



Verification Review of Energy Efficiency Program Year 2021 Evaluation Results

Report for the Nova Scotia Utility and Review Board

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Verification Review: Program Year 2021

*Towards practical and contextually sound
measurement, analysis, and reporting....*

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I. Introduction

This report is a savings verification review for Calendar Year 2021 conducted by H. Gil Peach & Associates, LLC for the Nova Scotia Utility and Review Board. The report is focused on verification of electricity energy savings and demand reduction as measured, modeled, and estimated by Econoler, the Independent Evaluator for Efficiency Nova Scotia's Demand Side Management (DSM) energy savings and demand reduction programs.¹ Energy savings are estimated for first year and demand reduction is modeled.

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

Examination is based on careful review of the evaluation for each program component or initiative in the DSM portfolio, including review of each evaluation's explicit or implicit design, and consideration of evaluation methods and standards, and/or evaluation protocols used in each evaluation. We reviewed calculating methods. Normally, our examination would include selected "due diligence" site visits to check installation counts and quality of work, and discussion of program experience with customers. However, due to the continuing Covid emergency in 2021 there were no on-site savings verification visits.

We reference the evolving developments in practice improve the fit between the evaluations and evolving standards of practice.

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

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

¹ Nova Scotia Power, Inc. served as the DSM Administrator for calendar years 2008 and 2009. Responsibility transferred to Efficiency Nova Scotia Corporation in October 2010. Calendar year 2011 represented the first full program cycle with Efficiency Nova Scotia as the DSM Administrator. The year 2021 is the fourteenth program year from the 2008 start and the tenth year with full administration by Efficiency Nova Scotia. Generally, Efficiency Nova Scotia's programs are mature programs. Those that are relatively new continue mature elements from other (previous) programs.

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

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

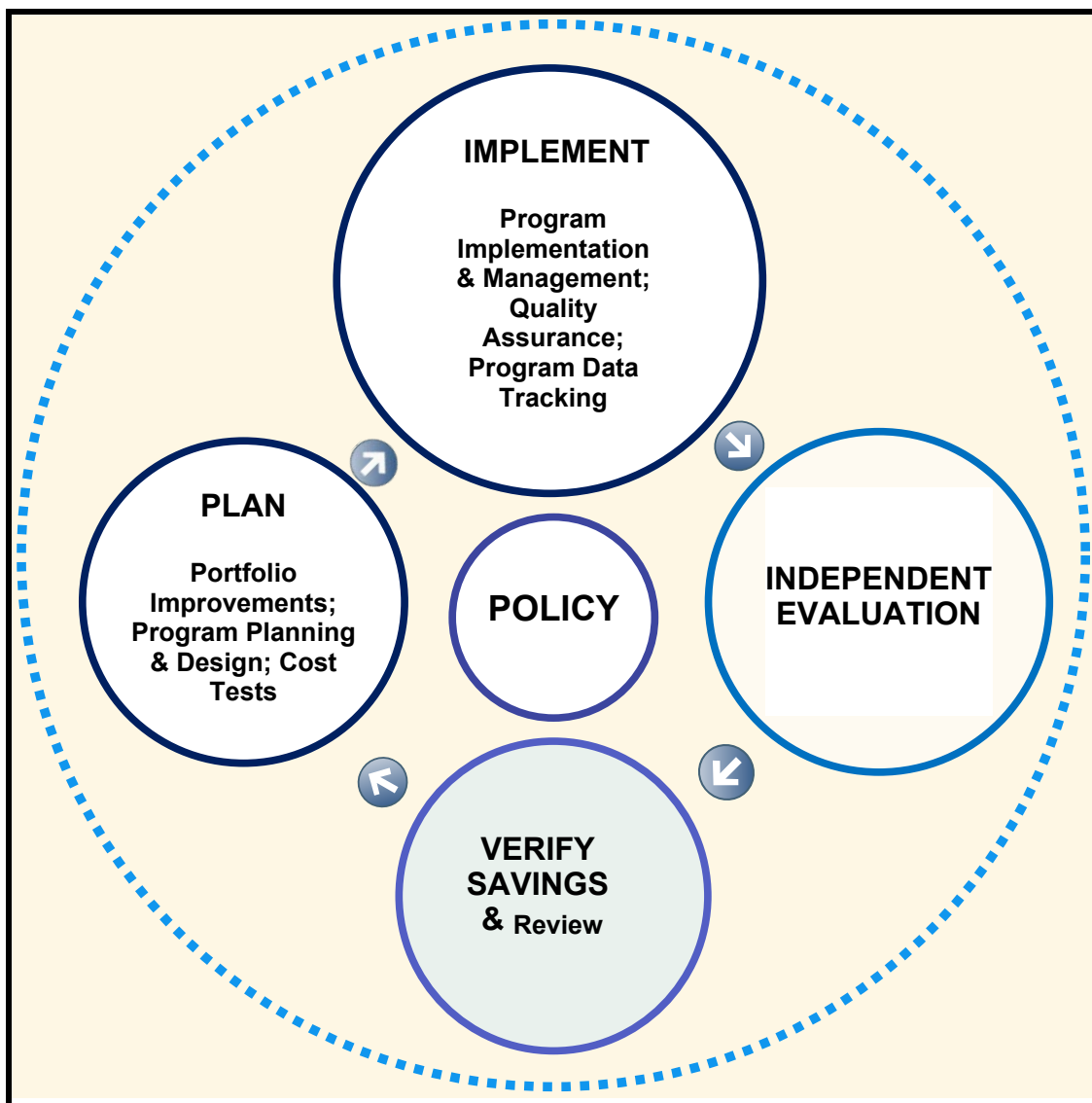


Figure 1: The Policy, Planning, Program Cycle.

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

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

In Figure 1, arrows show the clockwise direction of the primary flow of effort within a single Policy, Planning and Program cycle. Each step in the Demand-Side Management Cycle feeds information forward.

Policy - Policy informs all steps. As a regulated utility, Efficiency Nova Scotia follows regulatory determinations and guidance by the Nova Scotia Utility and Review Board. More generally, Efficiency Nova Scotia also operates in conformance with national and provincial legislation, accepted program practices, evaluation standards and protocols, principles of utility and business operation, accepted procedures for resource planning and acquisition and standards of accounting practice. At a more diffuse level – each of the professional disciplines engaged in work at Efficiency Nova Scotia brings its own standards and code of ethics which inform practice. As information and external factors change, the policy area continues to evolve.

Planning - The function of the Plan is to develop workable program plans and to provide energy savings projections, while incorporating new knowledge, much of which is moved forward from other steps. The Plan provides a high-level blueprint for Implementation in the form of a program portfolio and specific program plans.

Implementation - The Implementation step in each cycle feeds information forward to Planning through the development of practical knowledge gained by program managers and delivery agents. Program implementation and results are recorded in the data tracking system. Work in Implementation means being “on the frontline” encountering emergent realities that require being alert, recognizing patterns and identifying anomalies. In specific instances, this can require quick adaptation based on new information.

In this way, the programs are adapted from planning perspectives to field realities, moving programs forward through (usually incremental) changes to adapt to encountered situations. The focus of implementation is to implement the portfolio of programs as planned and to modify quickly in relation to the development of internal and contextual forces and limits that could not have been anticipated in the planning step.⁵ All of the steps in the DSM cycle provide support to Implementation.

Evaluation & Research - The Evaluator for Efficiency One programs is Econoler (<https://econoler.com/en/>), an international Canadian firm based in Quebec.

⁵ For an early article on this point, see Keating, Kenneth M., Ruth L. Love, Terry V. Oliver, H. Gil Peach & Cynthia B. Flynn, “The Hood River Project; Take a Walk on the Applied Side,” Pp. 112-118, *The Rural Sociologist*, Vol.5, No. 2, May 1985.

Econoler's evaluation team includes Equilibrium Engineering, Bouthillette Parizeau, Narrative Research, Richard Patterson of CDM Energy Solutions, and Energetix. Econoler served as team leader. Throughout this report, this team and Econoler are referred to as the Evaluator. Evaluation provides independent energy savings and demand reduction results plus, limited market evaluation, process evaluation, and supportive research. This year, research was focused on approach to market transformation, treatment of codes & standards, and approaches to event-based demand response.

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

III. Evaluation Frameworks Evolve

Efficiency Nova Scotia programs are almost entirely resource acquisition programs. This is the original framework for the energy efficiency (EE) and demand response (DR) classes of distributed energy resources (DERs). EE and DR programs are appropriately evaluated within a resource acquisition evaluation framework, which is the approach practiced for the evaluation of program components by Econoler.

However, evaluation frameworks continue to evolve. Beginning with work by BC Hydro in the late 1980's and by Sweden's NUTEK at about the same time, development of codes & standards programs and market transformation programs required evolution of evaluation practice to fairly evaluate these program innovations.⁶ Over the last several decades, as climate change became an important focus of government most jurisdictions, though legislation, put DERs and climate work programs on different policy tracks. Though legislative direction was received by public utility commissions and utilities for both areas, policy was not unified. In the last few years, particularly beginning in 2019, as experience with flooding, polar vortices, sustained drought conditions, water shortage, stressed crops, major wildfires, heat domes, and the concentrated rain effects of changes in patterns of atmospheric rivers have become increasingly common, a few jurisdictions

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

have enacted legislation that unifies and coordinates energy and climate policy.⁷ The program direction that emerges from these factors is legislation and regulatory policy to emphasize decarbonization as a program goal.

In addition, over the past 25 years, the program and evaluation framework advanced by the European Council for an Energy Efficient Economy (ECEEE) moves the central concept of energy efficiency to the central concept of energy sufficiency. This change in central concept of EE supports decarbonization and also emphasizes inclusion and social justice in DER work. Extension of evaluation metrics, methods and analytics is developing to accommodate this program evolution is continuing.

Looking ahead, another factor to take into account is the increasing likelihood of war. With increasing areas of our planet experiencing crop failure and collapse of civil order, have led to the climate related migrations of enormous numbers of people. Now, with the re-emergence of imperialist war by a nuclear power means the likelihood of world war is increasing. Preparation for war is quite different from preparation for climate problems. This change in external factors means that programs and program components should also be reviewed from both military and disaster planning perspectives as well as a climate perspective.⁸

As distributed energy resources move into a full system planning frameworks the impact of these factors also mean that development of microgrids becomes strategically important.⁹ These changes do not affect the current study, which uses a resourced acquisition framework. They are, however, factors in the program and evaluation environment which affect evolution of programs and evaluation.

