



SAVINGS VERIFICATION REVIEW

Of Efficiency Nova Scotia
Program Year 2024 Evaluation Results

Report for the Nova Scotia Energy Board

06/04/2025

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Verification Review: Program Year 2024

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



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I. Introduction

This report, conducted by H. Gil Peach & Associates LLC, for the Nova Scotia Energy Board, verifies electricity energy savings and demand reduction for 2024. It reviews measurements, models, and estimates provided by Econoler, the Independent Evaluator for Efficiency Nova Scotia's DSM programs.¹ The Econoler evaluations estimate first year energy savings (kWh) and model demand reduction (kW) for each Efficiency Nova Scotia energy conservation program. This report reviews, verifies, and, if appropriate, recommends adjustments to the savings and demand data and estimates. As with the evaluations, the primary focus of this study is impact evaluation. We also provide limited comments on other parts of the evaluation.

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

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 Demand Side Management (DSM) is a *cycle of repeated activities with the goal of continuous process*

¹ Efficiency Nova Scotia is Nova Scotia's conservation utility; it is currently operated under contract by E1 as the program implementer. 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 2024 is the seventeenth program year, including the start in 2008 and the fourteenth year with full administration by Efficiency Nova Scotia. Most programs can be considered as mature programs, though each year there are improvements or variations. This year, the Residential Behavior Program is new.

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

*improvement.*³ The cycle has five centers of focus (Figure 1).⁴ The arrows show the (clockwise) direction of the primary flow of effort. within a single Policy, Planning and Program cycle. Each step in the Demand-Side Management Cycle feeds information forward. For this report we call attention to only two steps in the cycle: Independent Evaluation and Verify Savings & Review.

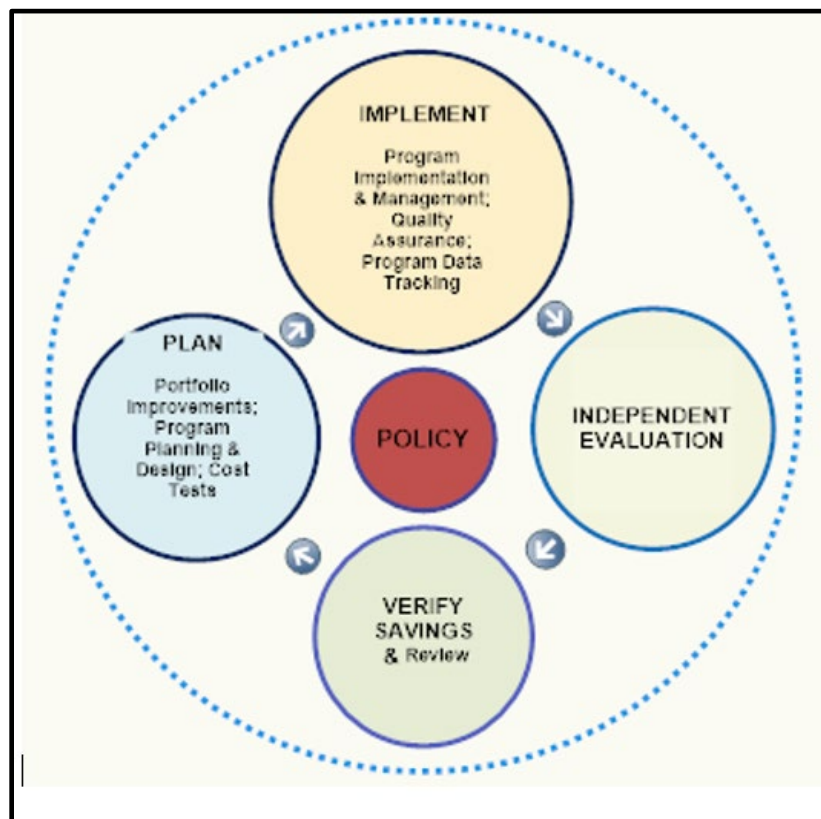


Figure 1: Savings Verification in DSM Cycle.

Savings Verification follows the Independent Evaluation and feeds forward into program planning.

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 steps not shown, including periodic potential studies, other special technical studies (such as socket studies), development and adoption of measurement protocols, development and updating of the Technical Reference Manual (including determination of effective useful life (EUL), structuring of benefit-cost testing options, and benefit/cost testing.

Independent Evaluation - The Evaluator for Efficiency Nova Scotia programs is Econoler (<https://econoler.com/en/>), a respected international Canadian firm based in Quebec.⁵ Econoler's evaluation team includes Equilibrium Engineering, Bouthillette Parizeau, Narrative Research, Richard Patterson of CDM Energy Solutions, and Akonovia. Econoler is the team leader. In the Savings Verification study, this team, led by Econoler, is referred to as the Evaluator. The evaluation provides independent results for energy savings and demand reduction plus limited market evaluation, process evaluation, and supportive research.⁶

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

III. Resource Acquisition and Other Evaluation Frameworks

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

Market Transformation. However, evaluation frameworks also continue to evolve. For example, there is a history of evolutionary modification to fit programs with codes and standard components and/or programs with market transformation components.⁷ The pioneers in this development in the late 1980s were Canada's BC Hydro and Sweden's

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

⁶ For DSM, there are three primary types of evaluation: impact evaluation, process evaluation, and market evaluation. A related kind of evaluation is the regulatory compliance evaluation, which is not a focus here but is part of the structure for other evaluation approaches.

⁷ The classic text on market transformation is Rogers, Everett M., *Diffusion of Innovations*, Fifth Edition. New York: Free Press, 2003. First published in 1962.

NUTEK, coupling EE with development of codes. Market transformation has resulted in programs that successfully transform practices and equipment. Typically, these programs end with regulatory bans on inferior practices and products and/or market collapse of inferior products. When a program works from a market transformation perspective, the evaluator should credit energy savings from the change in market flows to the program *to the extent they were caused by the program*. When a program involves codes & standards and/or market transformation, the evaluation framework normally requires an extended time perspective and an understanding of market transformation curves. As noted, Efficiency Nova Scotia's current programs are resource acquisition programs. Some of these programs also produce market transformation. Over time, they transform end-use energy efficiency and the building stock for the entire province.

Climate Change. The evaluation paradigm is also evolving to include climate change. However, the practice areas of energy (and water) conservation and climate change (with a focus on resilience and adaptation) are not yet well integrated from either a policy perspective or from an operational perspective. A few jurisdictions have enacted legislative authorizations that more closely coordinate energy and climate policy,⁸ but generally authority for energy savings and authority for climate work are separate within governmental organizations.⁹

Of course, energy people are aware of the climate emergency. Also, themes of energy efficiency conferences are now often built around climate issues. Missions of energy efficiency staff, including evaluators, are being increasingly expressed within climate change framework, but are not identical with climate missions. It is likely that disaster

⁸ For example, New York, Massachusetts, Minnesota, California, Oregon, Washington, Colorado, and British Columbia.

⁹ However, currently, in the US, the new national administration is severely defunding climate work, terminating key federal climate staff, and instructing remaining federal employees to avoid conferences for which terms such as "climate", "emissions", "underserved", "decarbonization", "electrification", "clean buildings initiatives", and the like are used to indicate conference content. Similarly, regulations for energy efficient appliances are being undermined to permit customer choice that disregards energy and resource waste, while protections for land and forests are being removed to facilitate "energy dominance." Of course, this political reversal has no bearing on the underlying physical processes of climate change which continue to accelerate. In a sign of recognition of actual climate realities, the administration is destroying the capabilities of federal disaster assistance agencies and promoting the concept that states will need to fund their own disaster preparedness and recovery from disasters. Hopefully, these are all temporary aberrations of only one national state since human and environmental survival depends on careful planning and coordination of effort. Also, a strong administrative state is necessary to enable and ensure disaster preparedness and effective recovery from climate disasters. In any case, only the US is taking this road, and Canada, along with China, and the EU will continue the necessary work in the climate area, and their progress and survival will not be curtailed.

preparedness and climate resiliency will eventually be authorized as explicit goals for energy savings and demand reduction projects. At that point, policy for the evaluation area will be adjusted to fit integrated goals.

What can be said in the absence of systematic authorization is that, for now, there is a “duty of anticipation” which has been developed for the planet by UNESCO and is expressed in the UNESCO Declaration of Obligations to Future Generations.¹⁰

Energy Sufficiency. Over the past 25 years, the program and evaluation framework advanced by the European Council for an Energy Efficient Economy (ECEEE) has moved increasingly towards energy sufficiency. The energy sufficiency concept is a return to the early goals of energy conservation, though it is driven by an understanding of resource limits. The energy sufficiency framework includes principles of social responsibility and the program tool of rationing to promote low-income objectives, inclusion, and social justice. The central idea is that there is enough energy to use, but not enough to waste. This approach incorporates low-income energy needs directly.

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

What will integration of climate into program goals and evaluation methods look like? What is clear now is that the time perspective for programs and for evaluation will have to be adjusted to the size and the time scale of climate change. This means that in program planning we will need a look ahead for a few years,¹¹ as we do now; and we will need to develop the medium term (through 2050 or 2070) and the longer-term projections (through 2100 or 2150) in resource planning.

Climate change goes in one direction and its scale is much larger than a human scale. So, if we are to be practical, it is prudent to train ourselves to think in the near term, 50 years, and 150-year medium-term planning as a starting point. To make an optimal decision for the near term, we must know what happens in the medium-term and the

¹⁰ UNESCO Declaration of Obligations to Future Generations, <https://www.unesco.org/en/legal-affairs/declaration-responsibilities-present-generations-towards-future-generations>. On anticipation, see Bruce Tonn, *Anticipation, Sustainability, Futures, and Human Extinction*. London and New York: Routledge, 2021, Pp. 3-4, and P. 55.

¹¹ We often do 20-year or 30-year resource plans, but these are usually only relevant for the next few years; then they are replaced by another 20 or 30-year plan. So, the operative part a resource plan is typically only 3-5 years.

long term, otherwise we may make the wrong investments now. Efficiency Nova Scotia published an extensive whitepaper in 2021 on the comprehensive integration strategies needed to achieve net-zero carbon by 2050 (though the whitepaper does not discuss economic impacts or resiliency issues that may be anticipated to arise and increase due to climate change). These factors should also be considered in developing a response to the climate crisis.

The principle of least-cost planning will have to be modified to incorporate the knowledge that the future will not, in most respects, be better than the present – that it will be increasingly harder to find money for necessary projects going forward in the context of many competing climate needs.

The method of economic discounting of the future will need to be reversed (same mathematical method, just inverted). The hard reality that a climate perspective brings is that we must work to extend measure life to match a much longer planning horizon, and that if we want the electric system to be functional and fully adequate in 2050, 2100, and 2150 we need to be working on some higher cost components now and save some of the least-cost components for later.¹²

New methods of analysis have been developed, primarily in relation to water utilities, to accommodate climate change.¹³ These approaches can be expected to develop for application across utilities (electric, gas, and water) with evolving knowledge of climate change. From a macro view it looks like the overall paradigm will be disaster preparedness and resilience, with the electricity and energy conservation goals proceeding within that planning context.¹⁴

¹² Costs escalate due to expected inflation, worldwide crop failures, increasing and overlapping climate disaster events, and the problem of scarce resources, the technical regret embodied in offshoring production through globalization, and the breakdown of supply chains as many countries need the same electrical components at the same time.

¹³ See Popper, Steven W., Warren E. Walker, Pieter J.T.M. Bloemen, and Vincent A.W.J. Marchau, eds., *Decision Making under Deep Uncertainty, From Theory to Practice*. Open Access edition, Saint Phillip Street Press, October 9, 2020, originally published in Cham, Switzerland: Springer Nature, 2019.

¹⁴ A practical general approach, called experimentalist governance has been put forward by Charles Sable and David Victor. This approach calls for joint work of parties, many local projects of different scales, listening to all points of view, minimizing and to the extent reasonably possible avoiding ideology or the right and left, and proceeding as in science on the basis of joint and coordinated planning, demonstration projects, and sound measurement, keeping what works and moving beyond what does not work. This approach is quite similar to methods long used in sociotechnical development by energy and water utilities, so will likely appeal to utility organizations. Sabel, Charles F. & David G. Victor, *Fixing the Climate, Strategies for an Uncertain World*. Princeton, New Jersey: Princeton University Press, 2022.

IV. Evaluation Standards

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

- (1) **Independent Evaluator** – In energy efficiency evaluation, the *primary* standard is that evaluation must be conducted by an independent evaluator to guarantee the integrity of reported savings and prevent conflict of interest and/or the appearance of a conflict of interest. We observe that the Evaluator meets this standard.
- (2) **Transparency** - Reports and calculation methods are made public and are open to inspection by any party. Third party review of evaluations helps ensure objectivity and credibility, and, when necessary, revision of evaluation results. Methods of analysis are clearly shown and discussed. The Efficiency Nova Scotia process coupled with the Evaluator's 2024 evaluation process meets this standard. However, there are some areas to improve, such as including full worksheets or computer printout information for all significance tests specifying in the evaluation for each test, whether the comparison is one-tailed or two-tailed, the p-value of the test, the power of the test, and the significance level criterion used in the analysis. Also, whenever data required for an evaluation is not provided to the Evaluator or is provided subject to a restriction to not include it in a public report, the Evaluator should flag the problem for readers.
- (3) **Evaluation Protocols** – In the energy efficiency evaluation area, there has been a successive development of evaluation protocols. Current protocols are associated with the Uniform Methods Project, the SEE Action protocols, and others. These provide current generally accepted guidelines for evaluation. All but one of the Evaluator's 2024 evaluations are consistent with current methodological guidance for evaluating energy efficiency programs. Of course, following an established evaluation protocol does not always guarantee a good evaluation, but it is a good step and an important indicator of competence and effectiveness.

V. Summary of Evaluated Savings Results

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

1. Evaluated Net Demand Reduction at the Generator

In 2024, Efficiency Nova Scotia operated two residential programs (Residential Efficient Product Rebates and Existing Residential) with nine components; three BNI (business, non-profit and institutional) programs (Business Energy Rebates, Custom Incentives, and Direct Installation/Small Business Energy Solutions) with four components; and one demand response program with two components (Residential DR and BNI DR).¹⁵

Table 1: Net Demand Reduction at the Generator.

