately the same proportion. Measures with higher or lower participation rates would reduce or increase the discrepancy in bill impacts between participants and non-participants.

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Request IR-17:

**Regarding the Rate and Bill Impact Analysis (RBIA) for Alternate Plan included in
Appendix B of EfficiencyOne 2020-2022 DSM Plan Filing:**

- a. What is the present value of the benefits to the participants of the 2020-2022 DSM plan on 2020.
- b. What is the impact of proposed 2020-2022 Alternate DSM Plan by considering avoided costs and lost revenue of both participants and non-participants?
- c. What are the assumptions used for estimating avoided costs related with energy and demand?
- d. How do DSM measures or programs selected at later date impact the RBIA analysis?

Response IR-17:

- a) For the 2020 Plan year, the present value of lifetime bill savings (net of DSM program costs and DSM rate effects) for Participants is \$501 million.
- b) Please refer to EfficiencyOne's response to SBA IR-16, part b).
- c) Please refer to EfficiencyOne's response to SBA IR-16, part c).
- d) Please refer to EfficiencyOne's response to SBA IR-16, part d).

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Request IR-18:

If applicable, please describe the methodology E1 employs in determining cost allocation related with proposed 2020-2022 DSM Plan between rate classes. Please provide any related workpapers with formulae intact.

Response IR-18:

Please refer to EfficiencyOne's response to Synapse IR-01.

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Request IR-19:

Referring to Efficiency One 2020-2022 DSM Application, Section 8, pgs. 88-95, the evaluation and reporting related to the DSM plan, specifically the Mid-course Adjustments and Flexibility E1 states they “will provide written advance notice of its intent to implement mid-course adjustments by program and their customer rate class impacts.” Please clarify to whom E1 will provide written notice of changes? The Board? Stakeholders? Both?

Response IR-19:

As is the current practice, EfficiencyOne will provide written advance notice of its intent to implement mid-course adjustments in the Annual Progress Reports that are filed with the Nova Scotia Utility and Review Board (NSUARB). The actual mid-course adjustments will be included in the Quarterly Report in Q1 which is also filed with the NSUARB.

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Request IR-20:

Referring to Efficiency One 2020-2022 DSM Application, Section 8, pgs. 88-95, the performance metrics E1 proposes as part of the DSM plan evaluation and reporting are the results of the DSM Plan performance under these metrics made available to stakeholders? If so, where can they be found. If not, please elaborate as to why not.

Response IR-20:

The table below identifies where each of the performance metrics as listed in the 2020-2022 DSM Resource Plan Application are reported.

Performance Metric	Performance Target	Performance Indicator	Reported Results
Cumulative annual energy savings	✓		2022 APR*
Cumulative annual system-peak demand savings	✓		2022 APR
Cumulative lifetime energy savings	✓		2022 APR
Annual incremental energy savings (reported by program and rate class		✓	APR & Quarterly reports
Cumulative incremental energy savings (reported by program and rate class		✓	2022 APR
Annual lifetime energy savings (reported by program and rate class		✓	APR & Quarterly Reports
Annual incremental system-peak demand savings (reported by program and rate class		✓	APR & Quarterly Reports
Cumulative annual system-peak demand savings (reported by program and rate class		✓	APR
Total ratepayer benefits		✓	APR

EfficiencyOne – EfficiencyOne Application for approval of a Supply Agreement for Electricity
Efficiency and Conservation Activities between E1 and Nova Scotia Power Inc. (DSM 2020-
2022) M09096 (E-ENS-R-19)
E1 Responses to Small Business Advocate (SBA)

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Total spending (reported by program and rate class)		✓	APR & Quarterly Reports
Customer satisfaction		✓	APR
Impact on rates		✓	Historical RBIA** (filed annually)
Low-income (participants, expenditures, savings)		✓	APR & Quarterly Reports

- 1 *Annual Progress Report (APR)
- 2 **Rate and Bill Impacts Analysis (RBIA)

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Request IR-21:

Regarding the Preferred Plan and Alternate Plan

- a. Please confirm that Preferred Plan includes additional program to what is considered in the Alternate Plan.**
- b. Please provide the list additional measures and programs considered in the Preferred Plan as compared to the Alternate Plan.**
- c. Please recreate and provide Tables 3, 4, and 6 included Appendix A of EfficiencyOne 2020-2022 DSM Resource Plan Filing by only including incremental DSM activities and programs considered in the Preferred Plan as compared with the Alternate Plan (see 1 (b) for the list of measures and programs).**
- d. Please provide and discuss cost-benefit analysis by only considering additional DSM activities included in the Preferred Plan as compared with the Alternate Plan.**

Response IR-21:

- a) The Preferred Plan does not include measures and programs additional to what is included in the Alternate Scenario. The same measures and programs are modelled in both, but with reduced participation in the Alternate Scenario.
- b) Please refer to part a) of this IR response.

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1 c) The following tables (Tables 1-3) reflect the incremental DSM activity between the
2 Preferred Plan and Alternate Scenario. This analysis reflects the correction to Enabling
3 Strategies noted in EfficiencyOne's response to Synapse IR-15, part b).
4

5 Please note, this is a mathematical exercise only. For example, the unit cost of first year
6 energy savings in the Preferred Plan and Alternate Scenario in 2020 are \$0.30/kWh and
7 \$0.29/kWh respectively. The table below indicates the unit cost of the incremental
8 difference is \$0.38/kWh. EfficiencyOne does not consider this to be a meaningful
9 comparison to current, past, or proposed levels of DSM as it considers only a portion of
10 activity within a Plan.

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1 Table 1: 2020 Incremental DSM – for illustrative purposes only. This table does not constitute a DSM plan

2020	Investment (\$ million)	Lifetime Benefits (\$ million)	First-Year Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Demand Savings (MW)	Total Resource Cost Test (TRC)	Program Administrator Cost Test (PAC)
Residential DSM Programs							
Efficient Product Rebates	0.4	0.9	1.7	12.0	0.2	1.3	2.4
Existing Residential	2.2	9.1	4.6	69.4	2.3	1.9	4.2
New Residential	0.3	1.4	0.6	17.7	0.2	1.5	4.5
<i>Low Income Participation</i>	<i>1.2</i>		<i>1.8</i>	<i>23.1</i>	<i>0.3</i>		
Business, Not-for-profit and Institutional Programs							
Efficient Product Rebates	0.9	6.2	4.3	61.9	1.2	2.4	7.0
Custom Incentives	1.0	4.7	3.5	48.8	0.9	2.0	4.9
Direct Installation	0.6	2.0	1.0	13.6	0.5	2.6	3.3
<i>Low Income Participation</i>	<i>0.1</i>		<i>0.6</i>	<i>8.3</i>	<i>0.2</i>		
Enabling Strategies							
Education and Outreach	0.1						
Development and Research	0.1						
Other Enabling Strategies	0.3						
Total	5.8	24.3	15.8	223.5	5.3	1.9	4.2

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1 Table 2:2021 Incremental DSM – for illustrative purposes only. This table does not constitute a DSM plan

2021	Investment (\$ million)	Lifetime Benefits (\$ million)	First-Year Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Demand Savings (MW)	Total Resource Cost Test (TRC)	Program Administrator Cost Test (PAC)
Residential DSM Programs							
Efficient Product Rebates	0.4	0.8	1.5	10.0	0.2	1.1	2.1
Existing Residential	2.3	9.9	4.6	70.9	2.5	1.9	4.3
New Residential	0.3	1.4	0.6	18.3	0.2	1.5	4.5
<i>Low Income Participation</i>	<i>1.2</i>		<i>1.7</i>	<i>22.8</i>	<i>0.3</i>		
Business, Not-for-profit and Institutional Programs							
Efficient Product Rebates	1.0	7.0	4.5	64.5	1.4	2.5	7.4
Custom Incentives	1.0	5.1	3.6	50.4	1.0	2.1	5.1
Direct Installation	0.6	2.3	1.1	14.4	0.6	2.8	3.6
<i>Low Income Participation</i>	<i>0.1</i>		<i>0.6</i>	<i>8.6</i>	<i>0.2</i>		
Enabling Strategies							
Education and Outreach	0.1						
Development and Research	0.1						
Other Enabling Strategies	0.3						
Total	6.1	26.6	15.9	228.4	5.8	2.0	4.4