IV. Evaluation Standards are Durable

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

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

⁸ For example, while climate factors lead logically to decarbonization and electrification, disaster management and military factors lead logically to proliferation of microgrids, encouragement of natural gas microgrids, both natural gas and electric heat pumps, build out of natural gas to cover electric system peaks, limiting electrification of the trucking industry, and support for continued development and availability of a variety of fuel forms.

⁹ EMERA's Tampa Electric, residential DC loop pilot in the US are an example (<https://blockenergy.com/about-emera-technologies/>); see also [Microgrid Pilot Program \(tampaelectric.com\)](https://tampaelectric.com)

(1) **Independent Evaluator** - The primary standard is that evaluation must be conducted by an independent evaluator to guarantee the integrity of reported savings and prevent conflict of interest. There has always been a separation of function between program implementers and program evaluators and a concern to place a wall between them.¹⁰ An aspect of this standard is that, except for specially commissioned projects with regulatory approval, program work and evaluation work are required to be conducted by different teams. The Econoler evaluation is conducted according to the standard for independent evaluation.

(2) **Transparency** - Evaluation plans, reports and calculation methods are made public and are open to inspection by any party. Third party review of evaluations helps ensure objectivity and credibility, and, when necessary, revision of evaluation results. The 2021 evaluation process follows this standard.

(3) **Evaluation Protocols** - Econoler has demonstrated thorough knowledge of the Uniform Methods Project evaluation guides and other protocols that form the most current sets of generally accepted guidelines for program evaluation. Current guidelines, such as the Uniform Methods Project supersede older guidelines issued by the California Public Utilities Commission, the Oak Ridge National Laboratory, and the Electric Power Research Institute. Econoler is using the current general evaluation guidelines appropriately.

V. Summary of Econoler Evaluated Savings Results

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

¹⁰ Exceptions can be made in emergencies and also in ongoing special “new project development,” “hothouse” or “skunk works” projects. A military example is the informal development of the Sidewinder missile. See Westrum, Ron, *Sidewinder, Creative Missile Development at China Lake*. Annapolis, Maryland: Naval Institute Press, 1999. Also, sometimes a major international consulting firm will provide ongoing program and evaluation support to a utility if an acceptable “firewall” is created between the program team and the evaluation team within the consulting firm.

A. Evaluated Net Demand Reduction at the Generator

Efficiency Nova Scotia operates six programs composed of a total of thirteen program components.¹¹ In Table 1, evaluated values for net peak demand reduction at generator are shown for the programs and program components. Econoler reports a portfolio net peak demand reduction of 27.484 MW at the generator.

2021 DSM Portfolio Net Evaluated Peak Demand Reduction (at Generator)			
Residential		Demand Reduction (MW)	
Rebates	Appliance Retirement	0.357	1.986
	Instant Savings	1.629	
Existing	Home Energy Assessment	1.495	9.377
	Green Heat	6.451	
	Efficient Product Installation	1.098	
	Mi'kmaw Home Energy Efficiency Project	0.147	
	Affordable Multifamily Housing	0.186	
New	New Home Construction	2.285	2.285
Residential Subtotal		13.648	
Business, Non-Profit, Institutional		Demand Reduction (MW)	
Rebates	Business Energy Rebates	5.401	5.401
Custom Incentives	Custom	6.105	6.390
	Energy Management Information Systems	0.003	
	Strategic Energy Management (SEM)	0.282	
Direct Installation	Small Business Energy Solutions	2.045	2.045
BNI Subtotal		13.836	
Overall DSM Portfolio Total		27.484	
Source: Data from Table 7: Comparison of Evaluated and Tracked Peak Demand Savings at the Generator, 2016-2020, P. 20 in 2021 DSM Programs Evaluation Executive Summary, Efficiency One, Final Report, March 17, 2022.			

Table 1: Net Demand Reduction at Generator.

¹¹ Although Efficiency Nova Scotia supports Codes and Standards, Codes and Standards are seen as coming primarily from the federal or provincial levels.

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

The top three portfolio components (Business Energy Rebates, Green Heat and Custom) yield 17.957 MW of demand reduction at the generator¹², or about 65% of the first-year net demand reduction for the program portfolio¹³. The bottom three program components are Energy Management Information Systems, Mi'kmaw Home Energy Project and Affordable Multifamily Housing which together contribute 0.336 MW of demand reduction¹⁴ or just over 1% of first-year net demand reduction¹⁵.

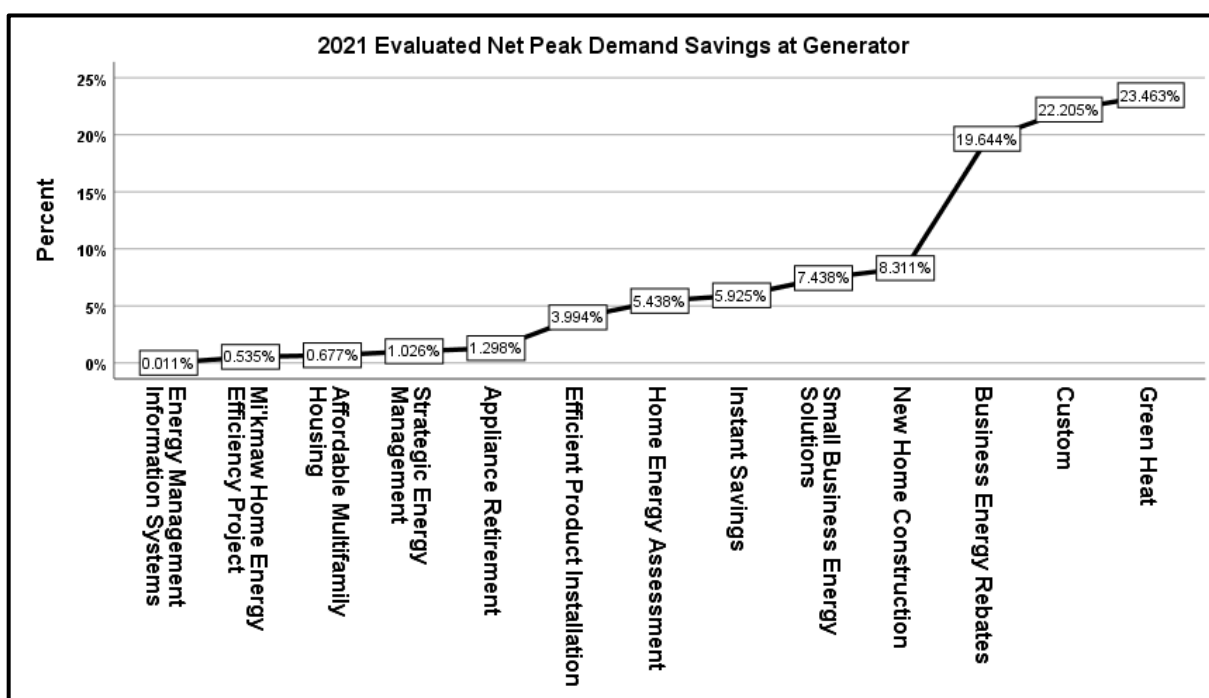


Figure 2: Rank Ordered Percent Net Demand Reduction at Generator.

¹² BER (5.401 MW) + GH (6.451 MW) + Custom (6.105 MW) = 17.957 MW

¹³ BER (19.644%) + GH (22.205%) + Custom (23.463%) = 65.312%

¹⁴ EMIS (0.336 MW + MHEEP (0.147 MW) + AMH (0.186 MW) = 0.336 MW

¹⁵ EMIS (0.011%) + MHEEP (0.535%) + AMH (0.677%) = 1.223%

B. Evaluated Net First-Year Energy Savings at the Generator

Evaluated net energy savings (GWh) at generator are shown in Table 2 for the portfolio of programs and program components. Econoler reports a portfolio net energy savings of 109.418 GWh at the generator.

Table 2: First-Year Net Energy Savings at Generator.

2021 Net Evaluated Energy Savings			
(at Generator)			
Program	Residential	Annual Net Savings (GWh)	
Residenital Efficient Products Rebates	Appliance Retirement	2.474	16.788
	Instant Savings	14.314	
Existing Residential	Home Energy Assessment	3.481	18.806
	Green Heat	6.795	
	Efficient Product Installation	7.812	
	Mi'kmaw Home Energy Efficiency Project	0.316	
	Affordable Multifamily Housing	0.402	
New Residential	New Home Construction	5.683	5.683
Residential Subtotal		41.277	
Program	Business, Non-Profit, Institutional	Annual Net Savings (GWh)	
Rebates	Business Energy Rebates	33.491	33.491
Custom Incentives	Custom	23.293	25.165
	Energy Management Information Systems	0.027	
	Strategic Energy Management (SEM)	1.845	
Direct Installation	Small Business Energy Solutions	9.486	9.486
BNI Subtotal		68.142	
Overall DSM Portfolio Total		109.418	
Source: Data from Table 6: Comparison of 2021 Evaluated and Tracked Energy Savings at the Generator, P. 19 in 2021 <i>DSM Program Evaluation</i> Executive Summary, Efficiency One, March 17, 2022.			

In Figure 3, net first year energy savings (GWh) by DSM program component is shown in rank order, from lowest to highest. On a first-year net energy savings basis, the top three program components are Business Energy Rebates, Custom and Instant Savings. These top three program components yield about seventy-one net GWh¹⁶ or about 65% of the 109.418 GWh net portfolio energy savings at the generator.¹⁷ The bottom four programs are Energy Management Information Systems, Mi'kmaw Home Energy Efficiency Project, Affordable Multifamily Housing and Strategic Energy Management, which together contribute about 2.6 net GWh, or about 2.4% of net portfolio energy savings at the generator.