2024 DSM Portfolio Net Evaluated Peak Demand Reduction (at Generator)			
Residential		Demand Reduction (MW)	
Rebate Programs	Appliance Retirement	0.337	2.765
	Instant Savings	2.428	
Existing Residential	Affordable Multifamily Housing	0.570	14.230
	Affordable Single-Family Housing	2.089	
	Efficient Product Installation	0.880	
	Green Heat	1.529	
	Home Energy Assessment	8.681	
	Mi'kmaw Home Energy Efficiency Project	0.481	
Residential Subtotal		16.995	
Business, Non-Profit, Institutional (BNI)		Demand Reduction (MW)	
Rebates	Business Energy Rebates	5.746	5.746
Custom Incentives	Custom	5.255	5.793
	Strategic Energy Management	0.538	
Direct Installation	Small Business Energy Solutions	2.155	2.155
BNI Subtotal		13.694	
Overall DSM Portfolio Total		30.689	
Source: Data from Table 6: Comparison of 2024 Evaluated and Tracked Peak Demand Savings at the Generator, P.17 in 2024 DSM Programs Evaluation, Final Report, Overall Executive Summary. Quebec City: Econoler, March 26, 2024. Numbers may not exactly match evaluation report due to rounding.			

¹⁵ Although Efficiency Nova Scotia does work to support Codes and Standards, direction in this area is seen as coming primarily from the federal or provincial levels, so energy savings from Codes and Standards are treated as outside countable energy savings by Efficiency Nova Scotia and the Evaluator.

In Table 1, the 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 30.69 MW¹⁶ (shown in Table 1) plus 8.091 MW in available demand response capacity at the generator (from the separate DR programs).*

Since the demand reductions at peak shown in Table 1 are caused by the installation of physical measures, they will repeat over several years. This type of demand reduction can be contrasted, for example, with the demand reduction results from a load shedding cooperative which reduces demand by its members for a short period each time the utility calls an event. It can also be contrasted with public emergency demand reduction, a behavioral approach in which the government calls for people to, for example, not charge their electric cars during certain hours, or not use electrical appliances or equipment except on certain days or at certain times.¹⁷

In Figure 2, MW values are presented on the X-axis, and programs are listed in rank order from lowest to highest on the Y-axis. Largest peak reductions are from Home Energy Assessment, Business Energy Rebates, and Custom.

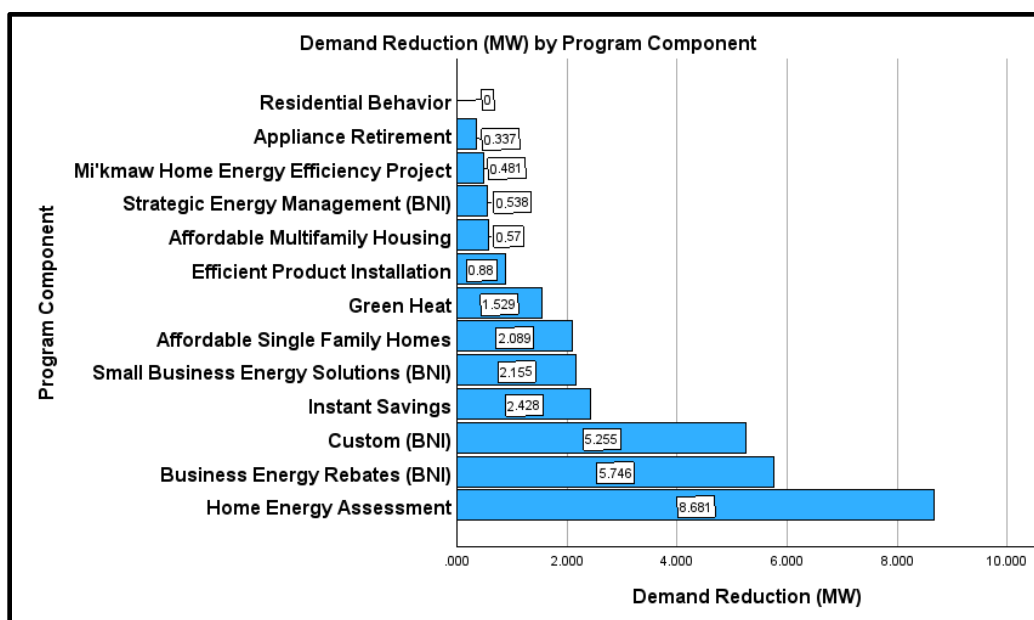


Figure 2: Program Components in Inverse Rank Order for Demand Reduction.

¹⁶ The evaluation shows 30.68 MW. Numbers in this study may differ slightly from the Evaluator's numbers due to rounding.

¹⁷ Behavior reduction of demand can work well in emergency situations (such as the disastrous ENRON fraud situation in California) when the public is fully attuned to an existential emergency, but these reductions are temporary and situational.

Separate from the programs listed in Table 1, there are also two capacity reduction demand response (DR) programs, Residential Demand Response and BNI Demand Response. Residential Demand Response yields an available capacity reduction of 0.057 MW, and the BNI program yields an available capacity reduction of 8.034 MW; together, this is 8.091 MW.¹⁸

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

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

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

2024 Net Evaluated Energy Savings (at Generator)						
Program	Residential	Annual Evaluated Net Savings (GWh)			Lifetime Evaluated Net Savings (GWh)	
Residential Efficient Products Rebates	Appliance Retirement	2.365	24.617		9.433	107.274
	Instant Savings	22.252			97.841	
Existing Residential	Affordable Multifamily Housing	1.159	53.331		19.397	1,029.782
	Affordable Single-Family Homes	3.719			74.428	
	Efficient Product Installation	8.948			52.525	
	Green Heat	0.872			15.697	
	Home Energy Assessment	31.962			859.594	
	Mikmaw Home Energy Efficiency Project	0.401			8.141	
	Residential Behaviour	6.270			6.270	
Residential Subtotal		77.948			1,143.326	
Program	Business, Non-Profit, Institutional	Annual Evaluated Net Savings (GWh)			Lifetime Evaluated Net Savings (GWh)	
Efficient Product Rebates	Business Energy Rebates	39.529		39.529	609.885	609.885
Custom Incentives	Custom	39.951	44.429		488.215	499.796
	Strategic Energy Management	4.478			11.581	
Direct Installation	Small Business Energy Solutions	10.854	10.854		177.557	177.557
BNI Subtotal		94.812			1,287.238	
Overall DSM Portfolio Total		172.760			2,430.564	
Source: Comparison of 2024 Evaluated and Tracked Energy Savings at the Generator, P. 16, <i>Econoler Overall Executive Summary, Efficiency One 2024 DSM Programs Evaluation, Final Report</i> , March 26, 2025.						
Note: Numbers in tables may differ slightly from Econoler or Efficiency Nova Scotia numbers due to rounding.						

¹⁸ Executive Summary, P. 17, Table 6.

The relation of lifetime energy savings to net first year energy savings is shown in Figure 3. The programs are listed on the vertical axis and the multiplier for each program (rounded to the nearest whole number) is shown on the horizontal axis. The multiplier is the ratio of Lifetime Evaluated Net Savings (GWh) to Annual Evaluated Net Savings (GWh) from Table 2.¹⁹

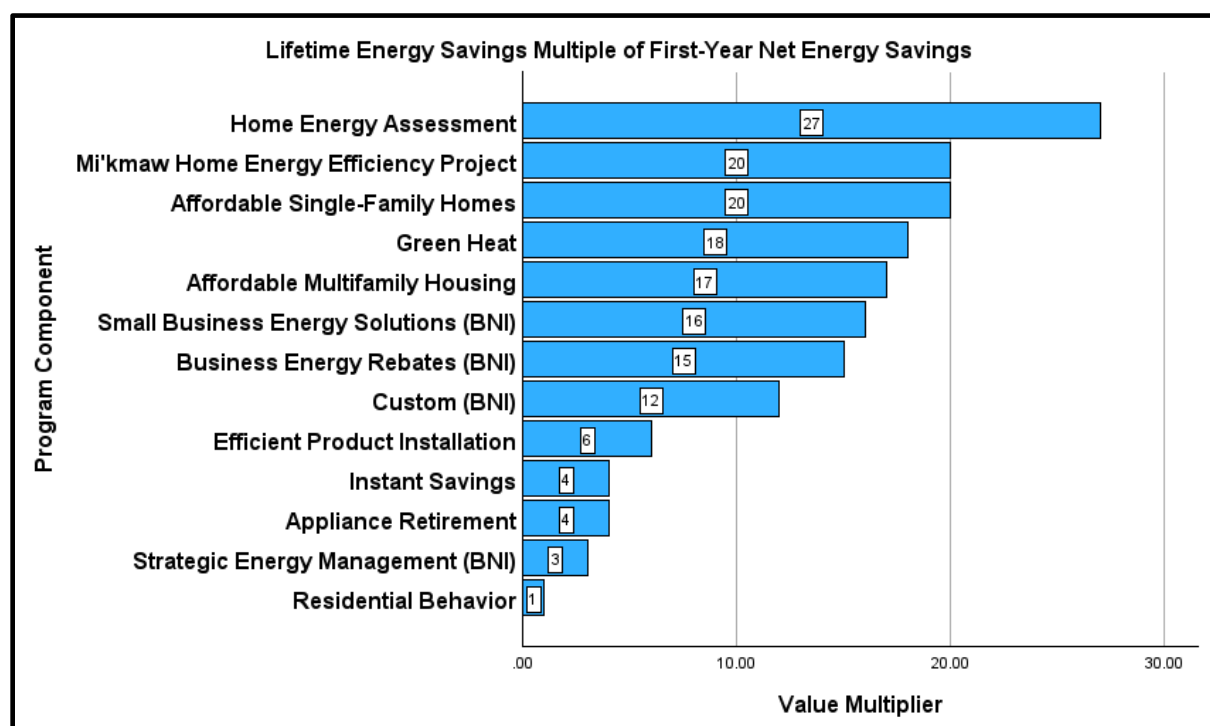


Figure 3: Rank Order for Evaluated Lifetime Net Energy Savings as a Multiple of Net First Year.

- The multiplier for Residential programs, taken together, is fifteen; the multiplier for BNI programs is fourteen; and the multiplier for the overall portfolio is fourteen. The multiplier represents the average lifetime of energy savings.

3. Sector Contributions

In Figure 4, BNI contributes net peak demand savings at the generator of about 45%; about 55% is contributed from the Residential sector.

¹⁹ The whole numbers shown on the bars in Figure 3 can be considered a rough indicator of measure life.

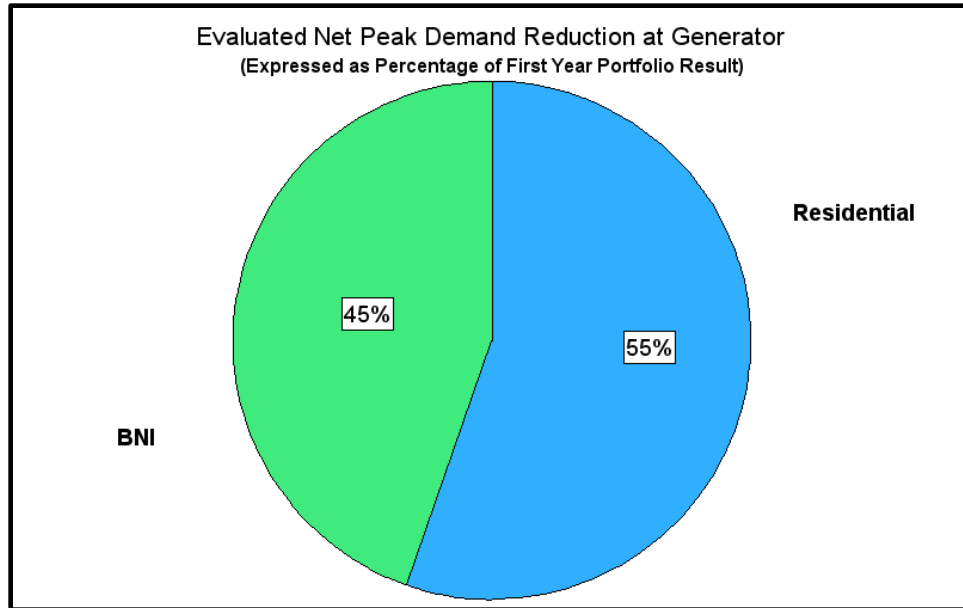


Figure 4: Percent Contribution to Net Demand Reduction at Generator by Sector.

In Figure 5, first-year net energy savings evaluated at the generator splits approximately 55%/45%, with about 55% from BNI, and about 45% from the Residential sector.

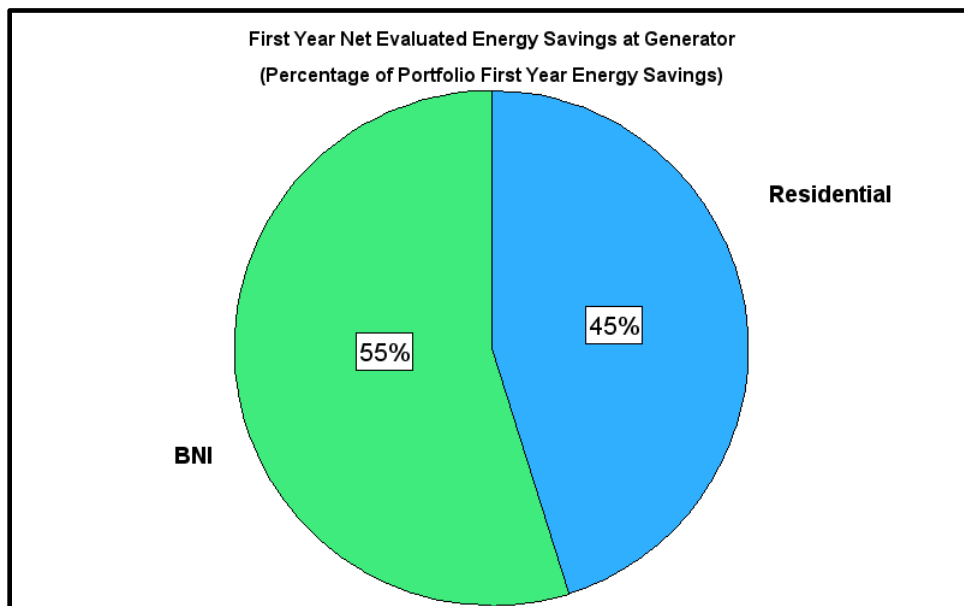


Figure 5: Percentage of First Year Evaluated Net Energy Savings at Generator.