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1 Table 3:2022 Incremental DSM – for illustrative purposes only. This table does not constitute a DSM plan

2022	Investment (\$ million)	Lifetime Benefits (\$ million)	First-Year Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Demand Savings (MW)	Total Resource Cost Test (TRC)	Program Administrator Cost Test (PAC)
Residential DSM Programs							
Efficient Product Rebates	0.4	0.7	1.3	8.7	0.1	1.0	2.0
Existing Residential	2.3	10.2	4.4	67.3	2.6	2.0	4.4
New Residential	0.3	1.5	0.6	18.9	0.2	1.6	4.6
<i>Low Income Participation</i>	<i>1.1</i>		<i>1.7</i>	<i>22.0</i>	<i>0.3</i>		
Business, Not-for-profit and Institutional Programs							
Efficient Product Rebates	1.0	7.8	4.6	66.3	1.6	2.6	7.6
Custom Incentives	1.0	5.5	3.8	52.0	1.0	2.2	5.4
Direct Installation	0.7	2.7	1.1	15.2	0.8	2.9	3.8
<i>Low Income Participation</i>	<i>0.1</i>		<i>0.6</i>	<i>8.9</i>	<i>0.2</i>		
Enabling Strategies							
Education and Outreach	0.1						
Development and Research	0.1						
Other Enabling Strategies	0.3						
Total	6.3	28.5	15.8	228.4	6.2	2.1	4.5

2

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1 d) The tables presented in part c) of this IR response include TRC and PAC results. Because
2 the measures offered in the Preferred Plan and Alternate Scenario are the same, there are
3 no differences in measure-level cost-effectiveness. Because the Alternate Scenario is
4 based on the Preferred Plan, cost-effectiveness between the preferred, alternate, and the
5 incremental difference is similar. Differences lie in programs that include the First
6 Nations and Affordable Multi-family program components, and Electric Thermal Storage
7 measures. These elements were scaled down more than the core program offerings to
8 produce the Alternate Scenario. The Residential Efficient Product Rebates, New
9 Residential, and Custom Incentives programs have the same cost-effectiveness results
10 because they do not contain these elements. Existing Residential observes no material
11 change to TRC, and Efficient Products Rebates and Direct Installation observe a marginal
12 increase in cost-effectiveness when comparing the incremental difference to the preferred
13 plan.

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Request IR-22:

**Regarding the participation and mitigation strategies presented in Tables 6 and 7
(EfficiencyOne 2020-2022 DSM Resource Plan Filing, Evidence, Page 26 and 28).**

**a. Does the proposed participation and mitigation strategies differ between proposed
Preferred and Alternative Plans?**

**b. Is yes, please provide the proposed participation and mitigation strategies
considered for the Alternate Plan?**

Response IR-22:

a) The proposed mitigation strategies are consistent between the Preferred Plan and Alternate
Scenario however the level of participation and investment is reduced in the Alternate
Scenario.

b) Please refer to part a) of this IR response.

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Request IR-23:

Regarding NSP's witness argument that Efficiency One's plan is biased because it relies on inflated fuel costs to determine avoided costs used to calculate ratepayer benefits associated with DSM measures (See NS Power Evidence, p. 72 at lines 11-13).

a. Did E1 compare the fuel costs included in the 2014 IRP calculation of avoided costs to current costs, and, if so, what conclusion was reached?

b. Please provide all documentation and sources that support this comparison.

c. If E1 did not make this comparison, explain in detail why it was not needed even though market conditions have changed between 2014 and when this plan was filed.

d. Please provide all records, meeting dates, materials such as memos, reports and presentations that show dialogue with NSP on their recommendation regarding the proper avoided costs to be used for

Response IR-23:

a) EfficiencyOne used Base-Case annual avoided costs of energy from the 2014 IRP for the Plan model and forward looking RBIA, not levelized avoided costs as suggested in the argument. EfficiencyOne did not perform a formal comparison of these avoided costs to current costs. Please refer to EfficiencyOne's response to SBA IR-13.

b) Please refer to part a) of this IR response.

c) EfficiencyOne relied on the avoided costs information provided by NS Power in the fall of 2018, as directed by the Nova Scotia Utility and Review Board.

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- 1 d) Please refer to EfficiencyOne's response to SBA IR-13.

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Request IR-24:

E1 recognizes that NSP is expected to file a new IRP in mid-July 2020, after E1 expects approval by the Board for its 2020-2022 Plan and planning for the 2023-2025 DSM Plan will have begun (Refer to Efficiency One 2020-2022 DSM Resource Plan and Supply Agreement, page 11 at lines 21-24):

- a. Is E1 prepared to update its 2020-2022 DSM plan to reflect NSP's updated IRP?**
- b. Has E1 ever revised its 2016 - 2018 three-year DSM plan? If so, please answer the following:**
 - i. how many revisions were made and the dates of those revisions;**
 - ii. explain the reason for the revisions;**
 - iii. provide the changes made to proposed investments by program and rate class, in both dollar and percentage terms, and including both increases and decreases in sub categories as well as aggregate changes in programs;**
 - iv. provide the changes in expected benefits by measure and rate class.**

Response IR-24:

- a) Please refer to EfficiencyOne's response to NSUARB IR-02.**
- b) EfficiencyOne did not revise the Nova Scotia Utility and Review Board approved Performance Targets or portfolio investment level for the 2016-2018 DSM Resource Plan.**
 - i. For each of the three years EfficiencyOne did provide an annual mid-course adjustment identifying revisions to program level energy savings targets and investment levels. The 2016 mid-course adjustment was filed with the ENS 2016 DSM Annual Progress**

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- 1 Report¹, the 2017 mid-course adjustment was filed with the ENS 2017 DSM Annual
2 Progress Report², and the 2018 mid-course adjustment was filed with the 2018 Q1
3 DSM Report³.
4
- 5 ii. Please refer to ENS 2016 DSM Annual Progress Report⁴, ENS 2017 DSM Annual
6 Progress Report⁵, and the 2018 Q1 DSM Report⁶ for the details on the mid-course
7 adjustments for 2016, 2017 and 2018.
8
- 9 iii. Please refer to ENS 2016 DSM Annual Progress Report⁷, ENS 2017 DSM Annual
10 Progress Report⁸, and the 2018 Q1 DSM Report⁹ for the details on the mid-course
11 adjustments for 2016, 2017 and 2018.
12
- 13 iv. EfficiencyOne reported achieved Lifetime Benefits for 2016-2018 at the portfolio level
14 in the 2018 DSM Annual Progress Report¹⁰. Achieved Lifetime Benefits by measure
15 and rate class have not been calculated.

¹ EfficiencyOne, ENS 2017 (2016 Year in Review) DSM Annual Progress Report, M07964, Exhibit E-2, March 31, 2017.

² EfficiencyOne, ENS 2017 (2017 Year in Review) DSM Annual Progress Report, M08604, Exhibit E-1, March 29, 2018.

³ EfficiencyOne, ENS 2018 Q1 Demand Side Management Report, M08716, Exhibit E-1, May 25, 2018.

⁴ *Supra* 1.

⁵ *Supra* 2.

⁶ *Supra* 3.

⁷ *Supra* 1.

⁸ *Supra* 2.

⁹ *Supra* 3.

¹⁰ EfficiencyOne, ENS 2018 DSM Annual Progress Report, M09096, Exhibit E-1, March 29, 2019.

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Request IR-25:

Does E1's 2020-2022 DSM plan include measures requiring conversion to electric heat pumps? If so, please provide a detailed report of the expected number of installations, costs and savings by rate class by year.

Response IR-25:

Yes, EfficiencyOne's DSM plan includes conversion from electric resistance to electric heat pumps. Incentives on electric heat pumps are offered in the following program components: Green Heat, Home Energy Assessment, First Nations Home Energy Efficiency, Custom, Small Business Energy Solutions, Business Energy Rebates, and Affordable Multi-Family Housing and Non-Profit Organizations. Of these program components, heat pumps are prescriptive measures modelled as distinct measures in Green Heat, Small Business Energy Solution, and Business Energy Rebates. Home Energy Assessment, First Nations Home Energy Efficiency, Custom, and Affordable Multi-Family Housing and Non-Profit Organizations measure characterizations reflect whole-project savings for a mix of projects—some installing heat pumps and some not. As such, the expected number of heat pump installations was not explicitly modelled and is not available for these program components.