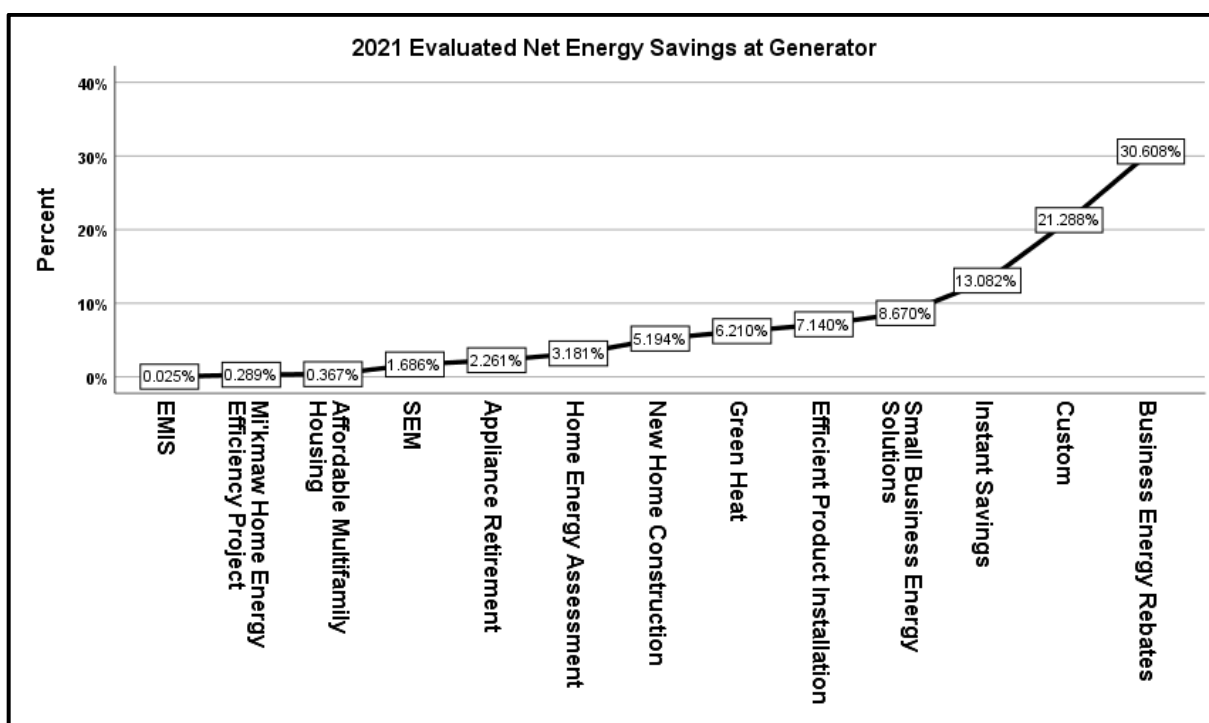


Figure 3: Program Rank Order for Net First-Year Energy Savings at Generator.

Net demand reduction at the generator (MW) is split essentially 50/50 with 49.7% (13.648 MW) Residential and 50.3% (13.835 MW) from BNI (Figure 4).

In Figure 4, net energy savings at the generator is split at essentially 60/40 with about 62.3% (68.142 GWh) from BNI and about 37.7% from the Residential sector (41.277 GWh).

¹⁶ BER (33.491 GWh) + Custom (23.293 GWh) + IS (14.314 GWh) = 71.098 GWh

¹⁷ BER (30.608%) + Custom (21.288%) + IS (13.082%) = 64.978%

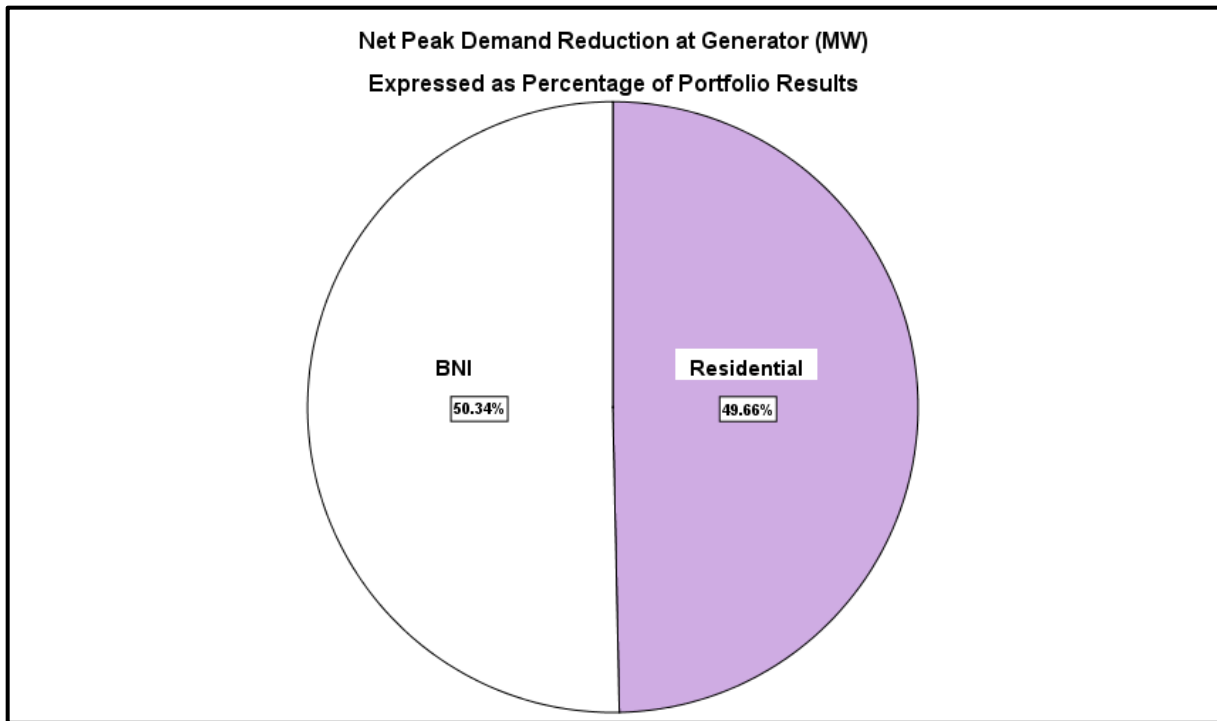


Figure 4: Percent Contribution to Net Demand Reduction at Generator by Sector.

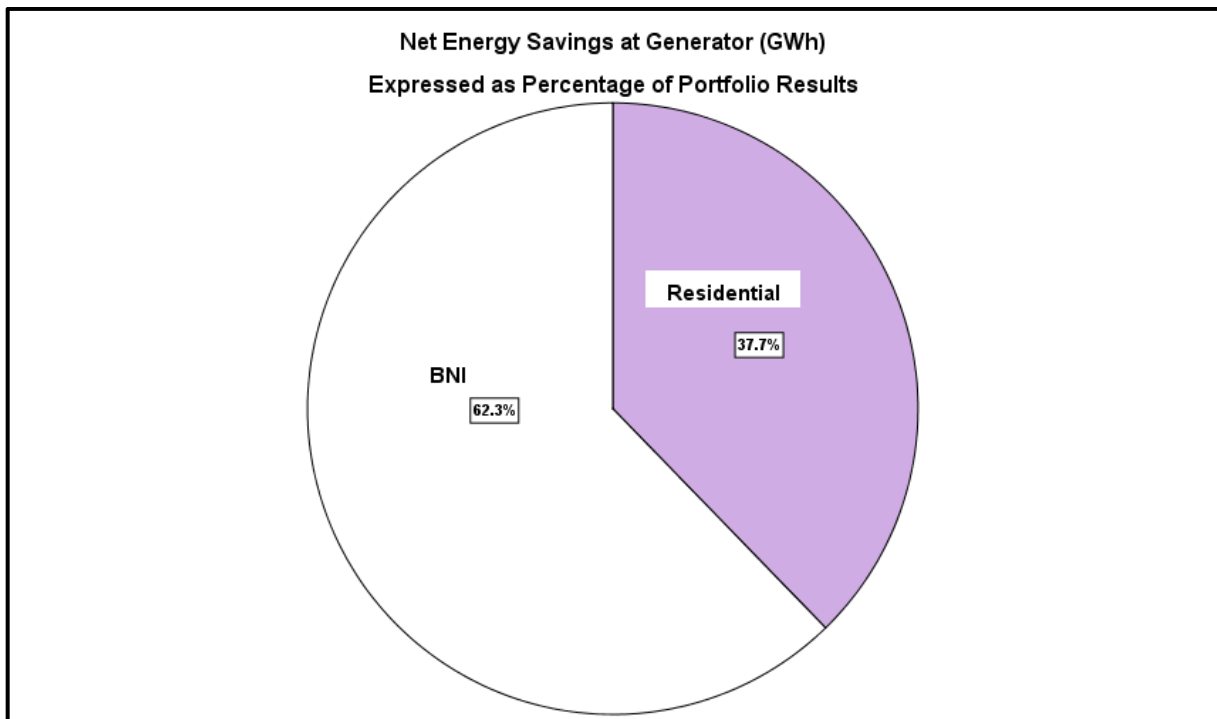


Figure 5: Percentage of Net Energy Savings at Generator by Sector.

C. Evaluated Lifetime Net Energy Savings at the Generator

Lifetime net energy savings is an important metric: “Understanding how long measures, programs and portfolios last (lifetimes) – and the degree to which savings change over time (persistence) – is critical to estimating the benefits of efficiency, calculating cost effectiveness and prioritizing long-term vs. short-term efficiency actions.”¹⁸ Lifetime net energy savings at generator is shown in Table 3. The Lifetime savings split is roughly 60/40 with 62.7 from BNI and 37.3% from Residential (Figure 6). This is essentially the same split as for first-year energy savings (Figure 5).

Table 3: Lifetime Multiple (%) and Lifetime Additional Net Energy Savings (GWh).

Program	Net		Lifetime Multiple	Lifetime Additional	Weighted Average EUL (Years)
	Annual	Lifetime			
	(GWh)	(GWh)	(%)	(GWh)	
	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5
Residential					
Appliance Retirement	2.474	9.925	401%	7	4
Instant Savings	14.314	121.022	845%	107	8
Home Energy Assessment	3.481	72.399	2080%	69	21
Green Heat	6.795	122.306	1800%	116	18
Efficient Product Installation	7.812	65.165	834%	57	8
Mi'kmaw Home Energy Efficiency Project	0.316	6.633	2099%	6	21
Affordable Multifamily Housing	0.402	7.117	1770%	7	18
New Home Construction	5.683	173.548	3054%	168	30
Residential Subtotal	41.277	578.115	1401%	537	14
Business, Non-Profit & Industrial					
Business Energy Rebates	33.491	488.237	1458%	455	15
Custom	23.293	337.282	1448%	314	14
Energy Management Information Systems	0.027	0.053	196%	0	2
Strategic Energy Management	1.845	10.402	564%	9	6
Small Business Energy Solutions	9.486	134.696	1420%	125	14
BNI Subtotal	68.142	970.670	1424%	903	14
Total	150.696	1548.785	1028%	1976	14
Numbers in column 3 are rounded to nearest whole percent. Numbers in columns 4 & 5 are rounded to nearest whole number.					
Source: 2021 Evaluated Net Lifetime Energy Savings at the Generator, Table 9, P. 28 in <i>2021 DSM Programs Evaluation Executive Summary</i> , Efficiency One, March 17, 2022.					