In Figure 6, there is an approximate 53%/47% split for the lifetime evaluated net energy savings with 53% from BNI and 47% from the residential sector.

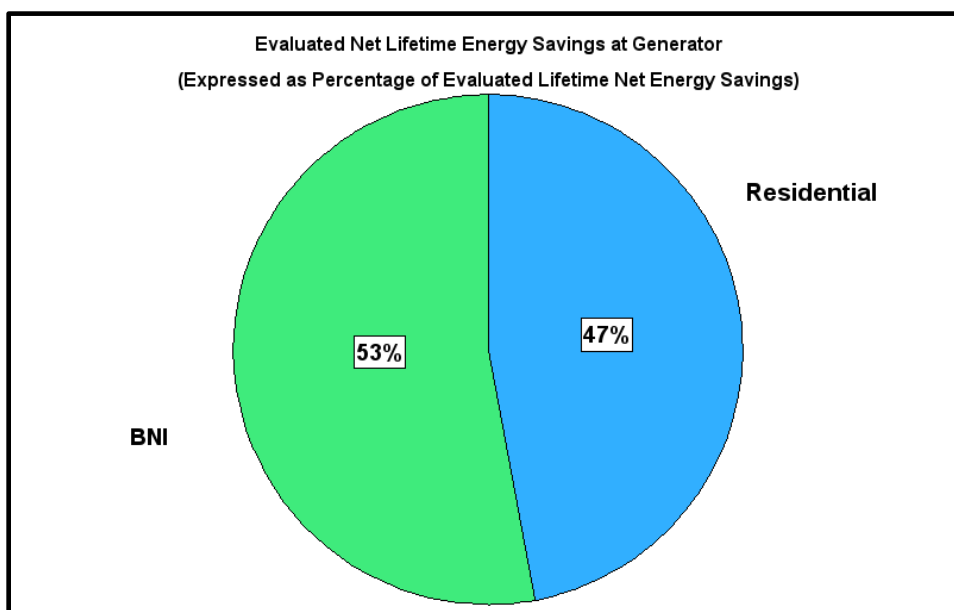


Figure 6: Percentage of Lifetime Evaluated Net Energy Savings at the Generator.

VI. Evaluation Effort for 2024 Programs

As shown in Table 3, the Econoler impact evaluation work was substantial, including sixteen impact evaluations. There are nine residential evaluations, of which six are comprehensive and three condensed; five BNI evaluations, of which three are comprehensive and two are condensed; and there are two demand response impact evaluations, one for residential and the other for BNI, both comprehensive evaluations.

A comprehensive impact evaluation is a full impact evaluation; a condensed evaluation includes new information but relies on other information developed in one or more previous comprehensive evaluations. A comprehensive evaluation includes baseline definition, savings calculation methodology, analysis of parameter values used to calculate savings, and net-to-gross ratios. The activities supporting comprehensive evaluation include customer data system analysis, surveys, project reviews, site visits, and a literature review.²⁰ The Program Year 2024 Evaluation Plan is shown in Table 3.

²⁰ See *Evaluation of DSM Programs, Overall Executive Summary, Efficiency One, Final Report*, March 28, 2023, P. 4

As a general rule, the evaluator's goal is to conduct a full (comprehensive) evaluation of each program every three years, with condensed evaluations in years between the full evaluations. However, full evaluations may be assigned to mature programs less frequently than every three years. Also, the evaluator notes that complex situations may require more frequent full evaluations.²¹

Table 3: Planned Evaluations for 2024 Programs.

2024 Portfolio Evaluation Plan				
Program Component	Impact Evaluation		Process Evaluation	Market Evaluation
	Comprehensive	Condensed		
Residential				
Appliance Retirement		X		
Instant Savings	X			
Affordable Multifamily Housing	X		X	
Affordable Single-family Homes		X	X	
Efficient Product Installation	X			X
Home Energy Assessment	X			
Green Heat	X			
Mi'kmaw Home Energy Efficiency Project		X		
Residential Behavior	X			
BNI				
Business Energy Rebates - Application Rebates		X		X
Business Energy Rebates - Instant Rebates	X		X	
Custom	X		X	
Strategic Energy Management	X			
Small Business Energy Solutions		X		
Demand Response Program				
Residential Demand Response	X			
BNI Demand Response	X			
Source: Econoler Table 1: 2024 Portfolio Evaluation Plan, P.3, <i>Efficiency One 2023 DSM Programs Evaluation, Final Report, Overall Executive Summary</i> , March 26, 2025.				
Note: The Custom Process Evaluation is limited to New Construction.				

The evaluations are further supported by Econoler by updating the Demand-side

²¹ See *Evaluation of DSM Programs, Overall Executive Summary, Efficiency One, Final Report*, March 28, 2023, P. 4 for a more complete set of considerations.

Management Measure Assessment (DSM MA) document. The update included a literature review of technical reference manuals, metering studies, and program evaluations from other jurisdictions, to gain information that could be used to modify unitary energy savings, peak demand-to-energy ratios, interactive effect factors, and estimate effective useful life (EUL) values.²² The 2024 review updated all prescriptive measures for Efficient Product Installation, Instant Savings, Mi'kmaw Home Energy Efficiency Project, Green Heat, Home Energy Assessment, Appliance Retirement, Home Warming, and the Demand Response Programs.

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 “actual” realized savings for that particular calendar year but are the savings that should be realized when each of the measures is in place for a full year.
- Generally, we did not check the evaluator’s mathematical calculations, but did carefully check the evaluator’s presentation of method for each program analysis. We reviewed the interaction, free-ridership, spillover, and net-to-gross approaches.
- We conducted 93 site visit inspections for the 2024 program year.

VIII. General Findings

- The method followed in each program impact evaluation follows a recognized analytic approach appropriate for each program type. The structure and format of each impact evaluation follows a consistent template (except for the Residential Behavior program which cannot be evaluated in the usual way since no physical measures are installed, and the compressed air leak detection work, which did not follow protocol).

²² Econoler uses the CIRx Screening Tool provided by Efficiency Nova Scotia.

- 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 usually have a methodological model diagram, followed by specification and discussion of methods employed. Where citations to other studies are included, we find them to be relevant. For each evaluation for which it applies there is an appendix containing clear delineation of calculations, methods, and (where included in the evaluation) surveys.
- The Evaluator has appropriately developed savings-weighted measure life analysis for net energy savings at the generator for all program components reporting energy savings (*except for the behavioral program since energy savings for this program are not based on known physical measures*).
- Carbon emissions offsets are appropriately developed.
- The Evaluator has demonstrated command of the current evaluation guidelines, while taking independent responsibility for evaluation designs, choice of analytic methods and calculations.
- The Evaluator has conducted *four* process evaluations and *two* market evaluations (Table 3). These evaluations are well-structured and useful for understanding the programs.
- In addition to the process evaluations, several of the program impact evaluations are supported by surveys and selected interviews, along with site visits, so that most evaluations contain some elements usually included in process evaluations, though structured process evaluations are not developed. While the primary focus of evaluation is on impact evaluation, the evaluator has been able to conduct a few process evaluations each year, and continuing to conduct additional process evaluations in the future would be desirable.

IX. General Recommendations

SVR24-G-1. The Savings Verification study recommends acceptance of the 2024 evaluation estimates for energy savings and demand reduction *except for four programs*. These are the Residential Behavior program (6.270 GWh; no demand

reduction), the Residential Demand Response program (no energy savings, 0.057 MW demand reduction), the BNI Demand Response program, (no energy savings, 8.034 MW demand reduction) and the compressed air part of the BNI Custom Incentive Program (Custom).

- For the BNI Custom Incentive Program (Custom), the portion of energy savings and demand reduction attributed to the compressed air leak audit projects we recommend not accepting the value reported by the Evaluator, since there was no independent evaluation following the relevant Universal Methods Protocol.²³ The Evaluator made an adjustment to an older value, and reported it for 2024, but *the protocol for independent assessment of compressed air was not followed*.
- For the Residential Behavior Program and the two Demand Response programs, the Evaluator conducted independent evaluations and correctly followed the relevant protocols. However, for these programs *the practical size of the savings and demand reduction is not large enough to be of practical value at either the household level or at the utility system level*. The Evaluator correctly followed the relevant protocols, but a problem with the protocols is that they do not take into account the very large sample size problem. ***For very large sample sizes statistical significance loses meaning and it is necessary to, instead, gauge performance using practical significance.*** The Evaluator correctly notes that these programs look OK from the perspective of statistical significance, however, the Evaluator should have flagged these programs for not producing practical energy savings or demand reduction.

SVR24-G-2. The Evaluator should flag programs which the evaluation demonstrates to produce only tiny savings (savings that may be statistically significant and are too small to have a practical significance). For these programs, the Evaluator should either recommend closing the program in order to spend available energy efficiency dollars more effectively, or provide an explanation for the program, making the business case explaining its value.

SVR24-G-3. The Evaluator should flag any program evaluations that do not permit following the relevant evaluation protocol(s), or that do not provide energy use information to the evaluator, or that provide energy use information but require it to

²³ Benton, N.; Burns, P. Zahlan, J. (2020). *Chapter 22: Compressed Air Evaluation Protocol, The Uniform Methods Project: Methods for Determining Energy-Efficiency Savings for Specific Measures*. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-77820.

be treated as proprietary and confidential, so that readers can be aware of any restrictions on the evaluation.

SVR24-G-4. The Evaluator should include full worksheets or computer printout information for all significance tests, specifying for each test, whether the comparison is one-tailed or two-tailed, the p-value of the test, the power of the test, the number of cases in each group, and the significance level criterion used in the analysis.

X. Individual Program Component Review

There are nine residential programs, four Business, Non-Profit, Institutional programs and two Demand Response programs.

A. Appliance Retirement Program (ARet)

The Appliance Retirement (ARet) program is one of two program components of the Residential Efficient Product Rebates program. Appliance Retirement advances the retirement of old, inefficient full sized and small refrigerators, freezers, and room air conditioners, by providing information on maintenance costs of old and inefficient appliances and offering free appliance removal and rebates for each retired appliance. The Evaluator reported that the program retired 77,696 old and inefficient appliances since 2012 from homes and schools.

The program requires participants to own the appliance which must be in working order and at least 10 years old to qualify for recycling. To maintain cost effectiveness, room air conditioners, small refrigerators and freezers are collected only when a full-sized refrigerator or freezer is retired at the same time. ARCA Canada Inc. (ARCA), the delivery agent (DA) for Efficiency Nova Scotia, collects and transports old appliances to a decommission/recycling warehouse where about 95% of components are decommissioned and recycled. ARCA schedules collection appointments and provides customer service. The graphic below outlines the Evaluator's program delivery/participation process.

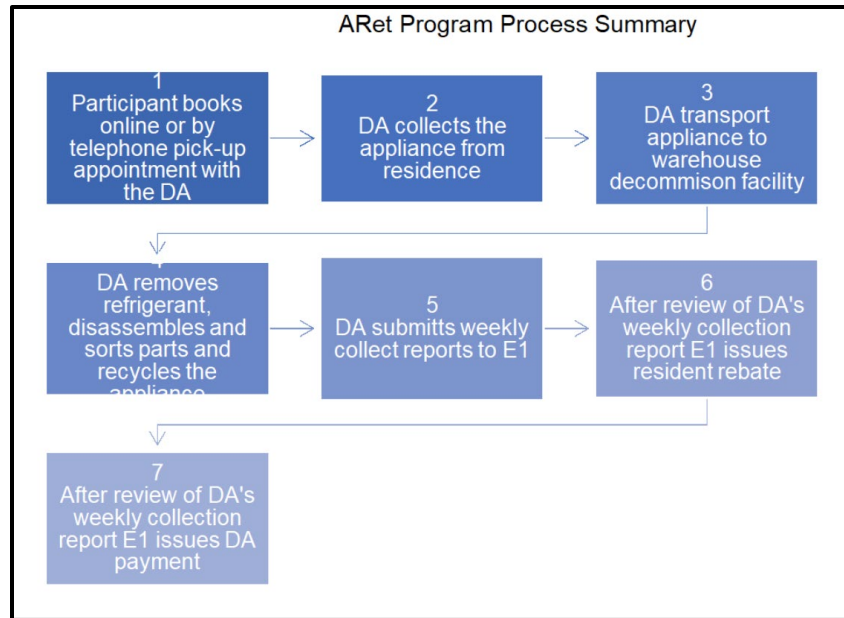


Figure 7: Appliance Recycling Process.

Rebates. The program offers the following rebate incentives for each retired appliance:

- \$50 for full-sized refrigerator
- \$50 for full-sized freezer
- \$10 for room air conditioner
- \$10 for small refrigerator
- \$10 for small freezer

Rule Changes. Since 2016 Efficiency Nova Scotia has adjusted the retirement criteria to increase program participation and maintain cost effectiveness:

- In 2016 appliance age criteria changed from 15 years in 2015 to 10 years in 2016.
- In 2020 full-sized freezer volume criteria were updated from 10-25 cubic feet to 7-25 cubic feet.
- In 2021 rebate criteria changed for retired full-sized refrigerators and freezers from \$30 to \$50.
- In 2023 appliance retirements were reported under the Affordable Single Family Housing program and the Mi'kmaw Home Energy Efficiency program (MHEEP), rather than the Appliance Retirement program...

Number of Retirements. In 2024, 5,941 appliances were retired, with the majority of retirements full-sized refrigerators (3,763) and freezers (1,756), resulting in 39% more retirements than reported in 2023.

Energy Savings & Demand Reduction. The Evaluator found that in 2024 both gross energy and peak demand savings increased by 39% from 2023. In 2024 gross energy savings generated 4.195 GWh and 0.598 MW in peak demand reduction at the generator. Reported net energy savings in 2024 were 2.365 GWh and the net peak demand reduction was 0.337 MW. The Evaluator concluded that the increase was a result of higher participation.

Evaluation Objectives. The Evaluator completed a condensed evaluation listing the following primary evaluation objectives:

- Calculate gross and net savings results: electrical first year and lifetime energy savings, peak and demand savings.
- Calculate avoided GHG emissions.

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

- Audit tracking sheet.
- Review of unitary savings.
- Calculate gross and net energy and peak demand by using evaluation results and 2022 NTGR results.
- Calculate the avoided GHG emission reduction.