Please refer to Attachment 1 of this IR response for a summary of the requested information for the Green Heat, Small Business Energy Solution, and Business Energy Rebates program components.

		2020				
Measure Name	Program Component	Participation (Units)	Peak Demand Savings (kW)	First Year Energy Savings (MWh)	Lifetime Energy Savings (MWh)	PAC Costs (\$)¹
Cold Climate Air-Source Heat Pump (24kBTU/hr)	Business Energy Rebates	27	72	221	3,975	\$28,136
Cold Climate Air-Source Heat Pump (48kBTU/hr)	Business Energy Rebates	6	33	100	1,807	\$12,789
Ground Source Heat Pump (60kBTU/hr)	Business Energy Rebates	6	70	187	4,663	\$42,283
Packaged Terminal Heat Pump (12kBTU/hr)	Business Energy Rebates	122	0	630	9,456	\$92,259
ASHP and AWHP - Electrical	Green Heat	42	86	97	1,737	\$58,723
GSHP	Green Heat	4	34	45	1,116	\$27,174
MSHP - Fully Electrical	Green Heat	5,240	8,341	11,353	204,349	\$2,096,764
MSHP - Mainly Electrical	Green Heat	1,384	2,546	1,111	19,991	\$386,983
Cold Climate Air-Source Heat Pump (24kBTU/hr)	Small Business Energy Solutions	53	145	442	7,957	\$208,436
Ground Source Heat Pump (60kBTU/hr)	Small Business Energy Solutions	2	21	55	1,369	\$25,391
		6,886	11,347	14,239	256,418	2,978,937

¹ PAC costs include incentives and administrative costs per the definition in E1 (NSPI) RIR-30, Attachment 1

		2021				
Measure Name	Program Component	Participation (Units)	Peak Demand Savings (kW)	First Year Energy Savings (MWh)	Lifetime Energy Savings (MWh)	PAC Costs (\$)¹
Cold Climate Air-Source Heat Pump (24kBTU/hr)	Business Energy Rebates	50	134	408	7,348	\$52,016
Cold Climate Air-Source Heat Pump (48kBTU/hr)	Business Energy Rebates	6	33	102	1,837	\$13,004
Ground Source Heat Pump (60kBTU/hr)	Business Energy Rebates	10	114	303	7,586	\$68,790
Packaged Terminal Heat Pump (12kBTU/hr)	Business Energy Rebates	137	0	705	10,576	\$103,190
ASHP and AWHP - Electrical	Green Heat	31	65	73	1,306	\$37,857
GSHP	Green Heat	5	40	54	1,342	\$32,691
MSHP - Fully Electrical	Green Heat	5,240	8,341	11,353	204,349	\$2,096,764
MSHP - Mainly Electrical	Green Heat	1,384	2,546	1,111	19,991	\$386,983
Cold Climate Air-Source Heat Pump (24kBTU/hr)	Small Business Energy Solutions	55	151	462	8,317	\$208,004
Ground Source Heat Pump (60kBTU/hr)	Small Business Energy Solutions	2	22	57	1,431	\$25,357
		6,920	11,445	14,628	264,083	3,024,655

¹ PAC costs include incentives and administrative costs per the definition in E1 (NSPI) RIR-30, Attachment 1

		2022				
Measure Name	Program Component	Participation (Units)	Peak Demand Savings (kW)	First Year Energy Savings (MWh)	Lifetime Energy Savings (MWh)	PAC Costs (\$) ¹
Cold Climate Air-Source Heat Pump (24kBTU/hr)	Business Energy Rebates	76	204	623	11,205	\$79,318
Cold Climate Air-Source Heat Pump (48kBTU/hr)	Business Energy Rebates	13	68	208	3,735	\$26,439
Ground Source Heat Pump (60kBTU/hr)	Business Energy Rebates	10	116	308	7,712	\$69,931
Packaged Terminal Heat Pump (12kBTU/hr)	Business Energy Rebates	152	0	782	11,729	\$114,439
ASHP and AWHP - Electrical	Green Heat	21	43	48	873	\$21,094
GSHP	Green Heat	6	47	63	1,570	\$38,236
MSHP - Fully Electrical	Green Heat	5,240	8,341	11,353	204,349	\$2,096,764
MSHP - Mainly Electrical	Green Heat	1,384	2,546	1,111	19,991	\$386,983
Cold Climate Air-Source Heat Pump (24kBTU/hr)	Small Business Energy Solutions	58	158	483	8,700	\$212,410
Ground Source Heat Pump (60kBTU/hr)	Small Business Energy Solutions	2	22	60	1,497	\$25,905
		6,961	11,545	15,038	271,359	3,071,520

¹ PAC costs include incentives and administrative costs per the definition in E1 (NSPI) RIR-30, Attachment 1

Rate Class (2020)	Peak Demand Savings (kW)	First Year Energy Savings (MWh)	Lifetime Energy Savings (MWh)	PAC Costs (\$) ¹
Direct Expenses by RC/Program				
Residential/Charitable (2,3,4)	10,916	12,610	227,299	\$ 2,589,787
Small General (10)	37	137	2,478	\$ 38,542
General Demand (11)	221	1,038	18,579	\$ 268,585
Large General (12)	10	76	1,323	\$ 10,816
Small Industrial (21)	21	96	1,715	\$ 19,605
Medium Industrial (22)	7	53	923	\$ 7,258
Large Industrial (23, 25)	8	62	1,077	\$ 9,827
Municipal (24)	127	169	3,025	\$ 34,517
Unmetered (999)	-	-	-	\$ -

Rate class estimates assume a distribution of costs and savings equal to the the distribution of the program component averages for BER, SBES, and GH

Rate Class (2021)	Peak Demand Savings (kW)	First Year Energy Savings (MWh)	Lifetime Energy Savings (MWh)	PAC Costs (\$) ¹
Direct Expenses by RC/Program				
Residential/Charitable (2,3,4)	10,909	12,622	227,623	\$ 2,578,521
Small General (10)	44	163	2,968	\$ 42,508
General Demand (11)	294	1,287	23,437	\$ 304,953
Large General (12)	16	101	1,817	\$ 14,609
Small Industrial (21)	27	120	2,184	\$ 23,528
Medium Industrial (22)	12	70	1,268	\$ 9,803
Large Industrial (23, 25)	13	82	1,480	\$ 13,273
Municipal (24)	131	183	3,305	\$ 37,460
Unmetered (999)	-	-	-	\$ -

Rate class estimates assume a distribution of costs and savings equal to the the distribution of the program component averages for BER, SBES, and GH

Rate Class (2022)	Peak Demand Savings (kW)	First Year Energy Savings (MWh)	Lifetime Energy Savings (MWh)	PAC Costs (\$) ¹
Direct Expenses by RC/Program				
Residential/Charitable (2,3,4)	10,903	12,636	227,924	\$ 2,571,543
Small General (10)	50	189	3,436	\$ 46,490
General Demand (11)	368	1,549	28,060	\$ 340,109
Large General (12)	22	128	2,285	\$ 17,884
Small Industrial (21)	34	145	2,629	\$ 27,107
Medium Industrial (22)	16	89	1,594	\$ 12,000
Large Industrial (23, 25)	18	104	1,860	\$ 16,248
Municipal (24)	135	198	3,571	\$ 40,139
Unmetered (999)	-	-	-	\$ -

Rate class estimates assume a distribution of costs and savings equal to the the distribution of the program component averages for BER, SBES, and GH

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Request IR-26:

Refer to NSP Evidence, p. 24 at lines 12-14 and 23-24, and FN 26: Did E1 engage NSP in the development of the Alternative Plan, as required in the UARB decision in M06733? Please describe and document all discussions in this area. If not please explain why not.

Response IR-26:

EfficiencyOne engaged NS Power beginning in the fall of 2018, sharing both the Preferred Plan and Alternate Scenario to encourage input into the development of both these options.