¹⁸ Hoffman, Ian M., Steven R. Schiller, Annika Todd, Megan A. Billingsley, Charles A. Goldman, Lisa C. Schwartz, "Energy Savings Lifetimes and Persistence: Practices, Issues and Data." Berkeley, California: Lawrence Berkeley National Laboratory, Electricity Markets & Policy Group Technical (hereinafter "LBL Technical Brief"), May 2015, P. 1. (<https://emp.lbl.gov/sites/all/files/savings-lifetime-persistence-brief.pdf>)

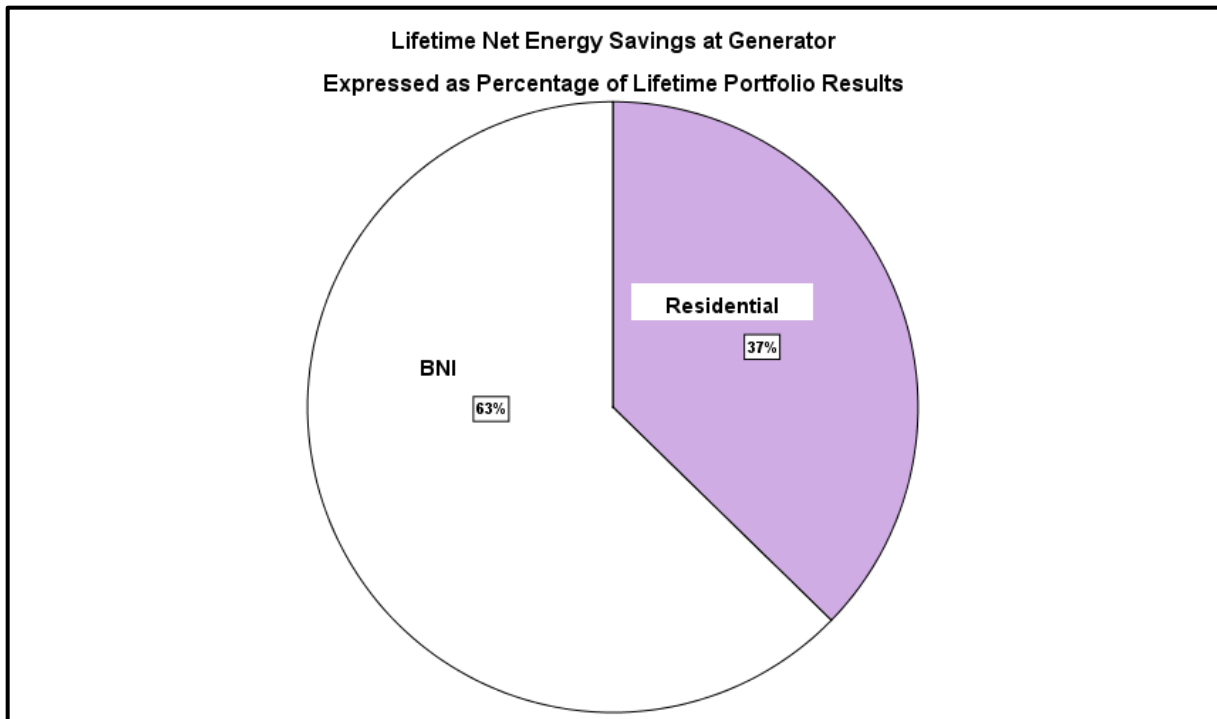


Figure 6: Percentage of Lifetime Net Energy Savings at Generator by Sector.

Figure 7 shows the curves for first year and lifetime net energy savings at the generator, with program components rank ordered from low to high GWh.

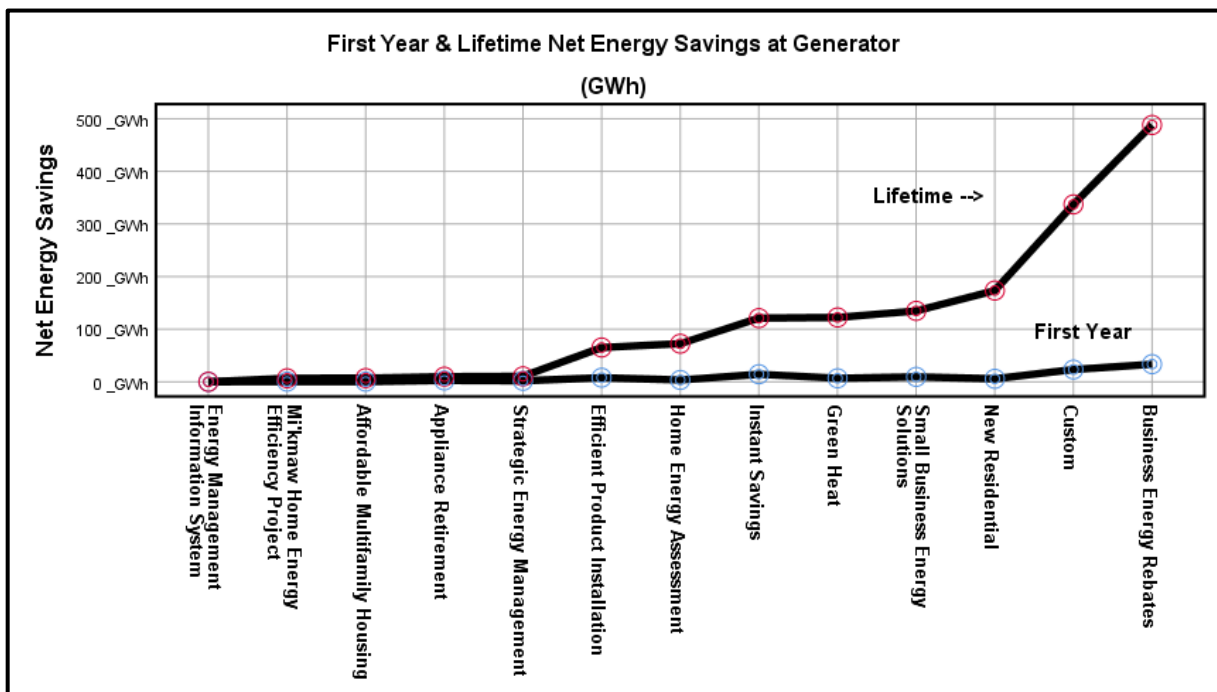


Figure 7: Rank Order Comparison of First Year vs. Lifetime Net Energy Savings.

The top three lifetime net energy program components are Business Energy Rebates, Custom and New Home Construction. These contributed 999 net lifetime

GWh¹⁹ to the portfolio total of about 1548.785 lifetime GWh, or about 64.5 of the total. The bottom five programs were Energy Management Information Systems, Mi'kmaw Home Energy Efficiency Project, Affordable Multifamily Housing, Appliance Retirement and Strategic Energy Management. These contributed about thirty-four lifetime GWh,²⁰ or about 2.2% of the total.

VI. Evaluation Effort for 2021 Programs

Thirteen impact evaluations (seven comprehensive and six condensed), one process evaluation, and three market evaluations were planned for 2021 (Table 4).²¹

Table 4: Planned Evaluations for 2021 Programs.

DSM Program	Program Components	Impact	Process	Market
Residential				
Residential Efficient Products Rebates	Appliance Retirement (ARet)	Condensed		
	Instant Savings	Comprehensive		X
Existing Residential	Efficient Product Installation (EPI)	Comprehensive		
	Mi'kmaw Home Energy Efficiency Project (MHEEP)	Condensed		
	Green Heat	Condensed		X
	Home Energy Assessment (HEA)	Condensed		
	Affordable Multifamily Housing (AMH)	Comprehensive		
New Residential	New Home Construction (NHC)	Condensed		
BNI				
Efficient Product Rebates	Business Energy Rebates (BER)	Comprehensive		X
Custom Incentives	Custom	Comprehensive	X - NC	
	Energy Management Information Systems (EMIS)	Comprehensive		
	Strategic Energy Management (SEM)	Comprehensive		
Direct Installation	Small Business Energy Solutions (SBES)	Condensed		
Selected market evaluation themes were also added to impact evaluation activities for the following program components: Efficient Product Installation, Affordable Multihousing, Energy Management Information Systems, Small Business Energy Solutions, Strategic Energy Management, and Residential Solar Photovoltaic. The SBES evaluation included the SBES Direct Install pilot, while the Custom evaluation included the OEM Operational Demand Savings pilot.				

¹⁹ BER (488.236 GWh) + Custom (37.282 GWh) + NHC (173.548 GWh) = 999.067 GWh

²⁰ EMIS (0.053 GWh) + MHEEP (6.633 GWh) + AMH (7.117 GWh) + ARET (9.925 GWh) + SEM (10.402 GWh) = 34.13 GWh

²¹ This is a reproduction of Table 1, 2021, Portfolio Evaluation Plan in *Evaluation of DSM Programs, Executive Summary, Efficiency One, Final Report*, March 17, 2022, P. 4.

VII. Savings Verification Approach

The savings verification review was conducted as follows:

- We focus on the “installed” annual energy savings and demand reductions. These are the annualized value of savings and demand reductions from the measures installed, regardless of what day of the year they were put into service. They do not represent the “realized” savings for the calendar year but are the savings that should be realized when each of the projects operates for a full year.
- Generally, we did not check the evaluator’s mathematical calculations, but did carefully check the evaluator’s presentation of method for each program analysis. We reviewed the interaction, free-ridership, spillover, and net-to-gross approaches.
- Due to the Covid-19 situation it was not possible to do site visit inspections for 2020. However, to compensate to the degree possible, we did conduct customer surveys for three program components and telephone interviews with Efficiency One staff for another.

VIII. General Findings

- Each program impact evaluation is comprehensive: The structure and format of each impact evaluation is consistent and since these evaluations are iterated from year to year, they maintain a high standard of practice. The evaluations are useful.
- Each evaluation has an Executive Summary. Each provides key definitions of terms and acronyms up-front. Each has a good table of contents. The evaluations have a methodological model diagram, followed by specification and discussion of methods employed. Citations to other studies are relevant. For each evaluation for which it applies there is an appendix containing clear delineation of calculations, methods, and surveys.
- Econoler has appropriately developed savings-weighted measure life analysis for net energy savings at the generator for all program

components reporting energy savings.

- Carbon emissions offsets are appropriately developed.
- The evaluations provide transparency.
- Econoler has demonstrated command of the currently accepted evaluation guidelines, while taking independent responsibility for independent selection of evaluation designs, choice of analytic methods and calculations.
- Econoler has conducted limited process evaluation and market evaluation.