Evaluator Findings. The Evaluator highlighted the following findings:

- The program exceeded both 2024 planned net electrical energy and peak demand savings of 1.937 GWh and 0.287 MW, respectively.
- 2024 net electrical energy savings was 2.365 GWh and peak demand savings was 0.337 MW savings at the generator resulting in 22% and 18% respectively above planned targets.
- Program participation increased in 2024 by 39% over 2023, totaling 5,941 appliances with high numbers of refrigerators and freezers.

- Evaluated net energy savings was very close to the value tracked by Efficiency Nova Scotia. The evaluated net energy and peak demand reduction were less than 1% below the values tracked.

Evaluation Issues: None. 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.

B. Instant Savings (IS)

The Instant Savings program is one of two components of the Residential Efficient Product Rebates program. Instant Savings is an instant cash rebate program offered to purchasers of energy efficient products, delivered by a Delivery Agent (DA), the Summerhill Group, Inc., and national and independent retailers at over 150 locations throughout Nova Scotia. In 2019 Efficiency Nova Scotia added online retailers to their list of retailers and in 2020 also offered online purchasing from manufactures.

Selected energy efficient products are offered through Spring and Fall campaigns as well as year-round. The Evaluator reports that Instant Savings program is promoted through point-of-purchase materials and signage, the Efficiency Nova Scotia website, television commercials, social media, and print, online and outdoor advertising.

Phasing Out LEDs. In 2024 a new campaign, “Lights Out” was initiated to notice both consumers and retailers that cash rebates will be phased out on LED lamps and fixtures beginning 2025.

Number of Products Sold. The Evaluator reported that in 2024, 395,472 energy efficient products were sold throughout Nova Scotia compared to 217,125 rebated products sold in 2023 representing an 82% increase over 2023. Energy Start LED Fixtures represented the largest number of products sold in 2024 totaling 268,740 compared to 88,337 sold in 2023.

Gross Energy Savings & Demand Reduction. Instant Savings evaluated gross energy savings totaled 26.884 GWh in 2024, a 73% increase over 2023 total of 15.512 GWh. Evaluated gross peak demand savings totaled 2.955 MW in 2024.

Evaluation Objectives. The Evaluator completed a comprehensive impact evaluation. The main evaluation objectives were to:

- Calculate gross and net savings results: electrical first year and lifetime energy savings, peak and demand savings.

- Calculate avoided GHG emissions.
- To determine the gross and net electrical energy and peak demand savings and avoided annual GHG emissions the comprehensive impact evaluation approach included:
 - Audit tracking sheet.
 - Review unitary savings.
 - Update Effective Useful Life.
 - Calculate gross and net energy and peak demand by using evaluation results.
 - Conduct a participant survey.
 - Calculate spillover using 2023 market effects.
 - Calculate avoided GHG emission reduction.

Evaluator Findings. The Evaluator reported the following key Instant Savings findings:

- Instant Savings exceeded both 2024 planned net electrical energy and peak demand savings of 12.544 GWh and 1.680 MW, respectively.
- 2024 net electrical energy savings was 22.252 GWh and net peak demand savings was 2.428 MW savings at the generator resulting in 77% and 45% respectively above planned targets. ENERGY STAR certified LED fixtures and lamp products generated 69% of the savings.
- achieved a 17% increase in savings from non-lighting products in 2024 compared to 2023.
- Achieved a decrease in free ridership for LED lamps and fixtures in 2024 from 59% in 2023 to 39% in 2024.
- Evaluated net energy and peak demand savings were 16% and 10% respectively higher than values tracked by Efficiency Nova Scotia.

Evaluator Recommendations. The Evaluator provided no new recommendations.

Evaluation Issues: None. 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.

C. Home Energy Assessment (HEA)

Home Energy Assessment (HEA) is a component of the Existing Residential Programs. This program encourages homeowners to increase the efficiency and comfort of their homes by providing rebates for qualified energy efficiency products and retrofits. HEA provides rebates for a wide range of equipment and building envelope activities.

Measurement. To measure performance, the program incorporates “test-in/test-out” (“D” and “E”) residential audits which include blower door testing. Delivery agent energy advisors conduct these assessments. Based on the results of the “E” assessment, a final EnerGuide rating and subsequent savings estimate are developed. Rebates are provided by the type of measure installed.

Marketing & Promotion. In 2024 a 6-month marketing campaign was conducted to help promote the adoption of Heat Pump equipment through the HEA Program. *Due to the focus on electricity savings and HVAC related efficiency gains, the HEA program is focused on homes that use electricity as their primary heat source.* However, since 2018, HEA has also offered services to non-electrically heated homes.

Evaluation Components. For 2024 the Evaluator completed a comprehensive impact evaluation of HEA. This evaluation included online past participant surveys (n=76 and n=483), audits of program tracking documentation (tracking sheet audit), calculation of gross and net results for electrical first year and lifetime energy savings, peak demand savings, avoided GHG emissions, assessments for energy savings associated with solar photovoltaic (PV), and reviews of spillover and free ridership. For 2024 AMI data was used for the billing analysis. Evaluation included a unitary savings review and an effective useful life (EUL) update.

Issues. A continuing issue with program operations is the failure of homeowners to complete the post-retrofit “E” assessments within the required program timeline. In 2023 the Evaluator recommended that unconverted D assessments be surveyed to better define spillover savings from this program activity. In 2024, the Evaluator surveyed 483 past participants and visited 19 sites. Out of 4,085 HEA program participants, 35% did not complete the exit assessment. Of those, 54% completed at least one efficiency measure installation activity due to the program, leading to additional attributable savings being credited from previous years.

Participation. HEA program participation increased from 2,783 homes in 2022 to 4,085 homes in 2023 to 5,367 in 2024, *the highest level of annual participation recorded since program inception.* The continued addition of new participants results from HEA now being able to serve the needs of homes that do not use electricity as the primary source of heat, though this results in greatly reduced per participant savings for this customer category.

Evaluated Net Energy Savings. Evaluated Net energy savings per 2024 participant was 5.45 MWh.

Canada Greener Homes. High savings and participation levels were the results stemming from the continued incorporation of the Canada Greener Homes (CGH) Grant into the HEA program beginning in 2023, with a significant jump in per-participant savings at that time and through 2024. The Evaluator found that the increase in participation and sustained average gross savings per home observed since the introduction of the Canada Greener Homes Grant continued in 2024.

Solar Photovoltaic Systems. However, the increased savings per participant overall also resulted from these additional grant monies that allowed for application toward the adoption of solar photovoltaic (PV) systems which produced 74% of the program's total gross portfolio savings in 2024, an increase from 64% of total program portfolio savings in 2023. The additional enrollment of PV systems as a measure that benefited from the Canada Greener Homes Grant was closed to new applicants on Feb 5, 2024, while work for homes already approved continued. While providing significant increases in total program savings and participation, this removal of a key measure from the program portfolio will lead to declines in participation and both average energy and demand savings per participant and total program savings going forward.

True-Up. To determine program savings, a weather-normalized billing analysis was conducted by the Evaluator to provide a 'true-up' of savings associated with the program. This Evaluator billing analysis is separate from the HOT2000 savings model used as a guideline for participant savings assessments. The net evaluated energy and peak demand savings determined by the Evaluator were higher than the results tracked by Efficiency Nova Scotia. This is due, in large part, to the solar photovoltaic upgrades. Since the final evaluated total program savings produced by PV systems is more than twice as much as the savings produced through efficiency measures, this produces much higher total savings per average participant. The Evaluator found that both HEA net electrical energy and demand savings exceeded targets: HEA achieved 31.962 GWh in net electrical energy savings and 8.681 MW in net peak demand savings at the generator in 2024, thus exceeding the planned net electrical energy savings of 19.012 GWh and the planned net peak demand savings of 4.799 MW.²⁴

From an evaluation perspective, the Home Energy Assessment (HEA) program, which includes long term federal coordination in the form of the HOT2000 savings software and a "test-in" and "test-out" procedure, plus the use of AMI data for understanding changes in energy use is one of the most carefully assessed energy conservation programs administered by Efficiency Nova Scotia. Econoler's work over several years with the evaluation of this program has included detailed testing and improvements to check and improve method and ensure accuracy and precision of energy savings results.

Evaluation Issues: None. This is an excellent evaluation in all respects, and the strengths of this evaluation carry over to others using all or parts of the method.

²⁴ Econoler, 2024 Evaluation of *Existing Residential Program*, P. 167.

D. Green Heat

Green Heat is a component of Efficiency Nova Scotia's Existing Residential program, providing financial incentives for the installation of efficient heating systems that use fuel from renewable resources. The new equipment can replace or supplement existing heating equipment. Incentives are available for central heating systems and for supplementing electric heat with an area heater.

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

There are several Green Heat measures. Rebate incentives for these measures differ by measure and system model. Some have a "buy Canada" provision:

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

The Evaluator reported that Green Heat's installations *continue to decrease* in 2024 by 21% compared to 2023 which decreased by 11% over 2022 which decreased by 45% over 2021. The Evaluator found that this persistent three year decrease in Green Heat installations is due to participants choosing to enroll in Efficiency Nova Scotia's Home Energy Assessment (HEA) program component and the Canada Greener Homes Grant (CGH) rather than the Green Heat program. This shift began in May 2021 to access higher federal incentive levels which were not available through the Green Heat program.

Nova Scotia homeowners enrolled in HEA receive Canada Greener Homes grants for up to \$5,000 to install energy efficiency retrofits including Mini-split Heat Pumps. Homeowners cannot receive both Green Heat and HEA/Canada Greener Homes Grant financial incentives. The Evaluator reported in 2023 that HEA installed more MSHPs in 2022 and 2023 than Green Heat, concluding that the increase in HEA MSHP installations is a direct result of the availability of the Canada Greener Homes grants. Since federal grants were closed to new applicants on February 5, 2024, the Evaluator predicts that Green Heat participant levels will increase going forward.

In 2024 Green Heat installed 1,408 total measures, the lowest level of measures installed since 2016, resulting in the lowest savings level since 2017. Green Heat 2024

gross energy savings was 1.651 GWh compared to 5.561 GWh in 2023 and total gross peak demand reduction was 2.748 MW compared to 4.668 MW in 2023.

The Evaluator attributed the 2024 decrease in savings, which was about 70% lower than 2023 levels, to a combination of the lower number of measures installed, reduced savings from MSHPs and wood-burning equipment, and billing analysis results which were used to update Green Heat unitary savings.

The Evaluator conducted a comprehensive evaluation. The main evaluation objectives were:

- Calculate gross and net electrical first year and lifetime energy saving and peak demand savings.
- Calculate avoided GHG emissions.

The Evaluator's Green Heat evaluation approach included review of tracking audit sheets, billing analysis, a survey of past participants, a unitary savings review, an expected useful life (EUL) update, calculations using evaluation results, use of the 2023 Net-to-Gross analysis results, and analysis of GHG emissions in CO2 reduction calculations.:

The Evaluator found that Green Heat:

- Achieved net electrical energy savings of 0.872 GWh, and 1.529 MW in net peak demand reduction at the generator in 2024 (less than the planning targets of 3.600 GWh and net peak demand reduction of 2.775 MW).
- 2024 participation decreased by 21% compared to 2023 while MSHPs decreased by 19%, demand reduction measures decreased by 36%. The total number of installed measures decreased to 1,408 in 2024 from 1,783 installed measures in 2023. The Evaluator projects increased participation in future years because participants will not have the choice to enroll in HEA with the Canada Greener Homes Grant program, which offered higher incentive levels (due to the CGH program's closure to new participants as of February 5, 2024).
- Using billing analysis results the Evaluator made substantial changes to gross electrical energy and peak demand savings parameters and calculations resulting in lower evaluated gross electrical energy and peak demand savings than savings tracked by Efficiency Nova Scotia which resulted in lower realization rates.
- The Evaluator recommends consideration of removing wood fireplace inserts and pellet fireplace inserts from Green Heat's list of measures due to their low savings and demand.

Evaluation Issues: None. A good evaluation. Methods choices were reasonable and within scope for an independent Evaluator.

E. Residential Efficient Product Installation (EPI)

Efficient Product Installation (EPI)

The Efficient Product Installation program (EPI) provides free direct installation of energy-efficient products to homeowners and renters, provided through contractors. In 2024 the Evaluator conducted a comprehensive impact evaluation for EPI program, *including a market evaluation to identify new opportunities for electrician-installed energy efficient measures*, as E1 phases out lighting measures.

From April to June 2023 EPI offered smart thermostats for electric baseboards as a pilot measure to accommodate demand for domestic hot water heater load controllers offered through the Efficiency Nova Scotia's Residential Demand Response program. Starting in 2024, Efficiency Nova Scotia offered eight (8) new electrician-installed measures including lighting products, and smart and advanced learning thermostats.

Listed below are EPI's 2024 eligible products available for installation:

1. Lighting Products
 - LED lamps (A-type, reflectors, and chandeliers)
 - LED nightlights
 - Solor Security Fixtures (new)
 - Motion Sensors (new)
 - Dimmer Switchers (new)
2. Domestic Hot Water Products
 - Faucet Aerators
 - Low-Flow Showerheads
 - Thermostatic Shower Valves
 - Pipe Insulation
 - Hot Water Tank Wraps
3. Smart and Advanced Learning Thermostats
 - Advanced Learning Thermostats (For Non-Electrically Heated Homes)
 - Smart Thermostats (For Mini-Split Heat Pumps (MSHPs))
 - Smart Thermostats (For Electric Baseboards or In-floor Systems) (new)
 - Advanced Learning Thermostats (For Central Electric Heating) (new)
4. Air Sealing Products
 - Foam Gaskets
 - Door Sweeps
 - Window Air Sealing
 - Door Weather Stripping
 - Window Film Kits

5. Other Products

- Smart Power Controllers for Audiovisual Equipment (new)
- Domestic Hot Water Heater Load Controllers (new)
- Humidity Sensors (new)

In 2024 the Evaluator conducted a market evaluation consisting of *jurisdictional scans in nine (9) jurisdictions*: five Canadian and four in the US, to identify direct install program measures that could be installed by electricians under EPI.

Potential measures highlighted include:

- Advance heat recovery ventilator controls consuming 67% less energy.
- Bathroom fans -efficient models saving up to 35.4 kWh per year.
- Block heater timers with unitary savings of 122 kWh/year.
- Heat reflector panels or rolls with saving estimated at 143 m³ of natural gas/year.