Engagement included:

- Various one-on-one meetings (through which NS Power expressed a desire to see additional emphasis placed on Demand Reduction initiatives);
- Demand Side Management Advisory Group (DSMAG) meeting held December 7th, 2018;
- A coordinated exchange with Navigant at the end of January 2019, through which EfficiencyOne facilitated the modelling of various DSM investment scenarios put forward by NS Power;
- The 2020-2022 DSM Resource Plan Technical Conference held February 20th, 2019; and
- Ongoing counsel to counsel communications. Discussions included savings and investment levels that were being considered throughout the engagement.

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Request IR-27:

Does E1 make adjustments to its plan to reflect the free ridership? If so, please confirm the percentage adjustment by technology type. Is this adjustment also referred to as “net-to-gross adjustment” in the E1 plan?

Response IR-27:

Please refer to EfficiencyOne’s response to NS Power IR-33¹. The 2020-2022 DSM plan model includes the effects of free-ridership and spillover via the net-to-gross ratio (NTGR), defined below².

$$NTGR = (1 - \% \text{ free-ridership} + \% \text{ internal spillover})$$

¹ M09096, 2020-2022 DSM Plan - E1 Responses to NS Power IR Requests 1-69, Exhibit E-3, March 29, 2019.

² M08604, 2017 DSM Programs Evaluation, Executive Summary, Exhibit E-1, March 29, 2018, page 23.

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Request IR-28:

Refer to Evidence, Page 2 of 62, regarding the proposed performance target of lifetime energy savings

a. Please clarify if EfficiencyOne is proposing the lifetime energy savings as an additional performance target, but not to replace what is currently being considered.

b. Does EfficiencyOne envision any situation where a program meets lifetime energy savings, but does not meet first-year energy savings target?

c. If yes to (b), please provide an example and discuss how this would be treated?

d. If no to (b), please discuss the need of tracking additional performance metric.

Response IR-28:

a) Please refer to EfficiencyOne's response to CA IR-11.

b) Please refer to part a) of this IR response.

c) Please refer to part a) of this IR response.

d) Please refer to part a) of this IR response.

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Request IR-29:

NSP proposes in its Reply Evidence that any variation in the amount approved by the Board for the 2020-2022 DSM Supply Agreement period from the \$34.05 million NSP carries in its non-fuel budget apportioned to DSM, be apportioned to the FAM account prior to the next General Rate Application (GRA) (NSP Evidence, p. 30 at lines 4-7).

Given NSP's proposal, please provide a table in excel spreadsheet format showing the impact on the current projected FAM rates for 2022 by rate class in both, dollar and percentage terms, if the Board approves:

- a. E1's Preferred Plan, with and without E1's proposed treatment of the HST Refund; and**
- b. E1's Alternative Plan, with and without E1's proposed treatment of the HST Refund.**

Response IR-29:

EfficiencyOne sought clarification from the SBA on this IR. The SBA requested that the IR be varied to read:

- a) For the approved budget of \$34.05 million of 2019 DSM Plan (M08604, Board Order), please provide EOne's best estimate of the DSM spending levels by rate class for direct program expenditures including cost for program delivery that are shared between different DSM programs. Please also provide the total other E1 administrative and general costs that make up the \$34.05 million budget. There is no need to allocate these administrative and general costs by rate class.**

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1 **b) For the proposed budget of \$41.9 million of Preferred Plan for 2020, please provide**
2 **EOne’s best estimate of the DSM spending levels by rate class for direct program**
3 **expenditures including cost for program delivery that are shared between different**
4 **DSM programs. Please also provide the total other E1 administrative and general**
5 **costs that make up the \$41.9 million. There is no need to allocate these**
6 **administrative and general costs by rate class.**

7
8 EfficiencyOne’s response is based on the clarification received from the SBA on this IR.
9

10 a) The 2019 approved DSM Plan spending by rate class is provided in EfficiencyOne’s
11 response to IG IR-04.
12

13 b) The 2020-2022 Preferred DSM Plan spending by rate class is provided in
14 EfficiencyOne’s response to IG IR-04. For estimated spending by EfficiencyOne’s cost
15 categories for the 2020-2022 Preferred Plan please refer to EfficiencyOne’s response to
16 Synapse IR-14.

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Request IR-30:

Please explain how NSP’s proposal to apportion the variation from the \$34.05 million for DSM that NSP carries in its non-fuel budget is consistent with the Board’s decision in M06247 and the enabling legislation the Electricity Efficiency and Conservation Restructuring (2014) Act, S.N.S. 2014, c. 5 (“2014 Act”).

Response IR-30:

EfficiencyOne considers the determination of whether the NS Power proposal to “apportion the variation from the \$34.05 million for DSM that NS Power carries in its non-fuel budget” through the NS Power Fuel Adjustment Mechanism (FAM), is consistent with the *Electricity Efficiency and Conservation Restructuring (2014) Act*¹, (the “2014 Act”) is ultimately a determination to be made by the Nova Scotia Utility and Review Board (NSUARB).

EfficiencyOne does acknowledge that this NS Power proposal is a departure from the current approach which has been used since the introduction of the 2014 Act, and as such, would likely be subject to further discussions involving key stakeholders, including the Demand Side Management Advisory Group and ultimately determined through a NSUARB review process.

¹ Electricity Efficiency and Conservation Restructuring (2014) Act. 2014, c. 5, s. 1.

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1 **Request IR-31:**

2
3 **Does E1 interpret the Board’s order in M06733 to mean that E1 should have presented the**
4 **alternative DSM funding plans ranging between \$27 million and \$34 million along with its**
5 **Preferred Plan? Please explain in detail how EOne interprets this portion of the order.**

6
7 Response IR-31:

8
9 In developing the Alternate Scenario included in its 2020-2022 DSM Resource Plan Application,
10 EfficiencyOne considered comments received from stakeholders which included support for both
11 higher and lower levels of investment than what had been proposed. EfficiencyOne did not
12 interpret the Nova Scotia Utility and Review Board’s order to require EfficiencyOne to include
13 the full range of investment suggestions as alternate scenarios in its subsequent Applications.
14 EfficiencyOne understood that any alternate scenarios included in an Application were intended
15 to represent a viable and deliverable DSM Plan, incorporating all of the requisite considerations
16 that would inform the EfficiencyOne Preferred Plan and be developed using the same rigor as the
17 Preferred Plan, albeit at a lower investment level than the Preferred Plan.

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Request IR-32:

**Did E1 solicit and present NSP's rate impact analysis along with its Preferred Plan? If so,
how do the first-year rate impact in total and for each rate class under E1's Preferred and
Alternative Plans compare to NSP's alternative plans?**

Response IR-32:

The Rate and Bill and Impact Analysis (RBIA) and Excel-based models that EfficiencyOne filed
on the Preferred Plan and Alternate Scenario were only its own. EfficiencyOne did not perform
any RBIA on the model outputs proposed by NS Power.

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Request IR-33:

How does E1 explain the differences in first year impacts across both E1 and NSP's plans?

Response IR-33:

Table 1 below presents the first-year impacts from the model outputs provided to NS Power from Navigant and EfficiencyOne's Preferred Plan and Alternate Scenario.

Table 1: First Year Impacts

	First Year Energy Savings (GWh)			Peak Demand Savings (MW)		
	2020	2021	2022	2020	2021	2022
NS Power Model Output						
\$27M Max demand:	102.0	101.7	101.8	36.5	36.4	36.5
\$34M Max demand:	128.6	127.7	128.5	42.0	41.9	41.9
\$27M Max impacts:	106.6	105.1	106.5	33.9	33.7	33.9
\$34M Max impacts:	134.7	134.0	134.7	39.8	39.7	39.7
EfficiencyOne						
\$43M Preferred Plan	140.2	141.3	140.2	38.7	40.3	41.1
\$37M Alternate Scenario	124.4	125.4	124.4	33.4	34.5	34.9

Several factors could influence the first-year impacts produced through the modelling exercise including assumptions and constraints applied, key considerations used for the development of a DSM Plan, included enhancements etc. An overarching difference between the NS Power model outputs and EfficiencyOne's Preferred Plan and Alternate Scenario is that the latter has been vetted to ensure deliverability in Nova Scotia over the 2020-2022 DSM Plan period. This requires an examination of the model outputs at the measure and program component level. A cursory review of NS Power's model outputs highlights instances where the machine-generated results may not be deliverable. Consider the following examples from the \$27M scenario optimized for maximum demand savings. Please note these are a subset of observations from a preliminary assessment.