IX. General Recommendations

1. **Savings Verification Recommendation No. 1:** The Savings Verification study recommends acceptance of the 2021 evaluation results for energy savings and for demand-reduction for all programs.

SVR-1: The Savings Verification study recommends acceptance of the 2021 evaluation results for energy savings and for demand-reduction for all programs.

2. **Savings Verification Recommendation No. 2:** Expected Useful Life for BNI Energy Management Information Systems seems low. We recommend that Efficiency Nova Scotia develop a review to check if EUL for this program could be increased.

SVR-2: We recommend that Efficiency Nova Scotia look at the history of EMIS projects for Efficiency Nova Scotia and assess whether focusing on optimization via supervisory control coupled with particular optimized devices (measures) could increase the EUL for this program component.

3. **Savings Verification Recommendation No. 3:** We recommend that Efficiency Nova Scotia look at this program component to see if EUL could be increased.

The EUL for this program component seems low. We recommend that Efficiency Nova Scotia consider if there may be ways to increase EUL by emphasizing certain measures and/or by adding an EMIS controlled optimization component.

4. **Savings Verification Recommendation No. 4:** To facilitate rapid and effective adaption of program offerings to the climate crisis, EfficiencyOne should conduct a study that integrates the net demand reduction and net peak demand reduction goals with the large-scale, systemic transformations required by the recent IPCC report and Nova Scotia Canada carbon emission reduction targets. The purpose of this study should be to measure efficacy of current practices, with specific focus to how they measure and integrate with proposed targets, and then suggest innovative, out-of-the-box thinking that may direct future program offerings, measures, and practices.

SVR-4: Climate and energy policy is not well integrated, but some jurisdictions, for example Washington state, Oregon, Colorado, and Minnesota are fusing these policy areas for climate adaptation and DERs. Conduct a study of what this kind of integration would look like for Nova Scotia to see how climate imperatives might better shape ongoing DER practice.

5. **Savings Verification Recommendation No. 5:** Several jurisdictions, for example Minnesota, have completed reviews of benefit cost testing using the new edition of the National Standard Practice Manual which emphasizes a full integrated planning approach for Distributed Energy Resources. Efficiency Nova Scotia should review the new manual and determine its possible usefulness going forward.

SVR-5: Set up a study group to review the new Standard Practice Manual with a view towards expanding planning and practice for Distributed Energy Resources.

6. Savings Verification Recommendation No. 6: Even without formal integration of climate policy and energy policy, it is worthwhile to set up a seminar series on climate adaptation and Distributed Energy Resources. Efficiency Nova Scotia should consider a set of seminars bringing climate expertise and ENS expertise together.

SVR-6: Set up a series of seminars on how climate adaptation and energy work fit best together. For example, the EMERA DC residential loop pilot in Florida would be a possible topic, as would presentation from jurisdictions that have moved recently to integrate climate policy and energy policy. Transportation electrification and decarbonization, as well as preparation for receiving and housing climate migrants could be additional topics.

X. Individual Program Review

There are thirteen program components. For Savings Verification, we focus on impact evaluation. Evaluations for program components are reviewed following the order of Table 5

Table 5: List of Program Component Evaluations.

Program Components (PY 2021)	
Residential	
1	Appliance Retirement Program (ARet)
2	Instant Savings
3	Efficient Product Installation (EPI)
4	Mi'kmaw Home Energy Efficiency Project
5	Green Heat
6	Home Energy Assessment (HEA)
7	Affordable Multifamily Housing (AMH)
8	New Home Construction (NHC)
Business, Non-Profit & Industrial	
9	BNI Energy Rebates (BER)
10	BNI Custom
11	BNI Energy Management Information Systems (EMIS)
12	BNI Strategic Energy Management (SEM)
13	BNI Small Business Energy Solutions (SBES)

1. Appliance Retirement Program

The Appliance Retirement program provides a small incentive to pick-up appliances. It provides environmentally sound disposal and recycling of components of household refrigerators, freezers, room air conditioners and small refrigerators or freezers. Appliances are picked-up, carefully examined, and are recycled by ARCA

Canada Inc., which is the delivery agent for the program. Eligible appliances must be in working condition and must be ten years of age, or older. Participants must own the appliances to be retired. The program also educates customers about the relatively high energy use of older appliances.

The Appliance Retirement program does not replace appliances. However, two other programs are rolled up within reporting for the Appliance Retirement Program. HomeWarming, a low-income program which is partially supported by the Province, replaces existing appliances with energy efficient appliances. Also, appliances retired and replaced in the Mi'kmaw Home Energy Efficiency program are accounted in the Appliance Retirement program. Within HomeWarming and the Mi'kmaw Home Energy Efficiency program, inefficient dehumidifiers, refrigerators, freezers, and clothes dryers may be replaced.

A total of 5,859 appliances were retired. The energy savings target (2.41 GWh) for Appliance Retirement was exceeded by the program achievement of 2.474 GWh. The demand reduction due to the program (0.357 MW) was smaller than planned (0.414 MW). Program participation increased.²²

The 2021 evaluation consists solely of a condensed impact evaluation. There is no market or process evaluation. The impact evaluation approach includes tracking sheet audit, update of measure assessment, calculations, use of 2018 (N=200) participant survey results, and GHG emission reduction calculations. Evaluation results include free-ridership, secondary market impacts, and internal spillover. Electric interactive effects were included. The evaluation method is consistent with Uniform Methods Project Refrigerator Recycling evaluation protocol.²³

This is a mature program. The evaluation is well designed, captures essential detail in all of its areas, and exemplifies the best current evaluation methods for this program type.

²² Since we were not able to do any on-site work due to Covid, we did a survey of participants. There were no systematic problems with this program component.

²³ Keeling, J.; Bruchs, D. (September 2017). Chapter 7: Refrigerator Recycling Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-68563 (<http://www.nrel.gov/docs/fy17osti/68563.pdf>). This version supersedes the 2013 version of the protocol.

2. Instant Savings

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

For 2021 there was a comprehensive impact evaluation and a market evaluation, including interviews with retailers, and a participant online survey. There is a substantial section on market evolution. Evaluation included unitary savings values and update of effective useful life (EUL) of measures. Interactive effects, free-ridership, and spillover were taken into account. Realization rates were calculated. Lighting evaluation follows the Uniform Methods Project protocol.²⁴

Although free ridership in some product areas (Type A LEDs) was high, net electrical energy savings (14.314 GWh) exceeded target (10.6 GWh). Peak demand savings (1.629 MWh) exceeded the target of 1.2 MW). Econoler found that “efforts to diversify the program component showed strong gains in 2021, with non-lighting products providing the majority of gross savings.” Though free ridership increased significantly, spillover also increased significantly. Econoler found that non-Type A lamps and fixtures are in a sustained growth phase.

In this evaluation, the included decisions on analytic approach, methods and quantitative values are fully within the scope of an independent evaluator. The analytic detail and coverage of the evaluation of this program is complete. This is in all respects an excellent evaluation that combines resource acquisition with market transformation analysis.

3. Home Energy Assessment

Home Energy Assessment (HEA) provides financial incentives in the form of rebates or zero-interest financing to homeowners to reduce consumption of energy. HEA is

²⁴ Dimetrosky, S.; Parkinson, K.; Lieb, N. (2017). Chapter 6: Residential Lighting Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/ SR-7A40-68562. (<http://www.nrel.gov/docs/fy17osti/68562.pdf>). This version supersedes the 2013 and 2015 versions of the protocol.

focused on shell insulation measures, plus better electric space-heating systems or certain “green” substitutes or additions (wood or pellet stoves or heat pumps) and water-heating systems (solar domestic water heaters and heat pump water heaters). HEA may also include mechanical ventilation systems. The HEA audit is used to optimize a package of measures to reduce the need for grid-supplied electricity for space and/or water-heating. To measure performance, it incorporates “test-in/test-out” (“D” and “E”) residential audits which include blower door testing. Delivery agent energy advisors conduct these assessments.²⁵ Based on the results of the “E” assessment, a final EnerGuide rating is developed. Rebates are provided by type of measure installed.

For 2021, a condensed impact evaluation was conducted. Unitary savings, spillover and free-ridership, effective useful life and overestimate ratio values were assessed and adjusted where necessary. Free ridership and spillover were assessed in 2020 and the 2020 value was used for 2021. Effective useful life was established for HEA in 2019 and was used in 2021.

The 2015 and 2018 billing analyses was used to determine the overestimation ratio (OR), which was used in space heating savings calculations. This is a correction factor that adjusts Hot 2000 simulations to actual billing data. “Unconverted D Assessment Spillover” (households that started in the program with the “D” audit, made improvements, but did not continue for the “test-out” “E” Audit) were included. Results for the Green Heat and Energy Products Installation programs were checked to insure no double counting of measures from possible program overlaps.

There were 961 participants. Energy and demand savings were short of targets, and savings per home continued to decrease. The decrease in savings per home is related to the inclusion of non-electrically heated homes.²⁶

Econoler found that the HEA tracking sheet has become more prone to calculation errors and other problems. Econoler’s recommendation is that the tracking sheet be updated and simplified. Econoler also reports progress and status on six recommendations from prior HEA evaluations from 2018-2020, and notes that a comprehensive evaluation of HEA will be completed for program year 2022. The comprehensive evaluation will permit updating overestimation ratios.

Work on this evaluation is notably solid, with careful progression over several years. The method, decisions and calculations performed by the evaluator are appropriate

²⁵ Beginning July 10, 2018, HEA has received funding for non-electrically heated households from the federal government Low Carbon Economy Fund (LCEF) via the government of Nova Scotia. Savings associated with measures that displace non-electrical energy consumption are reported separately to the Province of Nova Scotia.

²⁶ Since site visits could not be conducted due to Covid, we conducted a survey of participants. There were no systematic problems for this program component.

to this program type and within the scope of an experienced independent evaluator.

4. Green Heat

The Green Heat Program targets replacement and supplementation of heating systems by installation of equipment that uses fuel derived from renewable resources. The new equipment may either fully replace or supplement existing heating equipment. Incentives are available for central heating systems, as well as to supplement electric heat with an area heater. The following categories of heating system are rebated:

- Biomass: Wood stove, Pellet stove, Wood furnace or boiler
- Solar thermal: DHW solar system, Solar-air-space-heating system
- Heat Pumps: Air-source heat pump, Ground-source heat pump, Mini-split heat pump, Heat pump water heater

Since July 2018, non-electrically heated homes have been eligible for Mini-split heat pump (MSHP) incentives under the federal government Low Carbon Economy Fund (LCEF) through the Province of Nova Scotia. Nova Scotia Power offers on-bill financing for customers who purchase a heat pump, including MSHPs.