EPI's two funding sources are:

1. Electricity ratepayers to fund upgrades to reduce electricity consumption.
2. Government of Nova Scotia and the federal Low Carbon Economy Fund funds upgrades that reduce the use of other fuels.

The Evaluator reports results for electricity ratepayer portion of EPI only. There was a 2.4% increase in EPI 2024 participation in 2024 (9,993 vs. 9,763 in 2023). A total of 150,722 efficient products were installed in 2024, a 2% decrease compared to the 2023 total of 153,775, representing an average of 15.1 products installed per household, (similar to the 15.8 average for 2023). The Evaluator found that the average savings per participant decreased by 6.3% in 2024. LED lamps continue to be the most prevalent product type choice representing 74% of all products installed, accounting for 43% of gross energy savings. Gross energy savings totaled 9.093 GWh in 2024, compared to 9.481 GWh in 2023. Gross peak demand savings totaled 0.898 MW in 2023, compared to 0.942 MW in 2023.

The Evaluator's 2024 comprehensive impact evaluation's main objectives were to:

- Collect information on participant perspectives.
- Calculate gross and net EPI results, specifically first-year and lifetime electrical energy savings, and peak demand savings.
- Calculate avoided GHG emissions.
- Analyze market opportunities.

The comprehensive impact evaluation included a participant survey, review of the tracking sheet, a unitary savings review, site visits, an Estimated Utility Life (EUL) update, calculations using evaluation results, use of a Net-to-Gross ratio of 1 for low income participants, and voided GHG emission reduction calculations, as well as a jurisdictional scan of direct install programs in North America.

The Evaluator highlighted the following 2024 EPI impacts:

- High satisfaction rating (9.4 out of 10) with overall program from surveyed participants.
- Achieved 8.948 GWh in net electrical energy savings (less than the target of 10.569 GWh).
- Achieved 0.880 MW in net peak demand savings at the generator (less than the target of 1.127 MW).
- Enrolled 9993 program participants in 2024, a 2% increase over 2023; while 2024 average electrical energy savings per participant decreased by 6.3% due to the update to the 2024-2025 DSM Measure Assessment.
- Most product installation rates remain stable during 2024 site visits, except for smart thermostats for MSHPs where installation rates decreased. The Evaluator reports that an assumption of 100% installation rate was reduced to 84% installation (a 16% reduction) during 2024 site visits which found that participants disconnected their smart thermostats due to dissatisfaction with the product.
- The Evaluator reported that evaluated net electrical energy savings were 6% lower than tracked net electrical energy savings while evaluated net peak demand reduction was 1% higher than tracked net peak demand savings due to 2024-2025 DSM MA updates and to NTGR levels.

To improve smart thermostat installation rate, the Evaluator recommends conducting follow-up calls, providing installer education on product, and providing additional educational materials to participants.

Evaluation Issues: None. Good impact evaluation. However a deeper understanding of the smart thermostat problem requires a process evaluation with a focus on understanding customer perceptions regarding heat pumps, how they work, how the quality of heat is not similar to that of fossil fuels, and the need for careful instruction and support in the use of new heat pumps by households that have no previous heat pump experience.

F. Mi'kmaw Home Energy Efficiency Program (MHEEP)

MHEEP is a component of the Existing Residential Programs. Initiated in June 2018 as the First Nations Home Energy Efficiency Pilot, MHEEP began operations in 2019 as a residential energy efficiency upgrade program and appliance replacement program that provide home energy efficient upgrades to band-owned homes in the thirteen (13) Mi'kmaw communities in Nova Scotia, at no cost to the participant or to First Nation communities.

Energy efficiency upgrades are installed in collaboration with E1 Program Staff, community housing managers (HMs) that identify and select participants and review and approve recommended upgrades prior to installation, and two delivery agents (DAs) that conduct pre-and post-retrofit assessments, identify, recommend, and submit upgrades for review and approval by E1 Program Staff and HMs and DAs hire and manage Mi'kmaw preferred contractors.

Below is the Evaluator's reported program delivery design process.

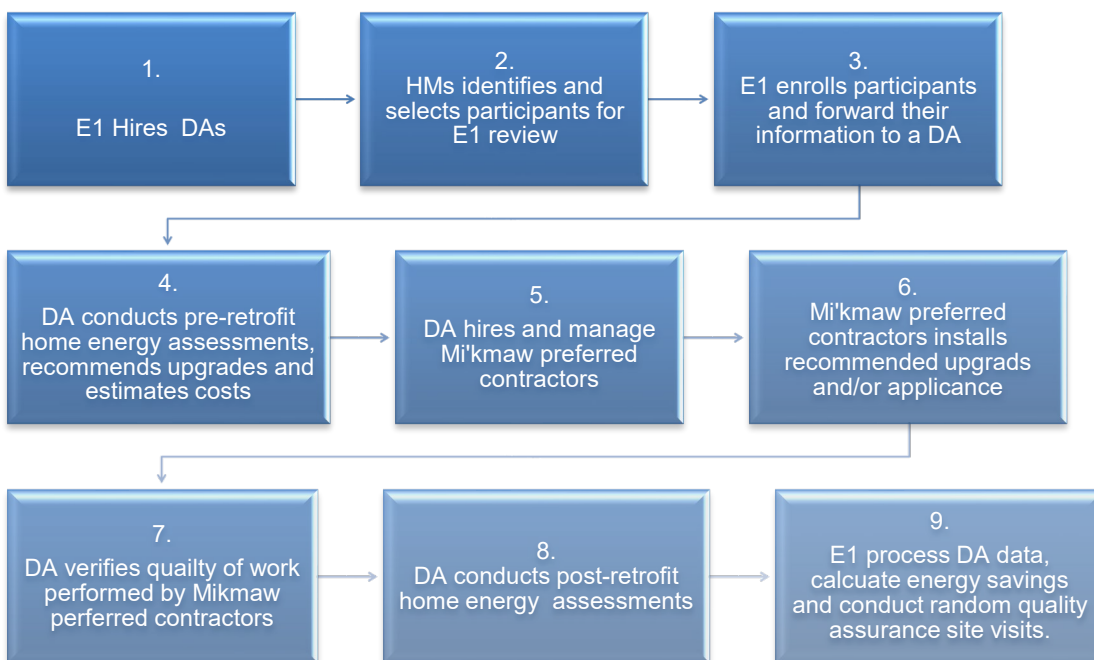


Figure 8: MHEEP Participation Process.

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

Measures Included in Program. MHEEP provides the following measures:

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

Funding. MHEEP's electrical and non-electrical upgrades are funded by two sources:

- 1) Electricity ratepayers fund standard upgrades that reduce electricity consumption and
- 2) The Province of Nova Scotia funds upgrades that reduce non-electrical fuel consumption and may contribute to some upgrades that reduce electricity consumption.

Participation: The Evaluator reported an increase in MHEEP participation in 2024 by 19% over 2023. In 2024, there were 192 Mi'kmaw participants,²⁵ compared to 162 participants completing home retrofit projects in 2023.

Household Energy Savings. There were 2.087 MWh gross energy savings per participant, a 41% decrease in average energy savings per participant from the prior year. The Evaluator states that the lower 2024 gross energy savings is due to new adjustment ratios.

Household Demand Reduction. Demand reduction increased in 2024 in comparison with 2023. According to the evaluator, the higher gross peak demand reduction is due to a higher participation level and an updated unitary savings value.

Condensed Evaluation: In 2024 the Evaluator conducted a condensed impact evaluation to calculate:

- Gross and net MHEEP results, specifically first-year and lifetime electrical energy savings,
- Peak demand savings,
- Avoided GHG emissions.

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

- An audit of tracking sheet,

²⁵ Evaluator reports that the 2024 number of participants is the highest since MHEEP began in 2019.

- A unitary savings review,
- An effective useful life (EUL) update study
- Calculations using evaluation results, NTGR ratio of 1, and avoided GHG reduction calculations.

As part of the 2024 evaluation the Evaluator changed the current savings calculation methodology using a new billing analysis to develop better adjustment ratios (AR) to apply to modelled savings estimates obtained from HOT2000, using whole home consumption instead of only space heating consumption. The Evaluator initiated this change because due to the high use of heat pumps instead of electrical baseboard heating, it was more difficult to isolate and calculate space heating consumption. The use of AR simplifies savings value calculation.

Evaluator's Findings: The Evaluator's 2024 MHEEP key evaluation findings:

- Achieved 0.401 GWh in net electrical energy savings, a decrease from targeted 2024 net electrical energy savings of 0.618 GWh.
- Achieved 0.481 MW in net peak demand savings at the generator, an increase from targeted net peak demand savings of 0.167 MW.
- Achieved 69% in 2024 compared to 95% in 2023 of electrical energy savings target.
- Achieved 19% increase in participation in 2024 compared to 2023.
- Achieved average savings per participant decreased by 41% in 2024.
- Achieved 0.401 GWh gross energy savings in 2024 compared to 0.577 GWh in 2023, a 41% decrease in gross energy savings.
- Achieved 0.481 MW gross peak demand savings in 2024, compared to 0.373 in 2023, a 29% increase in peak demand savings.
- Evaluated net energy and peak demand savings defined by the Evaluator were 31% lower and 15% higher net savings tracked by E1, due to revised adjustment ratios and to peak demand savings from heat pumps.

The average effective useful life (EUL) value of MHEEP measures as estimated by the Evaluator was 20.3 years in 2024, with 8.141 GWh in lifetime energy savings.

Evaluation Issues: None. This program evaluation is excellent in that it is coordinated with accepted federal EnerGuide methodology, with test-in and test out. The methods used and calculations performed by the evaluator are appropriate to this program type and within the scope of an experienced independent evaluator.

G. Affordable Multifamily Housing (AMH)

The Affordable Multifamily Housing (AMH) program provides affordable-housing owners and nonprofit organizations, including rehabilitation and transition housing, with incentives for building-wide energy retrofit projects that reduce electrical and non-electrical energy consumption. Project participants follow a prescriptive path by installing specific measures, or an energy audit is performed by one of five AMH approved energy auditors (EAs) at the beginning of the participation process to identify eligible energy efficiency measures.

The graphic below outlines the Evaluator's program delivery/participation process.

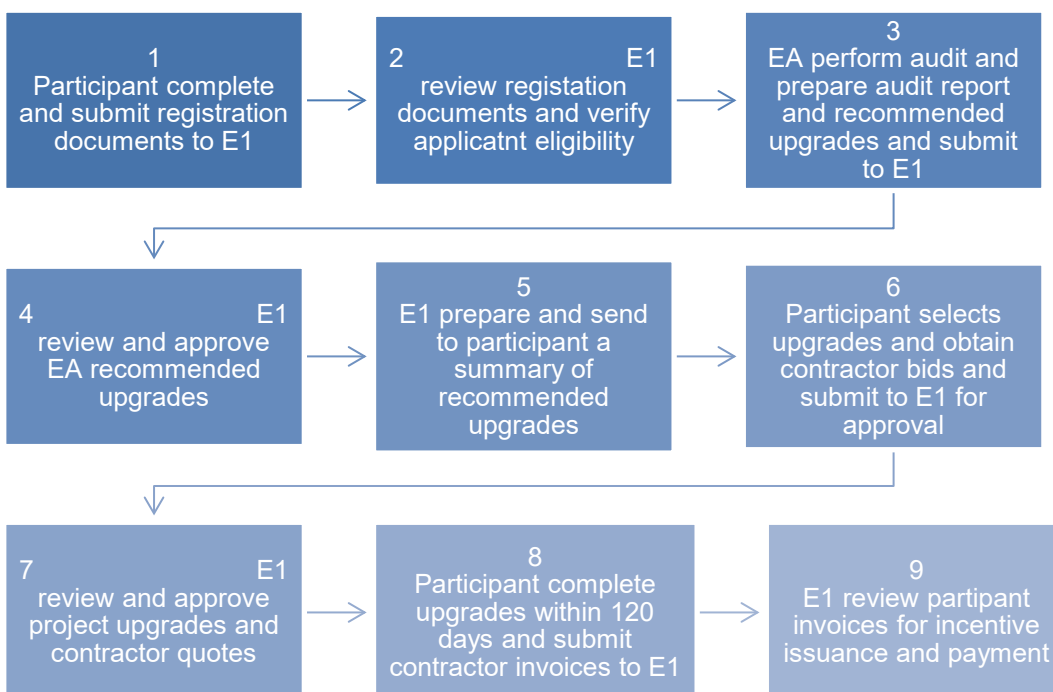


Figure 9: AMH Process Summary.

Affordable Multifamily Housing has two funding streams:

- 1) Electric ratepayers fund measures that reduce electric consumption.
- 2) The Province of Nova Scotia funds measures that reduce non-electrical fuel consumption and upgrades that can reduce electricity consumption.

Since April 2021, the Province of Nova Scotia's Green Fund provides increased incentive amounts allowing up to 80% of costs for electrical projects in residences and up to 100% in shelters and transitional houses.

Launched as a pilot in 2018, AMH continues to increase the number of projects, resulting in 5% more projects in 2024 than 2023. Participation increased from seventy-nine (79) projects in 2023 to eighty-three (83) in 2024.

The Evaluator found that comprehensive projects increased by about 70% from eleven (11) in 2023 to nineteen (19) in 2024 while prescriptive projects decreased slightly by about 6% from sixty-eight (68) in 2023 to sixty-four projects in 2024, generating 1.159 GWh in gross energy savings and 0.570 MW in peak demand savings, a decrease over 2023 by 21% and 23% respectively. The Evaluator stated that the decrease was due to lower average savings per prescriptive projects.

Observing that the energy savings per project vary since 2018, the Evaluator noted that prescriptive projects generated 80% more electrical energy savings, and 88% more peak demand savings than comprehensive projects in 2024.

2024 AMH maximum rebates did not change from the prior year. The maximum rebate per unit in a multi-unit residential building or cooperative is \$17,254. The maximum per affordable room is \$5,751. The maximum incentive for all building types is \$300,000.

The Evaluator completed an impact evaluation and a process evaluation stating that the major evaluation objectives were to:

- Collect information on Efficiency Nova Scotia program staff, participant, and Energy Advisor perspectives,
- Calculate gross and net savings results: electrical first year and lifetime energy savings, peak and demand savings, and
- Calculate avoided GHG emissions.