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- 1 • The Direct Installation program drops from its 2019 target of 9.3 GWh to 0.2 GWh/year
- 2 and offers only occupancy sensors and decorative lamps as measures;
- 3 • The First Nations Home Energy Efficiency program component operates at 0.2 GWh/year
- 4 and offers only dehumidifier and freezer replacement measures;
- 5 • The New Residential program drops from its 2019 target of 5.3 GWh to 1 GWh and only
- 6 offers incentives on the lowest performance tier currently available; and
- 7 • The Residential Efficient Products Installation program component drops from a target of
- 8 16.85 GWh in 2019 to 3.8 GWh/year with a measure mix that excludes 75% of measures,
- 9 including the most common household lamp (LED 9 W replacing 60W), and has nearly 3x
- 10 as many LED night lights as the preferred plan.

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Request IR-34:

Please explain how the 2016-2018 DSM Supply Agreement provide guidance on the appropriate level of individual year rate impacts associated with the Preferred Plan?

Response IR-34:

The 2016-2018 DSM Supply Agreement did not, in and of itself, guide assessment of the appropriate level of rate impacts within the Preferred Plan. Anticipated rate impacts by year, considered both in a historical context and prospectively, were a factor considered by EfficiencyOne informing development of the Preferred Plan.

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Request IR-35:

Does E1 believe that its inability to reach general agreement with respect to the level of energy savings and investment for the 2020-2022 DSM Plan falls under the provision in the 2016-2018 Supply Agreement entitled “19. Dispute Resolution”? What are the consequences for customers a result of E1 not being able to reach agreement on this matter?

Response IR-35:

No. EfficiencyOne does not believe that the terms of the 2016-2018 Supply Agreement, and in particular Section 19, apply to the negotiation of the 2020-2022 Supply Agreement.

EfficiencyOne does not anticipate any direct consequences to NS Power ratepayers as a consequence of EfficiencyOne and NS Power not reaching a tentative agreement regarding the terms of a Supply Agreement in advance of EfficiencyOne filing its proposed 2020-2022 DSM Plan Application; beyond the likely result of a lengthened regulatory proceedings and the resulting incremental hearing costs.

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Request IR-36:

**Refer to Small New Construction Service program discussed in EfficiencyOne 2020-2022
DSM Resource Plan Filing, Appendix A, Page 61, Line 18 – 24**

- a. Please discuss if previous years' DSM Plans (2016 – 2018 and 2019) included Small
New Construction service program.**
- b. For the year 2018, to the best extent possible, please provide performance indicator
table, similar to Table 19 included in the Appendix A, by only considering measures
offered for Small New Construction service program.**
- c. For the proposed Preferred Plan for 2020-2022, to the best extent possible, please
provide performance indicator table, similar to Table 19 included in the Appendix A,
by only considering measures offered for Small New Construction service program.**
- d. For the proposed Preferred Plan for 2020-2022, to the best extent possible, please
provide the list of measures that will be included for Small New Construction service
program.**

Response IR-36:

- a) Previous DSM plans, including 2016-2018 and 2019, did not include the Small New
Construction service.**
- b) The Small New Construction service was not active in 2018; therefore, there are no
performance indicators for the program in this year.**

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c) Table 1 below outlines the Preferred Plan for 2020-2022 performance indicators for the Small New Construction service. The Small New Construction enhancement to the Custom program component was characterized as a part of the Custom energy efficiency measure, i.e., it was not modelled as its own unique measure. Cost effectiveness testing is therefore not available, and all costs, savings, and participation values are estimates.

Year	Investment (\$ million)	First- Year Energy Savings (GWh)	Lifetime Energy Savings (GWh)	Peak Demand Savings (MW)	Total Resource Cost Test (TRC)	Program Administrator Cost Test (PAC)	Participation (projects)	Levelized Cost of Saved Energy (\$/kWh)	Nominal cost of saved energy (\$/kWh)
2020	2.7	6.4	88.4	1.0	N/A	N/A	22	0.045	\$ 0.030
2021	2.8	6.6	91.3	1.1	N/A	N/A	22	0.045	\$ 0.030
2022	2.9	6.8	94.2	1.1	N/A	N/A	23	0.045	\$ 0.030
Total	8.3	19.8	274.0	3.2	N/A	N/A	67	0.045	\$ 0.030

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1 d) The Small New Construction service offers both a prescriptive and performance path to
2 improve new building performance. For the prescriptive path, a set of prescriptive
3 measures will be developed to define a building built to a 50 percent better than National
4 Energy Code of Canada for Buildings (NECB) standard, examples of which include
5 building envelope and heating system measures. Incentives will not be based on single
6 measures, but rather the overall performance of the building.

7
8 A performance path, including building energy modeling, will also be offered for those
9 buildings that wish to pursue 75 percent better than NECB or Net-Zero Energy.

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Request IR-37:

**Refer to the discussion related with market barriers identified in EfficiencyOne 2020-2022
DSM Resource Plan Filing, Appendix A, Page 70, Line 10 – 17**

- a. Please provide list of initiatives undertaken by EfficiencyOne to overcome each of the
listed barrier in last three years.**
- b. To the best extent possible, please quantify the impact of each of the initiative listed
above in meeting performance indicators for the Direct Installation program.**
- c. Among the list of initiatives undertaken by EfficiencyOne in last three years for Direct
Installation program, please identify the list of initiatives that will be continued
during 2020 – 2022 DSM Plan.**
- d. Is EfficiencyOne planning any additional initiative to listed in (c) to overcome market
barriers? Please provide the description of each of these initiative to the best extent
possible.**

Response IR-37:

a) To address the affordability barrier, the Direct Installation program offers incentives to
offset a portion of the capital cost. These incentives are up to 60 percent of the project cost.
Small business customers can also receive interest-free financing, in addition to the rebate
incentive. The Direct Installation program is the only program where businesses can
combine both rebates and financing.

To address the awareness and resources barriers, the Direct Installation program offers free
energy assessments for small businesses, which includes a site visit from an energy auditor

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1 and a tailored report detailing energy efficiency opportunities, savings potentials,, and
2 paybacks. The free energy assessments also contribute to mitigating the affordability
3 barrier. Participants who go through the Do-It-Yourself path, rather than the audit path,
4 receive a pre-approval report that provides similar information such as savings and
5 paybacks for the measures submitted.

6
7 EfficiencyOne also offers the Efficiency Trade Network as a source of potential contractors
8 that participants can choose to utilize. EfficiencyOne staff, including Direct Installation
9 program staff, Business Development Managers, Onsite Energy Managers, and Energy
10 Solutions Advisors, are all available to help guide the participants through the process.
11 Energy auditors also provide this support for participants that receive an energy
12 assessment.

13
14 b) The Direct Installation program has seen continual growth since being reintroduced as
15 “Small Business Energy Solutions” and expects to achieve its 2019 Plan savings target of
16 9.3 GWh. Direct Installation savings increased from 4.123 GWh in 2016 to 9.589 GWh in
17 2018, an increase of 133 percent. In 2016, the program had 259 projects complete. The
18 total number of projects increased by 104 percent, at the end of 2018, to 529.

19
20 c) All initiatives indicated in part a) of this IR response are expected to continue as part of the
21 2020-2022 DSM Plan.

22
23 d) EfficiencyOne plans to build on the growing success of the Direct Installation program
24 by continuing to use the strategies listed in part a) of this IR response, in addition to
25 growing the network of regularly participating customers and contractors.

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Request IR-38:

Refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Evidence, Page 28, Table 7.