In December 2019, the Klondike pilot²⁷, implemented demand reduction measures, consisting of 1) electric thermal storage units, 2) three-element water heaters replacing electric hot water systems, and 3) DHW heater timers. The Klondike pilot includes Green Heat's increased financial incentives and introduces electric thermal storage, three-element water heaters and DHW heater timers as demand reduction measures province wide.

Econoler reported that Green Heat 2021 participation levels increased 8% over 2020 levels despite the COVID-19 pandemic and noted that of the 3,654 measures installed the most installed were MSHPs, totaling 3,035 units.

Econoler states that Green Heat's gross energy savings (11.218 GWh) of which MSHPs represent 76%, and peak demand saving (10.370 MW) were the highest to date in 2021 due to the high number of installed measures.

Econoler conducted a condensed impact evaluation and a market evaluation, but no process evaluation. Evaluation objectives were to:

²⁷ The Klondike pilot was launched in 2020 to provide residences and businesses serviced by the Klondike electrical substation enhanced energy efficiency incentives, awareness and new measures projected to generate gross peak demand savings of 0.003 MW.

- collect participant perspectives information
- calculate first year and lifetime energy savings peak demand savings and avoided GHG emissions
- analyze the mini-split heat pumps market evolution

To determine the gross and net electrical energy and peak demand savings, avoided annual GHG emissions and effective useful life (EUL) values and associated lifetime energy savings the condensed impact evaluation included: audit of tracking sheet, review of installation rates, participant survey, and unitary energy and peak demand savings values. Installation rates are assumed 100% due to the high cost of the measures. Also the chance of the measure being uninstalled is highly unlikely. There was also a participant survey to update the free ridership levels.

Econoler determined that Green Heat:

- exceeded targets of for net electrical energy savings and net peak demand savings
- produced net electrical energy savings of 6.795 GWh and 6.451 MW of net peak demand savings in 2021
- showed high participant satisfaction with an overall score of 9.0 on a 10.0-point scale
- decreased free-ridership levels decreased for MSHPs
- MSHP market is in a continuous growth stage
- evaluated net energy and peak demand savings increases were due largely to the decrease in free ridership, which resulted in a high overall NTGR in 2021

The evaluation of Green Energy is appropriate to this program type and within the scope of an experienced evaluator.

5. Residential Efficient Product Installation

A comprehensive impact evaluation was conducted in 2021 for the Residential Efficient Product Installation (EPI) program which provides, free of charge, direct installation of energy-efficient products to both homeowners and renters. The service is provided through contractors.

EPI 2021 eligible products for installation for electrical and non-electrical savings were:

- Light Emitting Diode (LED) lamps (A-type, reflectors, and chandeliers)
- LED nightlights
- Faucet aerators
- Low-flow showerheads

- Thermostatic shower valves
- Pipe insulation
- Hot water tank wraps
- Smart thermostats (for non-electrically heated homes)
- Retractable clotheslines
- Air sealing kits - foam gaskets
- Air sealing kits - door sweeps
- Air sealing kits - window air sealing
- Air sealing kits - door weather stripping

The Evaluator reported increased installation participation levels in 2021 totaling 10,028 participants representing a 15% increase compared to 2020 levels. Although EPI installations increased, the total number of efficient products installed, 155,935 represented a decrease in the number of products per household to 15.5 products compared to 17.5 products installed per household in 2020.

From April 28, 2021, to June 1, 2021, no installations were completed due to government mandates regarding the COVID-19 pandemic.

Both gross energy savings and peak demand savings in 2021 were slightly above EPI savings reported in 2020. However, savings were again less than in 2017. Gross energy savings totaled 8.174 GWh in 2021 compared to 8.120 GWh in 2020 and gross peak demand savings totaled 1.143 MW in 2021 compared to 1.10 MW in 2020. The average savings per participant decreased by 13% in 2021.

Most gross energy savings in 2021 was due to LED lamp installations which accounted for 74% of product installations and 56% of EPI gross savings.²⁸ Econoler explains that this “declining trend is due to a decreasing pool of opportunities per participant.” No details were offered regarding the cause of the “decreasing pool of opportunities” which might refer to fewer product installation opportunities due to product market saturation or fewer opportunities because the measures offered are not in demand by participants.

A participant survey question asked if additional efficient products were installed after participating in EPI. About 68% of the one hundred respondents said no; 96% of seventy-six respondents stated their participation in EPI was due to ENS’s promotion of energy efficiency products; 12% of 100 respondents stated ENS should offer more products.

²⁸ 115,024 LED lamps generate 4.572 GWh in gross savings although the number of A-type lamp replacements in single-family homes have continued to decline in 2021

The Evaluator's main evaluation objectives were to:

- collect participant perspectives information
- calculate gross results
- calculate net results

To determine the gross and net electrical energy and peak demand savings and avoided annual GHG emissions, the condensed impact evaluation included: audit of tracking sheet, on-site visits, Measure Assessment update, participant surveys, and calculation of GHG emission reduction.

The Evaluator highlighted the following 2021 EPI impacts:

- achieved 7.812 GWh in net electrical energy savings
- achieved 1.098 MW in net peak demand savings at the generator
- On-site visits found a slight reduction in gross savings due to LED lamp installation rate decreased from 98% to 94%
- free-ridership levels similar to 2019 in 2021
- spillover levels increased from 3% to 10% in 2021
- evaluated net energy and peak demand savings were 3% higher than tracked values due to increased NTGR values.

The evaluator provides no new recommendations for this program.

The methods and calculations performed by the evaluator are appropriate to this program type and within the scope of an experienced independent evaluator.

This is an excellent evaluation

6. Mi'kmaw Home Energy Efficiency Program

The Mi'kmaw Home Energy Efficiency Program, MHEEP, provides energy upgrades to band-owned homes in the thirteen (13) Mi'kmaw communities in Nova Scotia at no cost to the participant or to the community. Community housing managers (HMs), one delivery agent (DA), and two Mi'kmaw-preferred contractors deliver the Project's energy efficient measures and upgrades across all 13 Mi'kmaw communities in Nova Scotia.

The EnerGuide audit (test-in, test-out) is used. Measures include building envelope upgrades and upgrades for space heating equipment, bathroom fans, heat recovery ventilators and carbon monoxide detectors, plus appliance retirement and appliance replacement. The Delivery Agent conducts the test-in (or "D") audit and the post-retrofit assessment (or "E" audit). Provincial funding is used to reduce non-electric

energy consumption while electricity ratepayer funding supports reduction of electricity consumption. Based on tracking information, the primary measures in 2021 have been heat pump retrofits to replace electric resistance or electric furnace heating; and building envelope and air sealing measures.

MHEEP, introduced in 2018 as the First Nations Home Energy Efficiency Pilot. Phase 2 began in June 2019. In 2021, 82 band-owned homes participated in MHEEP, an increase in participation over 2020 when participation was depressed due to Covid, and also slightly more than prior to the pandemic.

In 2021, all in-home MHEEP work was suspended from April 28 to June 9 due to public health and government directives. In-home assessments and upgrades were not completed during this period.

Econoler conducted a condensed impact evaluation, consisting of a tracking sheet audit, updated the Measure Assessment, reviewed savings calculations, and calculated gross and net savings. The net-to-gross ratio was assumed to be 1.00. A realization rate of 100% was used. GHG emission reduction was calculated.

Econoler reports a five percent increase in average savings per participant over 2020 due partially to a lower proportion of participants with non-electrical heating in 2021. For the program, net electrical energy savings was 0.316 GWh and net peak demand savings at the generators was 0.147 MW. These results were lower than the planned 0.956 GWh and 0.517 MW.

The methods and calculations performed by the evaluator are appropriate to this program type and within the scope of an experienced independent evaluator.

Since on-sites could not be done for 2021 due to Covid, we supplemented knowledge on this program by discussion with the program staff.

7. Affordable Multifamily Housing

The Affordable Multifamily Housing (AMH) program provides affordable-housing owners with incentives for building-wide energy retrofit projects to reduce consumption of electricity. The program uses the same delivery model as Small Business Energy Solutions, with similar measures. Unless project owners follow a prescriptive path by installing specific measures, initial audits for projects occur at the beginning of the participation process, similar to the Small Business Energy Solutions Audit path.

In 2021 AMH targets affordable housing owners and non-profit organizations including rehabilitation and transition housing. It offers building wide energy retrofit projects that reduce both electrical and non-electrical consumption. Launched in 2018 as a pilot, AMH reached its highest participation level in 2021 totaling twenty-three projects driven by an increase in prescriptive projects, but both electrical and peak demand savings decreased.

In May 2021, maximum incentive amounts changed to \$15,000 per affordable unit, \$5,000 per affordable room, and a maximum of \$100,000 for shelters, transition houses and non-bed facilities such as food banks. Funding from the Province of Nova Scotia increased incentive amounts up to 80% starting April 2021.

From April 28, 2021, to June 2021, pursuant to government directives regarding the COVID-19 pandemic required suspension of all in-home visits, thus no energy audits were performed, and fewer projects were completed due to contractor delays and access constraints during this period.

The Evaluator completed a comprehensive impact evaluation stating the following evaluation objectives:

- collect participant perspectives information
- calculate gross and net electrical first year and lifetime energy savings, peak demand savings and avoided GHG emission

AMH participant overall satisfaction was rated ten out of a 10-point scale. Reasons for reported satisfaction were:

1. easy process
2. incentives allowed project implementation
3. allowable upgrades in old buildings
4. creates great value for tenants
5. satisfied with contractor installation

Econoler found that the number of AMH projects increased by 53% in 2021 compared to 2020 for a total of twenty-three projects. Comprehensive projects increased from 6 to 8 and prescriptive projects increased from 9 to 15 resulting in 0.402 GWh net energy savings and 0.186 MW in peak energy demand savings. These achievements do not reach planned net electrical energy savings of 1.52 GWh and 0.413 net peak demand savings.

The Net-to-Gross ratio for AMH is 1.0.

Of the twenty-three projects, fifteen were prescriptive projects generating 62%, or more than half of the savings. Per project energy savings decreased in 2021 compared to 2020: comprehensive per project gross energy savings dropped by 68% due to decreased building size. Prescriptive per project gross energy savings decreased 52% from 2020.

The Evaluator did not provide recommendations, but instead followed up on two recommendations made on past evaluation report recommendations. There is a new audit report template and Efficiency Nova Scotia implemented changes to the audit report to emphasize building envelope upgrades, including insulation.

8. New Residential Program

The New Home Construction Program is the single program component of the New Residential Program. There were 853 completions in 2021. The program encourages homeowners and builders to exceed building code requirements for energy efficiency in new homes.