The Evaluator conducted:

- Interviews with program staff, participants, and Energy Advisors.
- Interviews with dropped-out participants and non-participants to analyze barriers to participation and operating agreement design.

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

- Audit tracking sheet,
- Conduct desk reviews and participant interviews.
- Update EUL
- Calculate gross and net energy and peak demand by using evaluation results and using NTGR 1,
- Calculate avoided GHG emission reduction calculations.

The Evaluator highlighted the following Affordable Multifamily Housing findings:

- There were high levels of overall satisfaction from all ten (10) participants interviewed, who stated that they “would definitely” recommend AMH to other housing and affordable multifamily residential building owners.
- Participants lack understanding of how incentives are calculated causing confusion, over rebates covering up to 80% of *pre-tax* costs.
- Project delays and withdrawals were cited by the Evaluator as caused by the need for project management and technical/maintenance support and contractor reference support among some participants as indicated by comments from Efficiency Nova Scotia, the Energy Advisors, and participant interviews.
- Barriers: Cost of upgrades coupled with no budget for building maintenance or for efficiency upgrades in addition to rental rates in the operating agreement were reasons cited among dropped out and non-participants as barriers to AMH participation.
- Audit reporting templates received low satisfaction among Energy Advisors who found that the templates’ design and the layout are not user friendly.
- Achieved 1.159 GWh in net electrical energy savings (less than the planned target of 1.900 GW) and 0.570 MW in net peak demand savings at the generator (less than the planned target of 1.581 MW).
- Achieved highest participation since AMH started in 2018 totaling eighty-three (83) projects: sixty-four (64) prescriptive projects and nineteen (19) comprehensive projects, representing a 5% increase over 2023 which totaled 79 projects.
- Achieved increased gross peak demand savings in 2024 totaling 0.570 MW compared to 0.741 in 2023, a 23% decrease.
- Evaluated net energy savings is about the same as the value as determined by the Evaluator and as tracked by Efficiency Nova Scotia, but net evaluated peak demand savings tracked by Efficiency Nova Scotia were two percent (2%) lower due to the Evaluator’s adjustments.

The Evaluator provided four (4) new recommendations:

1. Revise incentive calculations.
2. Provide technical support and handholding to Affordable Multifamily Housing participants.
3. Investigate revising audit reporting templates.
4. Inform participants early of co-financing options.

Evaluation Issues: None. 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 a good evaluation. The well-designed process evaluation contributes depth of understanding to evaluation results.

H. Affordable Single-Family Homes (ASFH)

The Affordable Single-Family Housing (ASFH) program began in 2023 and provides energy efficiency retrofits and heat pump installations at no cost to income qualified homeowners serving both electric and non-electric heated homes under the HomeWarming brand. ASFH works collaboratively with Efficiency Nova Scotia's Appliance Retirement and Efficient Product Installation programs.

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

The total number of homes with installed ASFH building envelope measures was 880 homes in 2024, the program's second year of operation, of which 696 were also heat pump installation. A total of 1,210 homes participated in ASFH in 2024, an increase compared to the 242 homes that participated in the program in 2023.

The evaluator reported 2024 ASFH gross energy savings was 3.719 GWh, an increase compared to 1.444 GWh in 2023 and total gross peak demand savings in 2024 was 2.089, an increase compared to 0.627 in 2023.

In 2024 the Evaluator completed a condensed impact evaluation stating that the major evaluation objectives were to:

- Collect information on program staff, partner and participant and perspectives.
- Calculate gross and net savings results: electrical first year and lifetime energy savings, peak and demand savings.
- Calculate avoided GHG emissions.

The Evaluator:

- Developed participant survey.
- Conducted interviews with program staff, heat pump contractors, and delivery agents (DAs)

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

- Audit tracking sheet.
- Unitary savings review.
- Update Effective Useful Life (EUL).
- Calculation of gross and net energy and peak demand by using evaluation results and using a Net-to-Gross Ratio of 1.
- Calculation of avoided GHG emission reduction calculations.

The evaluator highlighted the following Affordable Single-Family Homes findings:

- There are high levels of overall satisfaction of ASFH among surveyed participants, DAs, and heat pump contractors,
- There is dissatisfaction with ASFH's long wait times, insufficient program and product information, reporting processes, and lack of user-friendly software tools.
- The program achieved 3.719 GWh in net electrical energy savings, a 32% increase over the planned target of 2.825 GWh, and 2.089 MW in net peak demand reduction at the generator, a 100% increase over planned target of 1.046 MW.
- The program achieved 1,210 total participants in 2024 installing 880 building envelope measures of which 696 were installed heat pumps, compared to 242 participants in 2023.
- The program achieved an increased net peak demand reduction in 2024 totaling 2.089 MW compared to 0.741 in 2023, resulting in an 181% increase.
- The net energy savings and peak demand savings tracked by Efficiency Nova Scotia were lowered by 21% and 3% respectively due to the Evaluator's adjustment ratios.

The evaluator recommendations included:

1. Assess and adjust program delivery concerning participant wait times.
2. Update and provide equipment operation and maintenance information.
3. Provide more program and product information and handouts to increase participant program delivery and process understanding.
4. Update DA and contractor record keeping and reporting processes.
5. Update DA and contractor training guides.

Evaluation Issues: None. 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.

I. Residential Behavioral Program (Efficiency Insights)

The Residential Behaviour program, “Efficiency Insights”, is new for Program Year 2024, and follows a similar previous residential behaviour program, administered by Efficiency Nova Scotia several years ago.²⁶ Efficiency Insight provides recurrent information in the form of Home Energy Reports to households in the treatment group, but not to households in the control group.²⁷ Participant households receive updates every two months on their energy consumption, a comparison with energy consumption for similar homes, energy-saving behavior tips, and recommendations to participate in other Efficiency Nova Scotia (ENS) programs. Website information supplements the Home Energy Reports. The goal of Energy Insights is to promote energy-saving habits and practices, and to market and promote participation in the Administrator’s measure-based energy efficiency programs. In itself, Efficiency Insights includes no physical energy-efficiency measures.

This program differs from all other of the DSM Administrator’s programs in that it is a standalone behavioral program. It markets, promotes, motivates, and encourages energy efficient behaviors and participation in the Administrator’s measure-based energy efficiency programs. If not for the energy savings claim, the same activity would be classed as marketing and promotional support for the measure-based programs, rather than as a residential behaviour program.

Figure 10: Efficiency Insights as a Residential Behaviour Program.

The contractor for Energy Insights, Bidgely, uses proprietary algorithms to create tailored Home Energy Reports (HERs). Efficiency Nova Scotia places Efficiency Insights content into Nova Scotia Power’s customer-facing “MyEnergy Insights” (MEI) platform. Customers are requested to complete a household survey on the MEI platform. This survey information is used to semi-customize the system for each household completing a survey.

In addition, Efficiency Nova Scotia Energy Efficiency Advisors (ESAs) assist customers in understanding the information they receive in the Home Energy Reports and from the

²⁶ For the previous program, 2013 and 2014 energy savings were reported in the evaluation for 2014, completed in 2015.

²⁷ Energy Insights was introduced in May 2024. There were four Home Energy Reports for each participating household (paper and electronic), keyed to the every-two-month (bimestrial) bill received from Nova Scotia Power. The plan is that for a full year of operation there will be “up to” six Home Energy Reports per household.

MEI platform.²⁸ They also provide guidance to customers to ensure fitness between the household and Efficiency Nova Scotia measure-based energy efficiency programs.

Program & Evaluation Design. The program contractor provided the Home Energy Reports, while the evaluator (Econoler) implemented key program design elements necessary to support the evaluation and conducted the evaluation. The target population is residential customers (rate codes 02B and 03B). The evaluator identified the target customers, ensuring that each household had an active account with bills over the prior year (2023) baseline period. The design is for an opt-out program, where the evaluator selects the participant households instead of the households choosing to join the residential behavior program.²⁹

The evaluator split Nova Scotia Power Inc. (NSPI) residential customers into three energy usage (kWh) groups. Then each energy usage group was split into a Treatment group and a Control group using the method of random assignment (Figure 1).^{30,31} In this design, the Treatment and control group should be essentially equivalent in the pre-program period, but the Control group is expected to use more energy than the treatment group once the program is implemented, as shown by the difference in the height of the green and blue bars in Figure 11. Estimated Program Savings is constructed as a difference of differences. First, for each energy usage group for (Treatment and Control) we compute the difference in kWh between the pre-program year (2023) and the program year (May through December 2024).

The difference of these differences is the estimated program energy savings (here the cumulative estimate of energy savings, prior to taking effects of savings from other program into account).³²

²⁸ The ESAs assist both participants assigned to the Efficiency Insights program and non-participants.

²⁹ Households assigned to the program by the evaluator could opt-out by Internet or by contacting Efficiency Nova Scotia and requesting to opt-out. Opt-out designs have two advantages over opt-in designs. First, opt-out programs generally capture more participants than opt-in programs, since effort is required to opt-out; second, if comparisons are planned, programs designed as opt-out more closely resemble the typical mix of customers, while opt-in customer groups are usually different from the typical customer mix, and so results of program are more difficult to compare to the regular customer mix over time.

³⁰ Econoler does not provide a description of the procedure, or a textual reference or computer program reference to indicate how the random assignment process was carried out.

³¹ Figure 11 is modified from Figure 7 in State and Local Energy Action Network, *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations*, 2012. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkely National Laboratory (<http://behavioranalytics.lbl.gov>), hereinafter SEE Action, Figure 7, Page 11.

³² The method is sometimes called a “Difference in Differences” (DiD) approach (SEE Action, P. 26) or a

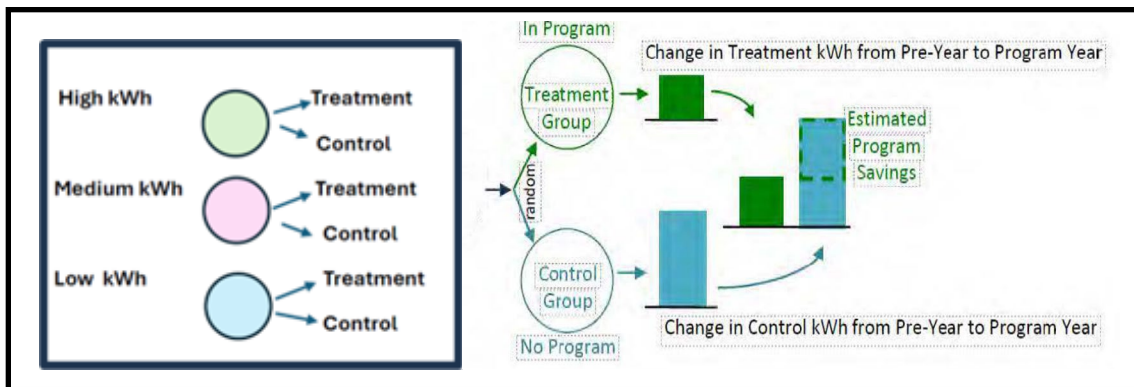


Figure 11: Random Assignment from Usage Groups to Treatment and Control.

Customers were partitioned into three energy use subgroups based on energy consumption (Table 4).³³ Then each energy use group was split into Treatment group and Control group using random assignment of cases resulting in six subgroups.

Table 4: Energy Use Ranges for Subgroups.

Energy Use Range by Subgroup (kWh/Year)		
Energy Use Subgroup	From	To
High	11,200	36,000
Medium	6,000	11,200
Low	730	6,000

“Separate Sample Pretest-Posttest Design” (Campbell, Donald T. & Julian C. Stanley, *Experimental and Quasi-Experimental Designs for Research*. Houghton, Mifflin and Company, 1963. Pp. 53-54. The “other programs” referred to are the measure-based programs for which Efficiency Insights encourages participation. Savings from participation in the measure-based programs is partitioned away and accounted to those programs (and not accounted as residential behaviour program savings).

³³ Energy use ranges for the treatment and control subgroups were uniform and were set as follows: High users: “...the upper limit was set at 36,500 kWh per year, which corresponds to 100 kWh per day on average. It was observed that only 0.5% of customers have an annual consumption over that limit. Thus, the upper limit allows to keep most customers inside the analysis, while limiting the risk of having unusual residential usage which would increase the variability in the consumption profiles.” Medium users: “...the intermediate limits were set at 6,000 kWh per year and 11,200 kWh per year to split the three (usage groups) relatively equally, with a small decrease in the number of customers in the medium and low (usage groups) to have more homogeneity and more chance to detect savings which are assumed to be lower in these (groups). Low users: “...the lower limit was set at 730 kWh per year, corresponding to an average daily consumption of 2 kWh per day, which is considered low. The distribution showed that only 0.5% of customers have annual consumption under that limit. Numbers in Table 1 and description of ranges from Pénélope Lévesque, Econoler, Email.

Attrition. Using these subgroup definitions, Table 5 shows the initial group sizes in March 2024, reduced group sizes in May 2024, and attrition for this period from sample selection to launch of the program.

Table 5: Attrition from March to May 2024.

Attrition (March 2024 - May 2024)						
Energy Use Subgroup	Treatment Group					
	March 2024		May 2024		Attrition	
	n	%	n	%	n	%
High	101,273	39%	97,368	41%	3,905	4%
Medium	93,233	36%	88,482	37%	4,751	5%
Low	66,708	26%	53,459	22%	13,249	20%
Total	261,214	100%	239,309	100%	21,905	8%
Energy Use Subgroup	Control Group					
	March 2024		May 2024		Attrition	
	n	%	n	%	n	%
High	17,859	31%	17,228	34%	631	4%
Medium	10,519	18%	9,927	20%	592	6%
Low	28,695	50%	22,976	46%	5,719	20%
Total	57,073	100%	50,131	100%	6,942	12%
Source: Group sizes are from Table 80, 2024 Treatment and Control Group Sizes, Econoler Residential Behaviour Evaluation, P. 184. Attrition is Change in number of households from March through May divided by initial number of households in May and expressed as a percentage.						

Table 6 shows group sizes at program launch in May 2024, reduced group sizes at the end of December 2024, and attrition for the first program year.³⁴

³⁴ Due to the program launch in May 2024, the first program year contains only eight months in order to align with the Efficiency Nova Scotia program year.

Table 6: Attrition from May 2024 to End of December 2024.