- a. Please provide similar table highlighting barriers addressed (fourth column of Table 7) in 2016 – 2018 and 2019 Plans.**
- b. If strategies to address barriers in the Preferred Plan are similar to previous years' strategies, please comment on the need to consider these strategies again.**

Response IR-38:

- a) Please refer to EfficiencyOne's response to NS Power IR-13¹.
- b) EfficiencyOne continually assesses program barriers and the effectiveness of mitigation strategies as part of program evaluations, customer feedback, market research and regular program tracking and reporting. EfficiencyOne considered existing strategies in the development of the 2020-2022 DSM Resource Plan. These strategies have been effective in reducing barriers and have been maintained in the Preferred Plan. While progress has been made, there are opportunities to support more participants with the existing strategies and complement them with new strategies being introduced in the 2020-2022 DSM Resource Plan.

¹ M09096, 2020-2022 DSM Plan - E1 Responses to NS Power IR Requests 1-69, Exhibit E-3, March 29, 2019.

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Request IR-39:

Refer to Evidence, Page 29, Line 7 – 11.

- a. Please provide reports/studies conducted by EfficiencyOne or any other third parties that concluded “program results show that participants who follow the facilitated path save more energy and achieve greater electricity bill reductions than participants who follow the self-directed path.”
- b. Please comment if E1 had strategies in place in 2016 – 2018 DSM Plans and 2019 DSM Plans that are in consistent with above finding.

Response IR-39:

- a) 2017 and 2018 annual program evaluations for the Direct Installation program report higher average savings for projects completed using the Audit (facilitated) path compared to those completed using the Do-It-Yourself (self-directed) path. These results are presented in Table 1 below.

Table 1: Direct Installation Program Path Average Savings for 2017-2018

	2017		2018	
	DIY Path	Audit Path	DIY Path	Audit Path
Average Savings (kWh) per project	17,635	28,300	17,407	31,000

- b) EfficiencyOne had strategies in place to support both the facilitated and self-directed paths for customers in the Direct Installation program over the 2016-2019 period. EfficiencyOne has offered (and continues to offer) energy assessments at no cost to customers following the facilitated path. This encourages customers to review and consider all opportunities for energy efficiency within their business with no associated

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1 upfront cost or risk. EfficiencyOne regularly procures energy auditors in support of this
2 service, so that there is no burden placed on the customer to locate a qualified individual.
3 Customers are directed to the facilitated path through standard marketing materials,
4 newsletters and the Efficiency Trade Network. Additionally, the rebate navigator on the
5 EfficiencyOne website directs customers towards the facilitated path if they are unsure
6 what measures they would most benefit from. EfficiencyOne encourages both end-use
7 customers and contractors involved in small business projects to take advantage of the
8 facilitated path, where applicable, in order to identify all possible opportunities for energy
9 efficient upgrades.

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Request IR-40:

**Refer to the discussion related with market barriers identified in EfficiencyOne 2020-2022
DSM Resource Plan Filing, Appendix A, Page 70, Line 10 – 17**

- a. Please provide list of initiatives undertaken by EfficiencyOne to overcome each of the
listed barrier in last three years.**
- b. To the best extent possible, please quantify the impact of each of the initiative listed
above in meeting performance indicators for the Direct Installation program.**
- c. Among the list of initiatives undertaken by EfficiencyOne in last three years for Direct
Installation program, please identify the list of initiatives that will be continued
during 2020 – 2022 DSM Plan.**
- d. Is EfficiencyOne planning any additional initiative to listed in (c) to overcome market
barriers? Please provide the description of each of these initiative to the best extent
possible.**

Response IR-40:

- a) Please refer to EfficiencyOne’s response to SBA IR-37.**
- b) Please refer to part a) of this IR response.**
- c) Please refer to part a) of this IR response.**
- d) Please refer to part a) of this IR response.**

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Request IR-41:

**Please confirm if EfficiencyOne is planning to conduct an Affordable Multifamily housing
program separately or in conjunction with the Small Business Energy Solutions.**

Response IR-41:

EfficiencyOne has included Affordable Multi-family Housing and Non-Profit Organizations as a
new program component under the Existing Residential Program in both the Preferred Plan and
Alternate Scenario.

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Request IR-42:

Refer to EfficiencyOne 2020-2022 DSM Resource Plan Filing, Appendix A Attachment 1,

- a. Please provide definition of the data provided in each column along with the description on how they were calculated.**
- b. Where applicable, please provide Appendix A Attachment 1 in Excel format with formulae intact file showing the relationship between data included in the file.**

Response IR-42:

- a) Please refer to EfficiencyOne's response to NS Power IR-30¹ for formulas and descriptions of calculations. Table 1 below lists definitions of each field.

Table 1: Definitions of Field Names

Field Name	Definition
General Measure Information (Columns A-Y)	
Measure Name	The name of the measure
Program	The program the measure is delivered under
Technology Type	Measures are categorized into 13 groups: BNI Cooking and Laundry, BNI Domestic Hot Water (DHW), BNI Energy Management, BNI HVAC, BNI Lighting, BNI Other, BNI Process, BNI Refrigeration, Res Domestic Hot Water (DHW), Res Lighting, Res Other, Res Refrigeration, and Res Heating, Ventilation and Air-Conditioning
Decision Type	Two decision types are available: Replace on Burnout/New Construction (ROB)/New and Early Retirement. This defines the type of measures and provides an indication of baseline assumptions, e.g. savings for ROB/NEW measures are compared against a commercially available or code/standard compliant option, whereas an early retirement measure would be compared to the existing technology for the remaining useful life of that equipment.
Measure Life	The number of years a measure is in service

¹ M09096, 2020-2022 DSM Plan - E1 Responses to NS Power IR Requests 1-69, Exhibit E-3, March 29, 2019.

EfficiencyOne – EfficiencyOne Application for approval of a Supply Agreement for Electricity Efficiency and Conservation Activities between E1 and Nova Scotia Power Inc. (DSM 2020-2022) M09096 (E-ENS-R-19)

E1 Responses to Small Business Advocate (SBA)

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Gross Annual Energy Savings per Unit at Meter (kWh) Pre-RUL	Gross annual unitary energy savings for the measure occurring during the estimated remaining useful life of the existing equipment
Gross Peak Demand Savings per Unit at Meter (Watts) Pre-RUL	Gross annual unitary demand savings for the measure occurring during the estimated remaining useful life of the existing equipment
Gross Annual Energy Savings per Unit at Meter (kWh) Post-RUL	Gross annual unitary energy savings for the measure occurring after the estimated remaining useful life of the existing equipment
Gross Peak Demand Savings per Unit at Meter (Watts) Post-RUL	Gross annual unitary demand savings for the measure occurring after the estimated remaining useful life of the existing equipment
Gross Per Unit One-Time Per Unit Incremental Measure Cost (\$)	Incremental cost to install the measures
2020 Incentive as a Percent of Incremental Measure Cost (%)	Program incentive as a percent of incremental cost to install the measures
Per Unit Program Administrator Cost (\$)	E1 cost to deliver the measure, including direct install costs if applicable
Per Unit Direct Installation Cost (\$)	Cost to deliver direct install measures, e.g. residential efficient products measures.
Per Unit DSM Administrator Cost (Incentive + Administrative) (\$)	The sum of E1 program administrator costs and incentive costs
Per Unit DSM Customer Cost (Incremental Measure Cost - Incentive) (\$)	Net customer costs including the effect of incentives
Total Per Unit DSM Cost (\$)	Total DSM costs (TRC) including incremental measure costs, and administration
Per Unit Present Value Avoided Cost Benefits (\$)	Represents the sum of discounted avoided cost cash flows for a measure's effective useful life. For early retirement measures, this may include a Pre and Post RUL savings adjustment.
Per Unit Present Value Non-Energy Benefits (\$)	Represents the sum of discounted non-energy benefit cash flows for a measure's effective useful life (not used in this plan)
Total Per Unit Present Value Benefits (\$)	Sum of avoided cost benefits and non-energy benefits
Net-To-Gross Ratio	The net-to-gross ratio (NTGR) of the measure, which includes the effects of free-ridership and spillover. $NTGR = (1 - \% \text{ free-ridership} + \% \text{ internal spillover})$
Net Total Resource Benefit-Cost Ratio (TRC)	The results of the Total Resource Costs test
Net Program Administrator Benefit-Cost Ratio (PAC)	The results of the Program Administrator Costs test

EfficiencyOne – EfficiencyOne Application for approval of a Supply Agreement for Electricity Efficiency and Conservation Activities between E1 and Nova Scotia Power Inc. (DSM 2020-2022) M09096 (E-ENS-R-19)

E1 Responses to Small Business Advocate (SBA)

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Net First-Year Unit Cost / kWh at Generator (\$/kWh)	This field is calculated in the model by summing incentive and admin spending (Per Unit DSM Administrator Cost in this workbook) and dividing it by net first-year energy savings divided by (1 - line loss factor).
Net Lifetime Unit Cost / kWh at Generator (\$/kWh)	This field is calculated in the model by summing incentive and admin spending (Per Unit DSM Administrator Cost in this workbook) and dividing it by net lifetime energy savings divided by (1 - line loss factor). For early retirement measures, this may include the summation of Pre and Post RUL savings through the lifetime of the measure.
Net Unit Cost / Watt at Generator (\$/W)	This field is calculated in the model by summing incentive and admin spending (Per Unit DSM Administrator Cost in this workbook) and dividing it by net demand savings divided by (1 - line loss factor).