The program steps are:

- Review home plans HOT2000 simulation software.
- Provide the builder or homeowner with a report.
- Once the home is built, have an energy advisor (EA), hired by an NHC delivery agent (DA), conduct a final inspection and an airtightness (blower door) test to verify the energy efficiency level of the new home.

The program provides a structured set of incentive levels. For single-family detached homes, the incentive levels are \$2,000 for 40% better than code (Tier 1), \$5000 for 65% better than code (Tier 2) and \$7000 for 75% better than code (Tier 3). For multi-unit homes, the incentive levels are \$1,000 for 30% better than code (Tier 1), \$2,000 for 65% better than code (Tier 2) or \$3,000 for 75% better than code (Tier 3). Tier 3 homes in both tracks can be certified as Net Zero Ready, Net Zero or Passive House.²⁹ Certified Tier 3 homes receive an additional \$2,000.

²⁹ The Province of Nova Scotia contributes \$2000 to the Tier 3 incentives.

For 2021, Econoler conducted a condensed evaluation. Free-ridership and spillover were taken into account.³⁰

For NHC, participants' gross energy savings were calculated by determining the difference between the to-code and the as-built modelled energy consumption values. Since the primary calculation tool for this program type is simulation, initial results were corrected using an overestimation ratio (OR), depending on the heating system. The ORs used in 2021 were borrowed from 2018 as they remain valid. For 2021, the program achieved 5.683 GWh net energy savings and 2.285 MW net peak demand savings at the generator. This exceeded the net savings target (5338 GWh) and was just short of the net demand reduction target (2.377 MW).

There were no recommendations for this program.

The methods and calculations performed by the evaluator are appropriate to this program type and within the scope of an experienced independent evaluator. *This is an excellent evaluation.*

9. BNI Efficient Products Rebates (BER)

This program serves the business, non-profit and institutional sector (BNI sector). The Efficient Product Rebates program for 2021 is the same as Business Energy Rebates (BER). The program has two components, Instant Rebates at point-of-sale and Mail-in rebates. The point-of-sale rebates are provided through electrical product distributors throughout Nova Scotia. The Mail-in rebates require an application submitted to Efficiency Nova Scotia. In 2021, the mail-in approach covered 301 projects by 187 participants. Electrical distributors provided 188,956 instant rebates for products sold. This number of instant rebates represents an increase of 18% from 2020.

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

³⁰ Since site visits could not be conducted due to Covid, we conducted a survey of participants. There were no systematic problems for this program component.

Econoler conducted a comprehensive impact evaluation for 2021. The evaluation included a small mail-in participant survey, a small instant rebates participant survey and eight distributor interviews. Econoler conducted a tracking sheet audit, a measure assessment update, site visits, and desk reviews. The on-site visits (n=40) were used to calculate adjustment ratios for lighting measures. Other adjustment ratios were continued from 2020. Econoler also calculated emissions reductions and developed a substantial study section on Business Energy Rebates market evolution. Econoler found that the commercial/industrial LED lamp market has reached maturity, while LED fixtures still have some growth potential.

For the combined program components, net energy savings was 33.491 GWh and net peak demand savings was 5.401 MW. These were lower than for 2020.

The evaluation of BNI Efficient Products Rebates, including methods and calculations performed by the evaluator are appropriate to this program type and within the scope of an experienced independent evaluator.

The evaluator provided one recommendation for program improvement – changes to the lighting measure worksheet.

10. BNI Custom Incentives Program

For 2021, the BNI Custom Incentives Program includes three primary components: (1) Custom, (2) Energy Management Information Systems (EMIS) and (3) Strategic Energy Management (SEM). EMIS and SEM evaluation are examined separately, with Custom reviewed here.

The Custom program had four components for 2021 (a) retrofit, (b) a special OEM Operational Demand Savings Pilot, (c) new construction and (d) building optimization. The Retrofit component helps with technical and financial support for scoping and feasibility studies, then helps implement technical changes using a customized and flexible approach. The special pilot pays incentives for low-cost measures based on winter avoided contribution to peak demand. New construction provides incentives for new buildings, additions to buildings and major renovation of existing buildings. Building optimization provides a recommissioning process and supports implementation of low-cost/no-cost efficiency improvements.

Retrofit had fifty-four projects started and completed in 2021. Another eighteen multiyear projects were completed in 2021. Six additional projects were started but not yet completed. One project started in a prior year continued through 2021 but is

not yet completed. The OEM Operational Demand Savings Pilot had three participants. For new construction, twenty-one projects were completed in 2021 as participation increased over prior years. There were six building optimization projects.

The evaluator provided four recommendations to the existing Custom programs and one recommendation to the OEM Operational Demand Savings Pilot program. These recommendations will work to increase the speed of ex-ante savings adoption, increase program participation rates, and improve overall program performance/offerings.

This evaluation, including design, selection of methods and calculations are appropriate to this program type and within the scope of an experienced independent evaluator. This is an excellent evaluation.

11. BNI Energy Management Information Systems (EMIS)

Energy Management Information Systems (EMIS) provide real-time energy consumption data from metered systems and enable businesses and institutions to make real-time energy decisions. The EMIS program provides funding to audit EMIS systems (EMIS audit), develop an EMIS implementation plan (EMIS implementation plan) and to install the metering and monitoring equipment (EMIS implementation). This program provides training and organizational support for implementing management information systems and processes.

In 2021 a single EMIS project was delivered to an ongoing SEM program participant. Econoler performed an impact evaluation to produce annual and lifetime demand savings for this activity. The evaluation consisted of documentation review, phone interviews, and a desk review for the project. Interviews were conducted with the program manager, a service provider, and a participant as part of the desk review. Free-ridership and spillover were assumed to be zero so for this program component net savings and gross savings are identical.

Evaluation results determined that project savings calculations were appropriate for final evaluation and no changes were made to tracked savings. The evaluation of EMIS is appropriate to this program type and within the scope of an experienced independent evaluator.

Measure life for EMIS depends on whether EMIS platforms include advanced system optimization via supervisory control or if the EMIS system just does one-time checks. For example, if EMIS is designed to control lighting in several buildings to

match a protocol and the system runs for seven years, the seventh-year savings should be the same as for the second or the fourth year because there is constant intelligent control (with occasional adjustment). Since the system has supervisory control, EMIS savings is not essentially behavioral savings, so it need not deteriorate rapidly. At the same time, it is up to the program administrator to determine assignment of savings. The savings from the program can be credited to the devices that the EMIS operates optimally (that previously were operating sub-optimally) or to the EMIS, or to a mix of these. The proportional allocation is up to the program administrator.

We recommend that Efficiency Nova Scotia look at the history of EMIS projects for Efficiency Nova Scotia and assess whether focusing on optimization via supervisory control coupled with particular optimized devices (measures) could increase the EUL for this program component.

12. BNI Strategic Energy Management (SEM)

Strategic Energy Management is an approach for integrating energy management into business practice – so that a focus on continually advancing energy-efficiency becomes an integral aspect of workplace awareness and cooperative activity. This kind of approach has previously been used to uplift awareness and attention to quality assurance and in workplace safety campaigns. Generically, SEM focuses on changes in daily operations (with management support) that engage staff in energy efficiency thought, alertness, and activities as they perform cooperative work. In a specific project it may be that only certain categories of workers are designated by management to be involved, such as engineers. It is a socio-technical approach to production that orients a production process to energy-efficiency goals. The origin of Canadian and US SEM programs is attributed to the Japanese Kaizen (continuous improvement) programs which assume that every process can be cooperatively improved and that with management support, intentional self-discipline, corporate-discipline, and awareness, improvements can continue over time, indefinitely.³¹ For 2021, there were six participants in the SEM program, one new participant, and five who were continuing participation in their second, third and fourth year of participation.

Econoler conducted a comprehensive impact evaluation of SEM. The evaluation consists of a documentation review, interviews, and a desk review of all six projects. Site visits are normally part of the evaluation protocol for new projects but were not

³¹ See <https://www.investopedia.com/terms/k/kaizen.asp>.

possible due to COVID-19 restrictions. Interviews were conducted with the program manager, the service provider and six participants as part of the desk review. The Evaluator reviewed and adjusted energy and peak savings where appropriate for each project. Free-ridership and spillover were confirmed to be zero.

In view of previous report recommendations on the treatment of Effective Useful Life for this program, Econoler adjusted lifetime savings for program participants based on self-reported measures installed. It is not reported that comprehensive documentation from participants were accessed to verify measure installation and operation, and since onsite verification activities could not be initiated due to pandemic restrictions the treatment of these savings are not as robust as previous studies. However, for those participants (2) that have whole-building metering, this was not an issue as measure-specific savings were not applied.

In addition, and similar to treatment of Effective Useful Life savings from EMIS participants, a form of administrative early retirement of measures is being used to determine lifetime savings of this program. However, there can be more persistent savings for measures associated with control automations.

While the lack of verification activity is not associated with best practices for the evaluation of this type of delivery program, the continued extenuating circumstances of the COVID pandemic continue to apply inordinate pressure on evaluation activities. And since the nature of the Strategic Energy Management program is one of continued mutual participation, misreporting of program activities and measures is extremely unlikely. Therefore, this evaluation meets the intent and scope of an experienced independent evaluation.

The evaluation of the Strategic Energy Management program is appropriate to this program type and within the scope of an experienced independent evaluator.

The EUL for this program component seems low. We recommend that Efficiency Nova Scotia consider if there may be ways to increase EUL by emphasizing certain measures and/or by adding an EMIS controlled optimization component.

13. BNI Small Business Energy Solutions Program (SBES)

The BNI Direct Installation Program has a single program component, Small Business Energy Solutions (SBES). SBES is available to businesses that use less than 350,000 kWh annually. For 2021 SBES incentives were increased considerably. There are two paths within the program, the audit path, and the do-it-yourself path. For 2021 there was also a Commercial Direct Installation pilot. Most participants (82%) were on the DIY path. There were 512 projects across the audit path, DIY path, and CDI pilot. This is a substantial increase in participation. Net energy savings was 9.486 GWh and net demand reduction at peak was 2.045 MW. Net energy savings was within one percent of target (9.60 GWh); net demand reduction was below the 2.27 MW target.

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

The evaluation approach consisted of a condensed impact evaluation, no process or market evaluations were conducted.³² Narrative Research conducted a survey of fifty participants. Econoler conducted a tracking sheet audit, reviewed peak demand savings for heat pumps, updated EUL values for lighting products, and computed free ridership. Econoler also completed GHG emission reduction calculations.