Attrition (May 2024 - December 31, 2024)						
Energy Use Subgroup	Treatment Group					
	May 2024		December 2024		Attrition	
	n	%	n	%	n	%
High	97,368	41%	92,268	41%	5,100	5.2%
Medium	88,482	37%	83,903	37%	4,579	5.2%
Low	53,459	22%	49,699	22%	3,760	7.0%
Total	239,309	100%	225,870	100%	13,439	5.6%
Energy Use Subgroup	Control Group					
	May 2024		December 2024		Attrition	
	%	n	n	%	n	%
High	17,228	34%	16,284	35%	944	5.5%
Medium	9,927	20%	9,422	20%	505	5.1%
Low	22,976	46%	21,328	45%	1,648	7.2%
Total	50,131	100%	47,024	100%	3,107	6.2%
Source: For May, group sizes are from Table 80, 2024 Treatment and Control Group Sizes, Econoler Residential Behaviour Evaluation, P. 184. For December, Treatment Group numbers are from Table 1: 2024 Residential Behaviour Evaluated Electricity Monthly Energy Savings in Econoler Existing Residential Program Final Appendix Report, P. 209. Change in number of households from March through December divided by initial number of households in May and expressed as a percentage.						

The reduction of group sizes over time occurs due to several factors. First, there are account closures, for example, due to death of the last person in an elderly household. Second there are ordinary move-outs. According to the evaluator, Efficiency Insights reports are discontinued if an account becomes inactive due to closure or a move.

In addition, it was determined by E1 and Econoler jointly that households that opt to

incorporate a solar DSM resource in the home will also be terminated from the program. This is necessary because utilities track only kWh supplied by the utility plus any kWh supplied to the grid by a household solar energy system, and do not track the output of solar systems used by the households.³⁵

However, customers who opt-in to other DSM technology options remain in the program. For these customers, the evaluator estimates program savings to the household from the additional program(s). These energy savings are then credited to the program(s) in which they are caused, and are deducted from the Efficiency Insights program, avoiding double counting.

Overall, attrition looks well-behaved and normal for this type of analysis.

Equivalence. In the 2024 Evaluation report for Residential Behaviour, Table 82, Average Daily Electricity Consumption Values for the Pre-program period, and Table 83, Distribution of Geographical Locations, the evaluator demonstrates the equivalence of the treatment and control groups on these variables for each usage group. For completion, there should be an overall comparison of Treatment vs. Control.³⁶

Effective Useful Life. The evaluator provides a general definition of effective useful life (EUL) as “the period a measure is expected to be in service and provide both energy and peak demand savings. This value combines equipment life and measure persistence, which includes factors such as business turnover or early retirement.” Demand savings are not relevant for the Efficiency Insights program since no demand reduction is claimed, so only energy is involved for the EUL for this program. The evaluator counts the EUL for Efficiency Insights as one year, equivalent to the estimated first year energy savings. Since no identified physical measure is installed for the Efficiency Insights program, the normal construction of EUL based on engineering analysis of specific home improvements does not apply. However, in the behaviour context, there is an estimated first year energy savings developed from a statistical calculation. The conservative practice is to claim only an EUL equivalent to the estimated first year energy savings, and no energy savings in subsequent years.³⁷ According to the Uniform Methods Project, “...the default assumption for most BB program administrators has been that behavioral savings do not persist, and that

³⁵ Some solar vendors provide an app by means of which a household can track solar system production of kWh by day and month, but there are many vendors and trying to acquire this information would be difficult.

³⁶ Econoler Residential Behaviour Report, Existing Residential, Pp. 190-191.

³⁷ Uniform Methods Project, *Residential Behavior Protocol*, August 2014 (<https://www.energy.gov/sites/prod/files/2015/02/f19/UMPCChapter17-residential-behavior.pdf>).

measure life is 1 year.” There are some studies that claim longer measure life. However, these studies do not agree among themselves, so that any attempt to assert some form of persistence of energy savings beyond one year is situational. To be conservative, crediting additional years would require continuous measurement with a control group, rather than a formula approach. In this context, the one-year value selected by the evaluator is reasonable.

Free Riders. If the random assignment works as planned, it assigns any free riders equally to the treatment and control groups, so that the effect of free riders cancels out in the subtraction of one group from the other.³⁸

Requirement for Independent Evaluation. The Econoler evaluation of the Efficiency Insights program *fully meets* the requirement for an independent third-party evaluation for which the evaluator (and not the program vendor) defines and implements the program evaluation. Econoler’s responsibility for the evaluation is complete, including the randomized assignment of households to treatment and control group, the technical definition of the energy use subgroups, data selection and cleaning, and all results calculations.³⁹

The standard is summarized in Figure 12: Evaluation Protocol Requirement for Evaluator Responsibility Met..⁴⁰ Using the SEE Action protocol, the Econoler Efficiency Insights evaluation has a top rating (five stars) on this criterion, and the alternative of assigning responsibility for any of these steps to the program vendor is not advised. Meeting this standard is required to guarantee the integrity of reported energy savings and to prevent any actual conflict of interest and also to prevent any appearance of conflict of interest. Evaluator and program vendor responsibilities are shown in Figure 13: Evaluator Responsibility for 2024 Behaviour Program Evaluation., based on

³⁸ We say, “if random assignment works as planned” because random assignment is a process, in which, if correctly performed, there is no bias *in the long run with repeated studies*, but there is no guarantee in any single application. There may be bias in any single application of random assignment: “...it is only in the long run that we can make claims about the unbiasedness of our estimation and testing procedures.” See Owora, AH, Dawson, J., Gadbury, G, Mestre, LM, Pavela, G, Mehta, T, Vorlad, CJ, Xun, P. and Allison, DB, “Randomization Can Do Many Things – But It Cannot “Fail.” Pp. 20-23, *Significance*, February 2022.

³⁹ Econoler fully meets the requirements of the State and Local Energy Action Network protocol for residential behavioral programs (see footnote 11) and the Uniform Methods Project, *Residential Behavior Protocol*, August 2014 (<https://www.energy.gov/sites/prod/files/2015/02/f19/UMPCChapter17-residential-behavior.pdf>).

⁴⁰ State and Local Energy Action Network, *Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations*, 2012. Prepared by A. Todd, E. Stuart, S. Schiller, and C. Goldman, Lawrence Berkely National Laboratory (<http://behavioranalytics.lbl.gov>). See Section 3.2.1, Page 22.

information provided in the evaluation.

Star Rating	Condition
★★★★★	An independent, third-party evaluator transparently defines and implements: • Program evaluation • Assignment of households to control and treatment groups • Data selection and cleaning, including identification and treatment of missing values, outliers, and account closures, and the normalization of billing cycle days
★Not Advisable★	Program implementer or sponsor implements any of the above activities

Figure 12: Evaluation Protocol Requirement for Evaluator Responsibility Met.

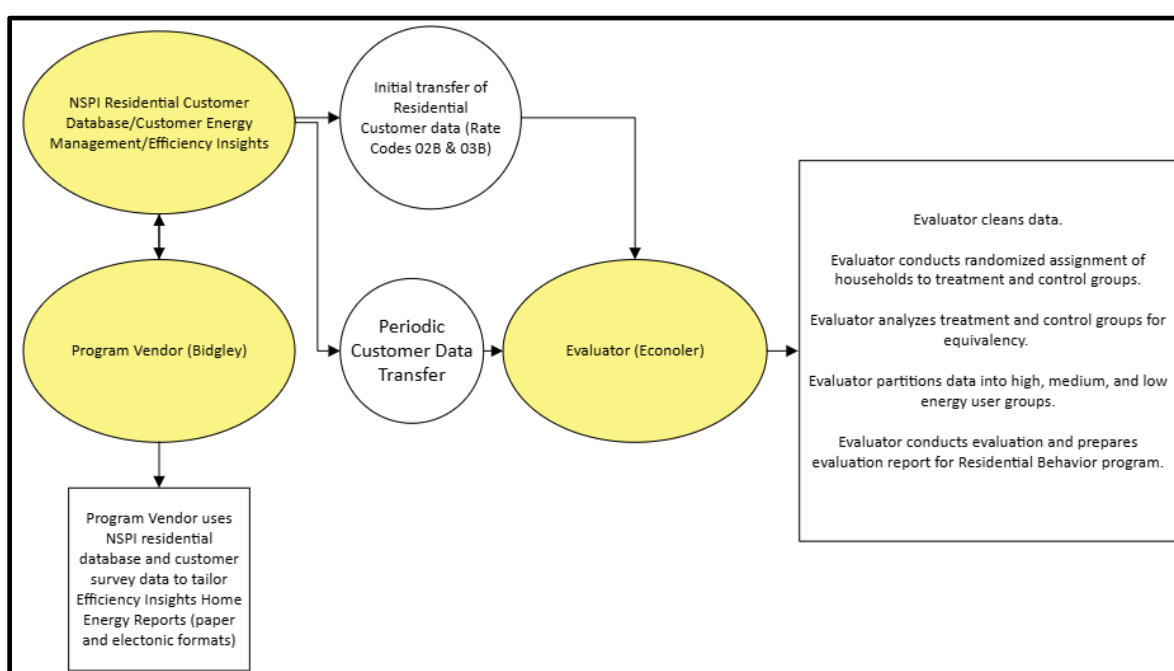


Figure 13: Evaluator Responsibility for 2024 Behaviour Program Evaluation.

Standard Data Preparation. The evaluator cleaned the data set by removing outliers, removing any duplicate data, and by removing customer accounts that became inactive due to moving or the customer closing the account. These steps in data cleaning are standard.

Opt-Out Accounts. Opted-out accounts (actual opt-outs and households that are treated as opt-outs because they did not receive electronic or paper Home Energy Reports (due, for example to an invalid address or to not being registered with the NSP MyAccount) were kept in the analysis to avoid unbalancing the treatment and control

groups.⁴¹

What are the Program Objectives? The residential behavior program has two objectives:

- (1) Encourage participation in measure-based residential energy efficiency programs.
- (2) Influence customer perceptions and behaviors in operation of the home to produce energy (kWh) savings.

Does Efficiency Insights Encourage Participation in the Other Programs? The answer is a *very tiny* bit “yes,” but *preponderantly* “no.” First, a tiny bit “yes,” since the program has the structure of a marketing and promotional program and has been put into place to encourage participation in the offered measure-based programs and there is indication of a very tiny effect in three out of nine similar tests. The effect is so small as not to warrant practical value; however, it can be claimed to be there. At the same time, the more practical answer is *preponderantly* “no”, since Efficiency Insights has nearly zero effectiveness, as measured by the Evaluator, in the “Difference” column, which records the *size of the claimed effect* (Table 7). In this table, the Evaluator runs analysis to determine a claimed effect for causing participation in the measure-based programs.⁴² Out of nine similar analyses of possible effect, the Evaluator only claims a (very tiny) effect for three of the nine analyses (one-third).

The three claims include for Green Heat (2 analyses out of 3), although the magnitude of each is only 0.1% (a participation difference of one-tenth of one percent, which is far too small to be of practical importance). The other claim is for Efficient Products Installation (1 analysis out of 3), which is also tiny (0.4% or four-tenths of one percent). There is no claim for Home Energy Assessment program (0 out of 3).

⁴¹ The Evaluator cites the Universal Methods Project, “Evaluators should include opt-out subjects in the energy savings analysis to obtain unbiased savings estimates.... Removing opt-out subjects from the analysis would bias the savings estimate because certain subjects in the control group would have opted out if they had been treated but it is impossible to know who that might be in the control group.” UMP, Chapter 17, p. 10. And according to SEE Action protocol, “Households that opt out should never be excluded from the dataset; they should be included as part of the treatment group to avoid selection bias. If households that opt out of a program are excluded from the treatment group, then the treatment group no longer contains the same types of households as the control group (because these people cannot be excluded from the control group).” SEE Action, P. 10

⁴² Percentage data in the table is from Econoler Table 85: Other Program Participation Levels. Econoler, Residential Behavior, P. 195. The “Claimed Effect” column reflects results of Econoler significance testing.

Statistical significance testing assesses the likelihood of an event occurring by chance over repeated tests, and can be an aid in academic work, particularly in theory development. In contrast, in applied statistics, for business cases, practical significance is favored due, in part, to a need to focus on cost-effectiveness and value as measured by production. In applied statistics, this is the effect size or practical importance (Figure 14: Statistical Significance vs. Importance.)⁴³

It is essential not to confuse the statistical usage of “significance” with the everyday usage. In everyday usage, “significant” means “of practical importance,” or simply “important.” In statistical usage “significant” means “signifying a characteristic of the population from which the sample is drawn.” Wallis, W. Allen & Harry V. Roberts, *Statistics: A New Approach*. Glencoe: Free Press, 1956, P. 385.

Figure 14: Statistical Significance vs. Importance.

Table 7: Evaluation Claimed Influence on Participation in Other Programs.

Measure-Based Program Encouragement Results (Difference of Means)				
Subgroup	Treatment	Control	(Size of) Difference	(Is There a) Claimed Effect
High Energy Use				
HEA	1.6%	1.7%	-0.1%	No
Green Heat	0.4%	0.3%	0.1%	Yes
EPI	2.0%	1.6%	0.4%	Yes
Medium Energy Use				
HEA	1.6%	1.7%	-0.1%	No
Green Heat	0.2%	0.1%	0.1%	Yes
EPI	2.1%	1.9%	0.2%	No
Low Energy Use				
HEA	1.0%	0.9%	0.1%	No
Green Heat	0.0%	0.0%	0.0%	No
EPI	1.3%	1.3%	0.9%	No

⁴³ Wallis, W. Allen & Harry V. Roberts, *Statistics: A New Approach*. Glencoe: Free Press, 1956, P. 385. Sociologists have been alerted to this difference between statistical significance and practical importance for some decades. Morrison, Denton & Ramon E. Henkel, *The Significance Test Controversy: A Reader*. Chicago, Aldine, 1970. The center of the focus on reinterpreting testing to follow the approach of W.S. Gosset rather than the approach of R.A. Fisher has been the American Statistical Association (see footnote 52) and the discipline of psychology, particularly the work of Jacob Cohen, such as Cohen, Jacob, *Statistical Power Analysis for the Behavioral Sciences, Second Edition*. Hillsdale, New Jersey, Hove, and London: Lawrence Erlbaum Associates, 1988.