Year-Specific Measure Information (Columns AB-AM, AN-AY, and AZ-BK)

Measure Name	The name of the measure
Participation (Units)	Estimated number of units installed
Peak Demand Savings (kW)	This field is calculated in the model by multiplying the per unit gross demand savings by the net-to-gross ratio and then dividing this net savings value by (1 - line loss factor). This is then multiplied by measure participation thus yielding total net savings at generator.
First Year Energy Savings (MWh)	This field is calculated in the model by multiplying the per unit gross first year energy savings by the net-to-gross ratio and then dividing this net savings value by (1 - line loss factor). This is then multiplied by measure participation thus yielding total net savings at generator.
Cumulative Peak Demand Savings (kW)	This field is a summation of savings across program years-to-date. In 2020, this will equal first year savings in 2020 as the first program year. In subsequent years, the savings from each previous year are added together, however, measures with effective useful lives less than the total years being summed will be removed from the cumulative savings total. Therefore, this result may not simply be the sum of first year savings across program years.
Cumulative Energy Savings (MWh)	This field is a summation of savings across program years-to-date. In 2020, this will equal first year savings in 2020 as the first program year. In subsequent years, the savings from each previous year are added together, however, measures with effective useful lives less than the total years being summed will be removed from the cumulative savings total. Therefore, this result may not simply be the sum of first year savings across program years.

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Lifetime Energy Savings (MWh)	This field is calculated in the model by multiplying the per unit lifetime energy savings by the net-to-gross ratio and then dividing this net savings value by (1 - line loss factor). This is then multiplied by measure participation thus yielding total net savings at generator. For early retirement measures, lifetime savings may include the summation of Pre and Post RUL savings through the lifetime of the measure.
Total Avoided Cost Benefits (\$)	Total avoided costs for the measure for the given year of the plan.
TRC Costs (\$)	Total TRC costs for the given year of the plan. TRC costs include the measure incremental costs adjusted by NTGR and program administrator costs.
Total Net Resource Benefits (\$)	TRC benefits net of TRC costs for the given year of the plan.
TRC (Ratio)	The ratio of TRC benefits to TRC costs for the given year of the plan.
PAC Costs (\$)	Total program administrator costs for the given year of the plan.
PAC (Ratio)	The ratio of avoided cost benefits to program administrator costs for the given year of the plan.

1

2 b) Please refer to EfficiencyOne's response to NS Power IR-30².

² Ibid.

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Request IR-43:

Refer to EfficiencyOne Application, Appendix A Attachment 1 – Tech Tables, Technology Type: “BNI Other” and Measure Name: “Customer Energy Efficiency” (row 145) which is estimated to provide first-year energy savings of about 30 GWh in 2020,

a. Please explain what type of programs are included in the “Customer Energy Efficiency” category for 2020.

b. Please provide the breakdown of total estimated savings by end-use technology.

c. Please explain what type of programs were included in the “Customer Energy Efficiency” category in 2018 and 2019.

d. Please list all the differences if “Customer Energy Efficiency” measure proposed in the 2020-2022 DSM Plan is going to be different than what has been offered in 2018 and 2019.

Response IR-43:

a) The measure on row 145 of Appendix A, Attachment 1 – Tech Tables is the “Custom Energy Efficiency” measure. “Custom Energy Efficiency” is a measure within the Custom program component, which falls under the Custom Incentive program. Programs contain Program Components, which contain measures.

The Custom Program Component covers these general categories:

- Retrofits;
- New Construction;
- Building Optimization;
- Demand Reduction; and

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- 1 • Small New Construction Service.

2
3 Because the Custom program component is flexible and performance-based, it does not
4 have a fixed set of measures. It is modelled as a single general measure comprising all five
5 of these categories. This approach is consistent with the 2016-2018 Plan modelling
6 approach.

- 7
8 b) Since the modelling approach does not rely on the forecasting of individual projects, the
9 end-use shares for these measures cannot be determined

- 10
11 c) Please refer to part a) of this IR response.

12
13 Historical activity in the Custom program component is the same as was assumed in the
14 2020-2022 Plan, except for Demand Reduction and the Small New Construction Service,
15 which are new for the 2020-2022 Plan.

- 16
17 d) EfficiencyOne plans to continue offering the Custom program component as it is currently
18 structured and delivered in 2018 and 2019, with some enhancements for New Construction
19 and Demand Reduction. These enhancements are summarized in section 5.2.2 of Appendix
20 A of EfficiencyOne's application.

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Request IR-44:

**Regarding “custom incentives” program included in 2018 DSM Annual Progress Report
(Table 1, Page 2 of 86).**

- a. The Evaluation results show a net savings of 11.603 GWh net incremental energy savings in 2018 for “Custom Incentives” program of BNI category, which is less than half of the than the Mid-Course Adjustment first-year energy savings. Please provide an explanation as to the less-than-proposed net savings in the Custom Incentives Program of BNI category.**
- b. Please comment if the measures included in this program are similar to “Customer Energy Efficiency” measure included in 2020 – 2022 DSM Plan. (EfficiencyOne Application, Appendix A Attachment 1 – Tech Tables, Technology Type: “BNI Other”, row 145).**
- c. What enhancements is EfficiencyOne is making such that first-year energy savings target set for “Customer Energy Efficiency” measures will be met during 2020-2022 Plan considering that “custom” program only achieved 14.7 GWh as compared to the Mid-Course Adjusted first year savings target of 25.8 and Planned first-year savings target of 34.4 GWh?**

Response IR-44:

- a) In 2018, net savings in Custom Incentives were below target due several factors, which included the following:**
- Lower than expected number of participants;**
 - Lower than expected savings per participant;**

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- Discrepancies in energy models submitted to EfficiencyOne for New Construction projects, which overestimated energy savings;
- Project-specific timeline delays;
- No longer claiming milestone savings (as of 2018, EfficiencyOne will only claim savings from completed projects); and
- Postponing the claiming of energy savings from cannabis production facility projects as third-party research had to be conducted in order to establish an appropriate baseline.

b) Please refer to EfficiencyOne's response to SBA IR-43 parts a) and c).

c) In addition to the planned enhancements referenced in EfficiencyOne's response to SBA IR-43, EfficiencyOne is taking the following actions and enhancements to the Custom incentives program, which will contribute to higher savings levels in 2019 and subsequent years:

- Establishing a standing offer with a Nova Scotia-based expert in building energy modeling to improve the quality of energy models submitted for evaluation;
- Increased business development activities, including the recruitment of an additional Business Development Manager;
- Enhancing internal expertise through training and recruitment, particularly in the area of energy modelling;
- Improving project management to minimize project delays where possible; and
- Leveraging industrial market research and participants' feedback to continue to evolve offerings to meet participants' needs.

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Request IR-45:

**Regarding “Per Unit Program Administrative Cost (\$)” reported in Column L of
EfficiencyOne 2020-2022 DSM Resource Plan Filing, Appendix A Attachment 1,**

a. Please describe how measure-level program administrative cost is estimated?

**b. Please provide sourcing documents with formulae intact workpapers, if applicable,
relied on estimating per unit program administrative cost.**

Response IR-45:

a-b) In most cases, Navigant’s PROCess model allocates Program-level incremental costs on
the basis of first year energy savings. As such, EfficiencyOne used 2017 financial and
program evaluation data to inform Program-level administrative costs on a per-kWh basis.