Econoler Provided no program recommendations in the 2021 evaluation for this program.

The evaluation of the Small Business Energy Solutions program is appropriate to this program type and within the scope of an experienced independent evaluator. The evaluation shows careful attention to detail.

³² A condensed impact evaluation involves using some or all of the previous year's impact evaluation parameters such as unitary savings values, adjustment ratios, installation rates, and NTGRs to provide evaluated results.

14. Market Transformation and Codes and Standards

Energy savings and demand reduction impacts of Codes and Standards are evaluated by Econoler but are accounted outside the DSM Administrator's DSM portfolio. Savings from Codes and Standards do not overlap with savings from programs and program components in the Efficiency Nova Scotia DSM portfolio.³³ Savings associated with DSM programs represent increased savings relative to regulated minimum efficiency performance standards (MEPS). Activity in Codes and Standards modify the regulated minimum efficiency standards and so affect program savings.

For 2021, Efficiency Nova Scotia tasked Econoler to study the integration of market transformation programs into portfolios with resource acquisition programs and how code and standards are treated. Econoler did a literature review and also interviewed seven agencies that have integrated market transformation into their program portfolios. These agencies are BC Hydro, Northwest Energy Efficiency Alliance (NEEA), Bonneville Power Administration (BPA), ComEd Illinois, Efficiency Vermont, National Grid Massachusetts, and the New York State Energy Research & Development Authority (NYSERDA). BPA does not run an independent program but is the primary funder of NEEA. A particular focus is on the role of the regulatory. Some regulators fully support the market transformation programs modality. Others support only the codes and standards subset of market transformation. Others do not recognize savings from market transformation but rely on a resource acquisition approach. In all three regulatory approaches, program administrators use market transformation approaches, for example, designing programs within a market transformation framework. As Econoler notes, market transformation work normally has a timeline of five to ten years, rather than a yearly program timeline. Econoler also brings together an outline of methodologies for market transformation programs, and the integration of market transformation with codes and standards. Like other program approaches, market transformation involves particular risks and opportunities. Econoler suggests paths for Efficiency Nova Scotia engagement in market transformation and suggests the next step would be to conduct a preliminary assessment of potential markets in which market transformation programs would most likely be effective.

We find this study of market transformation and codes and standards to be proficient and well-crafted. The range of current practice is complete for programs in the field.

³³ Codes and Standards savings are calculated as differences in successive regulated minimum efficiency standards. Program savings are calculated as difference in increased efficiency of a product relative to the regulated minimum efficiency or a current baseline practice.

Risks and opportunities are indicated. The advice provided is sound.

There is a dimension not included by Econoler, which is the context of climate change. If we believe the climate scientists, we have not enough time to do whatever will be done to adapt to the climate emergency. Some jurisdictions have mapped out steps through legislation that represents a profound paradigm shift. For example, Washington state has recently directed a doubling of electric generation on a constrained timescale, banned coal, required net zero generation, directed limitation of natural gas, and now requires gas and electric utilities to provide low-income customers with rates for not more than six percent of household income (for gas and electric together). It is understood that both electricity and gas rates will rise dramatically, on a year-on-year basis, and this policy change for inclusion of low-income households, directed through the regulatory commission and the utilities, is planned to permit rapid build out of energy infrastructure while protecting low-income households from increasing rates. Similarly, Denmark has recently announced a comprehensive plan to shift all residential heating from natural gas to either district heating or heat pumps by 2030. As part of the response to the climate emergency, a massive improvement in production of net energy savings and net peak demand reduction is necessary. In this context, moving programs into a market transformation and codes and standards approach seems a reasonably moderate step in a direction that makes sense. However, while some jurisdictions are attempting to address the climate emergency, others are cutting back on energy efficiency.

15. DSM Measure Assessment

For 2021, Efficiency Nova Scotia tasked Econoler to develop an in-depth review of all parameters necessary to calculate the annual and lifetime gross energy and peak demand savings of most prescriptive measures and some semi-prescriptive measures offered through Efficiency Nova Scotia's programs. The 2020-2022 DSM Measure Assessment was constructed to ensure consistency in gross savings values to improve ability to define and track targets for energy and peak demand savings. The project also puts all gross savings calculation methods into a single reference document. This compendium includes interactive effects, peak demand-to-energy ratios and peak coincidence factors, installation and in-service rates, and unitary savings. Effective useful life (EUL) values are also included for all measures. This technical reference manual also draws from review of calculation methods and assumptions from several jurisdictions.

We find this work to be well executed and sound. Every utility should have a current and complete technical reference manual of this kind.

XI. References

California Evaluation Protocols

https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/EE_and_Energy_Savings_Assist/CAEnergyEfficiencyEvaluationProtocols.doc.

Darby, Sarah & Tina Fawcett, "Energy Sufficiency: An Introduction," Concept Paper. European Committee for an Energy Efficient Economy,

<https://www.energysufficiency.org/static/media/uploads/site-8/library/papers/sufficiency-introduction-final-oct2018.pdf>.

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

Gellings, Clark W. & John H. Chamberlin, *Demand-Side Management Planning Concepts & Methods*, Second Edition, Liburn Georgia: The Fairmont Press, 1992.

Gellings, Clark W. & John H. Chamberlin, *Demand-Side Management Planning*, Liburn, Georgia: The Fairmont Press, 1993.

Hargrave, Marshall, "What is Kaizen?," Investopedia.

<https://www.investopedia.com/terms/k/kaizen.asp>

Hoffman, Ian M., Steven R. Schiller, Annika Todd, Megan A. Billingsley, Charles A. Goldman, Lisa C. Schwartz, "Energy Savings Lifetimes and Persistence: Practices, Issues and Data." Berkeley, California: Lawrence Berkeley National Laboratory, Electricity Markets & Policy Group Technical Report, May 2015.

International Energy Agency, *Creating Markets for Energy Technologies*. Paris: Organization for Economic Cooperation and Development/International Energy Agency, 2003.

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

Keating, Kenneth M., Ruth L. Love, Terry V. Oliver, H. Gil Peach & Cynthia B. Flynn, "The Hood River Project; Take a Walk on the Applied Side," Pp. 112-118, *The Rural Sociologist*,

Vol.5, No. 2, May 1985.

Kramer, H., Lin, G., Curtin, C., Crowe, E., and Granderson, J. Proving the Business Case for Building Analytics. Lawrence Berkeley National Laboratory, October 2020.
<https://doi.org/10.20357/B7G022>

Lawrence Berkeley Laboratory, Building Energy Information Systems and Performance Monitoring Tools, 2014-2016 Assessment of Automated M&V Methods, Summary of Work (<http://eis.lbl.gov/auto-mv.html>).

Morse, William L. & H. Gil Peach, "Control Concepts in Conservation Supply," *Energy*, Vol. 14, No. 11, Pp. 727-735, 1989

New York evaluation guidelines

[http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/\\$FILE/NY_Eval_Guidance_Aug_2013.pdf](http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/$FILE/NY_Eval_Guidance_Aug_2013.pdf).)

NREL, *Uniform Methods Project Chapter 6: Residential Lighting Evaluation Protocol*, February 2014.

Peach, H. Gil, Pam Brandis, Michael J. Maranda, Ryan Miller, Anne West & Howard Reichmuth, "Evaluator as Fool, Reducing Uncertainty Through Evaluation," Brooklyn, New York: International Energy Program Evaluation Conference, August 2005.
(<http://www.iepec.org/conf-docs/papers/2005PapersTOC/papers/031.pdf>)

Rogers, Everett M., *Diffusion of Innovations*, Fifth Edition. New York: Free Press, 2003, First published in 1962.

National Energy Screening Project, National Standard Practice Maul, For Benefit-Cost Analysis of Distributed Energy Resources, 2020. <https://nationalenergyscreeningproject.org/>

Uniform Methods Project <https://www.energy.gov/eere/about-us/ump-home>

Uniform Methods Project Refrigerator Recycling Evaluation Protocol. See: <http://www.nrel.gov/docs/fy17osti/68563.pdf>. Prepared by Doug Bruchs and Josh Keeling, The Cadmus Group, April 2013.

Uniform Methods Project Residential Lighting Evaluation Protocol. See: (<http://energy.gov/sites/prod/files/2015/02/f19/UMPCchapter21-residential-lighting-evaluation-protocol.pdf>). Prepared by Scott Dimetrosky, Katie Parkinson, and Noah Lieb, Apex Analytics, LLC, December 2014.

Uniform Methods Project, Residential Behavior Protocol, August 2014. See (<http://energy.gov/sites/prod/files/2015/02/f19/UMPCchapter17-residential-behavior.pdf>).

Prepared by James Stewart of The Cadmus Group & Anika Todd of Lawrence Berkeley Laboratory, December 2014.

XII. Appendix: Questions to ask of DSM Evaluations

- (1) Is the evaluator free of conflicts of interests?
- (2) Does the independent evaluator have control over methods and measurement approaches?
- (3) Is the evaluation oriented to the goal of truth in measurement?
- (4) Is the evaluation open, well documented, and transparent?
- (5) If the evaluator uses a Technical Resource Manual, are values and calculation methods critically reviewed?
- (6) Are appropriate evaluation guidelines or protocols cited and used?
- (7) Is impact evaluation supported by process and market evaluation?
- (8) Is market evolution critically developed and well reported?
- (9) Does the evaluator engage with program administration and program technical staff in the design of the evaluation?
- (10) Does the evaluation make use of literature reviews and/or consultation with experts, where appropriate?
- (11) Are problems identified by the evaluator during fieldwork reported to program managers on a timely basis?
- (12) Does the evaluator follow up to check implementation of recommendations in the next program cycle and include follow-up in the next evaluation report?
- (13) In a complex evaluation, does the evaluator include a list of abbreviations and definitions?
- (14) In a complex evaluation, is method and measurement approach explained?
- (15) For surveys, are the survey questions presented in an appendix to the

evaluation?

- (16) Is statistical confidence and statistical precision reported for surveys or interview sets?
- (17) For programs that require on-sites, are there enough on-site visits?
- (18) Are there careful project file reviews?
- (19) Are there critical unitary savings reviews?
- (20) Is analysis of metered energy data conducted correctly and used when it is relevant?
- (21) Is there critical review of simulation models when simulation models are used in a program and/or for evaluation?
- (22) When metering is done, are potential problems with the accuracy and/or precision of metered results explored and reported?
- (23) Is effective useful life (EUL) well estimated?
- (24) Are avoided GHG emissions calculations conducted correctly?
- (25) Is the method of calculation of free-ridership and spillover carefully reported and clarified?

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