The exceptions to this approach included:

- New Pilots and Program modifications with no historical basis were estimated
based on expected non-incentive cost profiles and expected energy savings from
these activities; and
- Demand reduction measures relied on average per measure Program
Administrative costs for modelling purposes, since there are no energy savings
associated with these measures (i.e., to translate per-kWh administrative costs into
per unit administrative costs).

This approach and the cost outputs are consistent with the methodology of the
NSUARB approved Cost Allocation Model which has been subject to an annual audit.

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Request IR-46:

**Regarding “Per Unit Direct Installation Cost (\$)” reported in Column L of EfficiencyOne
2020-2022 DSM Resource Plan Filing, Appendix A Attachment 1,**

a. Please describe how per unit direct installation cost is estimated?

**b. Please provide sourcing documents with formulae intact workpapers, if applicable,
relied on estimating per unit direct cost installation cost.**

Response IR-46:

EfficiencyOne notes that “Per Unit Direct Installation Cost (\$)”, is reported in column M, not
column L as referenced above.

a) Direct install costs are used in the Efficient Products Installation, Appliance Retirement,
and the First Nations Home Energy Efficiency Program components. Direct Install costs
are based on actual direct install costs where available and are estimated for new measures.
Please refer to part b) of this IR response for more details.

b) Described below are the direct install costs for the three program components that contain
direct install costs.

Efficient Products Installation

The direct install costs in the Efficient Products Installation program component were not
calculated. However, they were based on actual 2017 measure-level costs in delivery agent
contracts. There were only two deviations from these historical values:

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1 1. The Efficient Products Installation program component will have a new contract with
2 service providers in 2020. While the future contract costs are unknown, EfficiencyOne
3 applied a global increase of 2%; an average estimate approximating inflation.

4
5 2. Feedback from program delivery agents suggested that the cost of smart power
6 controllers is likely to increase due to trade tensions between the US and China.
7 EfficiencyOne included an estimated 30% increase in the cost of the smart power controller
8 measure over the current contract price.

9
10 Appliance Retirement

11 Appliance retirement direct install costs were based on actual direct install costs for the
12 program, adjusted for inflation in each year at a rate of 1.8% with an additional 5% increase
13 in the first year to account for some anticipated price impacts due to the aluminum and
14 steel tariffs being imposed by the United States. Inflation was applied in every year since
15 this increase is a component of the delivery agent contract.

16
17 EfficiencyOne notes that in preparing this IR response, an error was identified where
18 inflation was applied as if the current direct install costs occurred in 2017 instead of 2018,
19 i.e., costs are slightly higher than intended in each year. Please see attachment 1 of this IR
20 response (filed electronically) for an analysis of the direct install costs as filed, the
21 corrected direct install costs, and the amount of total error.

22
23 First Nations Home Energy Efficiency

24 The costs for refrigerator, freezer, and dehumidifiers used a slightly different cost estimate
25 than Appliance Retirement and did not escalate over time. Since refrigerator, freezer, and
26 dehumidifier replacement measures which are planned for the First Nations pilot are
27 identical to those offered through via the Appliance Retirement program component,
28 EfficiencyOne has included these measures in its assessment contained in Attachment 1 of
29 this IR response, filed electronically. The net impact of the revised direct install costs for

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1 refrigerator, freezer, and dehumidifier replacements in Appliance Retirement and First
2 Nations is a total of \$4k over the 2020-2022 period.

3
4 There are six remaining First Nations measures which do not have historical costs
5 associated with them: Clothes dryers, Clothes Washers, Drain Water Heat Recover, Heat
6 Pump Water Heaters, Programmable thermostats, and Whole home retrofit. As these
7 measures have not been delivered in this program before, these costs are based on program
8 manager estimates.

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Request IR-47:

**Regarding “Per Unit Program Administrative Cost (\$)” reported in Column M of
EfficiencyOne 2020-2022 DSM Resource Plan Filing, Appendix A Attachment 1,**

a. Please describe how measure-level program administrative cost is estimated?

**b. Please provide sourcing documents with formulae intact workpapers, if applicable,
relied on estimating per unit program administrative cost.**

Response IR-47:

a-b) Please refer to EfficiencyOne’s response to SBA IR-45 for information relating to “Per
Unit Program Administrative Cost (\$)” reported in Column L of EfficiencyOne 2020-2022
DSM Resource Plan Filing, Appendix A Attachment 1.

Please refer to EfficiencyOne’s response to SBA IR-46 for information relating to “Per
Unit Direct Installation Cost (\$)” reported in Column M of EfficiencyOne 2020-2022 DSM
Resource Plan Filing, Appendix A Attachment 1.

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Request IR-48:

**Regarding the measure-level incentive included in Column N of EfficiencyOne 2020-2022
DSM Resource Plan Filing, Appendix A Attachment 1,**

- a. Please describe how measure-level incentive is estimated?**
- b. Please provide sourcing documents with formulae intact workpapers, if applicable,
relied on estimating per unit incentive cost.**
- c. For a particular measure, are the incentive levels assumed to be same across different
years of 2020-2022 DSM Plan period? If yes, please comment on why this a reasonable
approach?**

Response IR-48:

- a) Please refer to EfficiencyOne's response to IG IR-24.
- b) Please refer to EfficiencyOne's response to IG IR-24.
- c) Please refer to EfficiencyOne's response to NS Power IR-31, Attachment 2¹. Columns X,
Y, and Z of the "Measure" sheet contain incentives by measure for each year of the plan.
- Incentives are assumed to be the same in each year of the plan unless there is a known or
anticipated future change. Such changes include those to delivery agent fees (please refer
to EfficiencyOne's response to SBA IR-46); anticipated future changes to product costs;
and diversification efforts. Where incentives differ from current levels, they are estimates

¹ M09096, 2020-2022 DSM Plan - E1 Responses to NS Power IR Requests 1-69, Exhibit E-3, March 29, 2019.

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1 informed by EfficiencyOne's program delivery experience. Like all incentives, they are
2 subject to change with market conditions, measure uptake, program evaluation, etc. More
3 information on the incentive setting process and its current status can be found in
4 EfficiencyOne's response to IG IR-21.

5
6 For measures which are still emerging or continue to observe reductions in price,
7 EfficiencyOne estimates reduction in incentives over time. For example, in the Business
8 Energy Rebates program component, the incentives on Pole/Arm-Mounted Area
9 Luminaires are reduced from \$160 to \$120 per unit in 2021. Low output (15k – 35k lumen)
10 Premium High Bay Luminaires incentives are reduced in 2021, and higher output (60k
11 lumen) Premium High Bay Luminaires incentives are reduced in 2022.

12
13 Conversely, a modest selection of measures in the Small Business Energy Solutions
14 program component are assumed to have increases in incentives in the second and third
15 years of the plan. These are non-lighting measures, and this increase reflects planned
16 diversification efforts. The total incremental increase in incentives for these measures is
17 approximately \$22k over the duration of the Plan.

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Request IR-49:

**Regarding “Per Unit Program Customer Cost (\$)” reported in Column O of EfficiencyOne
2020-2022 DSM Resource Plan Filing, Appendix A Attachment 1,**

- a. Please describe how measure-level per-unit customer cost is estimated?**
- b. Please provide sourcing documents with formulae intact workpapers, if applicable,
relied on estimating per unit customer cost.**
- c. For a particular measure, are the customer cost assumed to be same across different
years of 2020-2022 DSM Plan period? If yes, please comment on why this a reasonable
approach?**

Response IR-49:

- a) Measure-level per unit customer costs are calculated within Navigant’s PROCess model
by subtracting the measure-level incentives (Column K* Column J) from the Gross Per
Unit One-Time Per Unit Incremental Measure Cost (\$) (Column J).
- b) Measure-level per unit customer costs are calculated as in part a) of this response. Since
these calculations are intrinsic to the PROCess model itself, EfficiencyOne does not
possess formula-intact workpapers.
- c) No, some of these values change as result of changing measure incentives over the course
of the 2020-2022 DSM Resource Plan.