Initial Calculations of Energy Savings. An initial estimate of energy savings is developed by the Evaluator using a standard difference-in-difference approach. Savings are calculated in two ways, using average daily consumption and using monthly savings. The equation for development of cumulative savings is given by Econoler as shown in Figure 15,⁴⁴ and this is the approach used to report results for the evaluation. This cumulative savings is based on daily metered data, and adjusted for control group savings is not yet adjusted to account for participation in other DSM programs, which requires additional calculations.

$$\begin{aligned} \text{Cumulative Savings} &= [(Post_kWh_{Control} - Post_kWh_{Treat}) - (Pre_kWh_{Control} - Pre_kWh_{Treat})] \\ &\times \sum_{i=1}^N Nb_Days \end{aligned}$$

Figure 15: Equation for Cumulative Savings.

Savings Deductions for Participation in Other Residential Programs. Section 31.2.8 of the Residential Behavior evaluation gives the equation for adjustment of cumulative energy savings for energy savings due to other DSM programs as shown in Figure 16: Equation for Net Energy Savings.

$$\text{Net Savings} = \text{Cumulative Savings} - \text{Savings Deductions for Participation in Other Programs.}$$

Figure 16: Equation for Net Energy Savings.

Final savings results following application of this equation by Econoler are shown in Table 8.

⁴⁴ Source: Econoler Residential Behavior Evaluation in Existing Residential, P. 192.

Table 8: Evaluated Net Energy Savings.

Evaluated Net Energy Savings			
Energy Use Subgroup	Cumulative Energy Savings (GWh)	Savings Deductions for Other Programs	Net Energy Savings (GWh)
High	3.051	0.354	2.696
Medium	2.837	0.044	2.793
Low	0.781	0.000	0.781
Total	6.669	0.398	6.270
Source: Data from Table 86, Evaluated Residential Behaviour Net Electrical Energy Savings, Econoler Residential Behaviour Evaluation (Existing Programs, P. 195).			

The behavioral energy use data is very similar to directly metered data since it is directly metered data with adjustment. The other DSM programs report estimated first-year energy savings, and none or almost none of this is directly metered. Although both are represented by numbers which can be added or subtracted, the *qualities* of the numbers derived from the two systems are different. There may be different ways to approach this problem. Econoler's approach to quantitatively combining numbers which are qualitatively different is practical: "The savings deductions for the measures installed in other DSM programs do not need to match the savings derived from consumption data. The savings deductions are made to remove savings that were already claimed in the other DSM programs to avoid double counting. They need to match the unitary savings value claimed in the other DSM program and be removed from the Residential Behavior savings to account for the higher proportion of participants in other DSM programs in the treatment group compared with the control group."⁴⁵ This may not fully address the complexity of combining the numbers from two qualitatively different systems for generating numbers, but it does prevent any obvious double counting.

Sample Size and Statistical Significance. Use of statistical significance testing for very large sample sizes is *questionable* since, historically, these tests were developed for a much smaller range of sample sizes. There exists a tension between two principles. The first principle is that in both physical and social science sampling, increasing sample sizes is generally regarded as beneficial. This is due to the fact that larger sample sizes enhance the likelihood of achieving statistically significant results (Figure 17).

⁴⁵ Marie Couture-Roy, Econoler, Email.

The larger the sample size, other things being equal, the smaller the error and the greater the reliability or precision of results.

Figure 17: Increasing Sample Size Increases Precision.

With a sufficiently large sample, a statistical test will almost always demonstrate a significant difference, unless there is no effect whatsoever, that is, when the effect size is exactly zero; yet very small differences, even if significant, are often meaningless.

Figure 18: Very Large N Tends to Make All Differences Statistically Significant.

However, there is also *counter-principle for very large sample sizes* (as used in the current study). *For large sample sizes, the number of cases included in the analysis is a primary driver of statistical significance assigned to analysis results* (Figure 8).⁴⁶ For residential behaviour studies statistical significance typically becomes an artifact of sample size. The solution to this problem is to drop statistical significance and focus on effect size.⁴⁷

We can see the effect of the number of cases on statistical significance (or margin of error) used in an analysis in the evaluator's contrast of results of two approaches for calculation of energy savings. These are a monthly method and the use of a daily average for a defined year. When months are individually analyzed and the results of each month's analysis then added together to get energy savings for the year, the result is different from the result derived by aggregating daily values over a year, calculating a single average and multiplying it by the number of days to get a value for the year.

Here is how it happens: Each month has approximately thirty days, so the estimate of energy savings for that month is based on (approximately) $n=30$ daily values for each house.⁴⁸ This causes most of the monthly results to fail the test for margin of error.

⁴⁶ Figure 8 is from Sullivan, Gail M. & Richard Fein, "Using Effect Size—or Why the P Value Is Not Enough," *Journal of Graduate Medical Education*, September 2012, Pp. 279-282.

⁴⁷ See Lantz, Björn, "The Large Sample Size Fallacy," *Scandinavian Journal of Caring Sciences*, 2013, Vol. 27, Pp. 487-492.

⁴⁸ In developing the cumulative savings, although the value for a day is aggregated up from smaller observations, the unit in the monthly analysis is a day, so there are (approximately) 30 observations per household.

Another way to say this is that for most months the effect size (average kWh savings per household) is *extremely* small, and the number of observations is not large enough to detect it.⁴⁹

The data quality rule used for use of the margin of error result by the evaluator requires not recognizing (assigning a value of zero to) cumulative energy savings for most months in the analysis. For high users, values are counted only for October and November (1.764 kWh). For medium users, only the value for October (0.585 kWh) is counted. For low users, only the value for December (0.267 kWh) is counted.⁵⁰

In contrast, if the calculation is done for a year, all of the days in the year are counted as observations and a mean energy use per day is calculated and this can be projected to a total for the year without losing observations. So, for a year defined as eight months, then $8 \times 30 =$ approximately 240 observations are available and are included in the estimation process for each household. Given the number of households in the yearly analysis using the average day method, the calculation yields strong statistical significance. This has the effect of *appearing* to validate cumulative energy savings built up from meaningless average daily savings at the household level of 0.062 kWh/day to 0.135 kWh/day.

When sample sizes become extremely large, traditional tests of statistical significance can become misleading. The reason is that p-values are highly sensitive to sample size. When working with small-to-moderate samples, statistical significance generally reflects meaningful differences. However, in very large samples even minuscule effect sizes become statistically significant simply due to the sheer volume of observations. This leads to a situation where practically meaningless differences are labelled "significant" according to conventional tests.

Statisticians are not in agreement as to whether significance testing is useful in such cases. Some argue that tests may still provide insights, but they must be interpreted carefully. Some suggest that effect sizes (such as Cohen's d or the magnitude of correlation coefficients) become much more important than p-values. This means that the device of significance testing is out of its productive range at this scale and that

⁴⁹ At the individual household level, the effect size for high users is 0.132 kWh per day, (0.34% of average daily consumption) for medium users at 0.135 kWh/day (0.62% of average daily consumption), and for low energy users at 0.062 kWh/day (0.57% of average daily consumption). See Table 84, 2024 Evaluated Cumulative Electrical Energy Savings, Econoler Residential Behavior Evaluation, Existing Programs, Pp. 192-193.

⁵⁰ Econoler, Existing Residential Program, Final Appendix Report, Table 1: 2024 Residential Behaviour Evaluated Electricity Monthly Energy Savings, "Total Monthly Savings" line for each kWh usage group (high, medium, low).

practical significance (effect size) rather than statistical significance should be used as the criterion.

Sampling and Independence of Cases. Regarding independence of cases—standard significance tests assume that the observations are completely independent of each other.⁵¹ If there is dependency within the data, standard statistical tests can produce misleading results. In the current study, we have energy use data from multiple measurements on households. The equivalence analysis is sufficient to show that there is no geographical pattern. However, we know that weather has not been accounted for and that within a utility data is highly influenced by days, months, and years of weather patterns and climate trends—so the observations are not fully independent of each other but are chained and run in a pattern.

Because significance and confidence are driven by number of cases and the cases are joined physically by environmental and weather conditions, and so are not really independent, statisticians may question reliance on the use of statistical significance testing for very large samples. This is particularly true when the values of individual household energy savings are too small to be meaningful to the individual household, as they are in the current study, but the level of significance is high *as an artifact of sample size*.

Effect Size at the Household Level. For high users the evaluator reports the effect size per household at 0.132 kWh per day, (0.34% of average daily consumption) for medium users at 0.135 kWh/day (0.62% of average daily consumption), and for low energy users at 0.062 kWh/day (0.57% of average daily consumption), all less than one-percent per day. If we were interested in the effect per home, these effect sizes are far too small to be meaningful, and *it would be appropriate to avoid crediting energy savings to the Efficiency Insights program at the household level*.

Effect Size at the System Level. However, at the system level we are not interested in energy savings per household, but in the aggregate effect of the program at the level of the utility system. According to the evaluator's analysis, this is approximately 6.27 GWh for an eight-month period, defined as a year.⁵²

When we evaluate a measure-based energy efficiency program, we can have metered measurement backed up by engineering estimates. For The Efficiency Insights

⁵¹ Picture the standard statistical example of drawing balls from an urn. In this example, each case is completely independent of the others.

⁵² Table 86, Evaluated 2024 Residential Behavior Net Electrical Energy Savings, Econoler Residential Behavior Evaluation, Existing Programs, P. 195.

program, since there are no physical measures installed, we have only the metered (AMI) based result, which is a black box, and the countable result of 6.27 GWh is an artifact of sample size in that for residential behaviour projects the very large sample sizes are necessary to detect household energy savings. The statistical significance of results is not relevant because with the very large sample sizes, nearly everything that might be measured comes out as statistically significant. Instead, when sample sizes are very large (as they are in residential behaviour studies), we need to look at effect size as our criterion.

If we were looking at kW rather than kWh, we could focus on the value of the size of the kW impact at specific hours of the year to show a value for system planning, and it might be that at some particular hours, perhaps at yearly system peak or some other peak, a very small kW improvement would be of value. However, the indicator for this program is energy rather than demand.

For the aggregate GWh savings claim to have value for energy savings from this project as a meaningful result, we would need to see how NSPI values this size (6.27 GWh per year spread out over all the feeders of the system and all the days of the year and also spread over something like 80% of residential customers). Knowing how the effect is generated from practically meaningless savings per household and without installation of any physical program measures, would this actually have any practical impact on decisions for the next new power plants?

1. Findings (Observations Regarding the Evaluation)

This evaluation is well constructed at a technical level, is well executed, and fully meets the requirements of the two most relevant evaluation protocols (Universal Methods Project and SEE Action). However, neither protocol addresses the tension evident due to the very large sample sizes and extremely small effect sizes typical of residential behaviour evaluations. Neither protocol has been updated to current, more limited, understandings of statistical significance⁵³ and the process nature of randomized controlled trials. Neither has been adjusted to shift from statistical significance to consideration of practical effect size and making the business case as the primary criterion for assessing results.

⁵³ Here are some of the current perspectives on P-values: P-values do not measure the probability that the studied hypothesis is true, or the probability that the data were produced by random chance alone; Scientific conclusions and business or policy decisions should not be based only on whether a p-value passes a specific threshold; A p-value, or statistical significance, does not measure the size of an effect or the importance of a result; By itself, a p-value does not provide a good measure of evidence regarding a model or hypothesis. American Statistical Association Releases Statement on Statistical Significance and P-Values, Provides Principles to Improve the Conduct and Interpretation of Quantitative Science, March 7, 2016 (www.amstat.org/asa/files/pdfs/p-valuestatement.pdf).

At the utility system level, the effect size for the first year is 6.27 GWh. Unless NSP demonstrates otherwise, this is not a meaningful effect size at the system level. For comparison, the NSP system requirement was 11,326.3 GWh for 2024,⁵⁴ so this is about 0.06% (six one-hundredths of one percent).

There is a problem with large sample sizes and statistical significance, so statistical significance for the 6.27 GWh should be disregarded.

As with statistical advice that would apply at the household level for an effect size so small as to be meaningless, 6.27 GWh is likely meaningless at the system level. Due to the effect size at the household level, a savings claim for the program does not make sense. Similarly, unless NSP demonstrates otherwise, a 6.27 GWh effect at the system level means that a savings claim for the program at the system level does not make sense.⁵⁵

Currently, behavioural RCTs, of which the current program is an example, are *black boxes*. There is no coherent specification of the mechanism or warrant, either of specific behaviors that would save energy or of how much energy would be saved through these (unknown) behaviours. A more robust approach to RCTs has been specified by Cartwright and Hardie.⁵⁶ This approach requires establishing warrants. Warrants are arguments for why the program should work, a set of reasons that specify both mechanism and why the mechanism will function.⁵⁷ They involve specification of causal roles and support factors. In addition, if warrants and causal relations can be specified and specific action effects found, we will want to understand these in relation to the separate program elements (Home Energy Reports, resources on the website, usefulness and effectiveness of behavioral tips, effectiveness of recruitment to participate in other measure-based programs, and the effectiveness of interaction with energy advisors). There should be a very careful exploration and analysis of whether the energy advisors provide different levels of support to Treatment and Control households as well as careful analysis of records of interactions with each. For

⁵⁴ Nova Scotia Power, Total System Requirements, 2024, Non-Confidential Annual FAM Reporting, NSPI (FAM), A8. This includes self-generation, interprovincial supply, and supply from US.

⁵⁵ It is not unusual for organizations with targets to meet to maximize production of numbers that appear to reach toward targets. The problem is to not run a “numbers producing process” in the abstract, but to keep a focus on targets that are meaningful to households and to the utility system.

⁵⁶ Cartwright, Nancy & Jeremy Hardie, *Evidence-Based Policy, A Practical Guide to Doing Better*. Oxford & New York: Oxford University Press, 2012.

⁵⁷ A full discussion of claims, grounds, warrants, backing, modal qualifiers, and possible rebuttals is developed by Toulmin, Rieke, and Janik in *An Introduction to Reasoning*. New York, Macmillan Publishing & Collier MacMillan, Canada, 1979.

example, who (and what percentage) in Treatment and Control has contacted an Energy Efficiency Advisor, and when? Do those who contact an advisor achieve greater energy savings? Separately, we need analysis that tracks the completion of the survey (or not) and how timing of completion of the survey affects actions and energy savings subsequent to that completion. Analyses regarding energy savings could be performed using data that should already be in hand, and subsequent process evaluation could explore how specific customer actions might have been affected.

2. Recommendations

SVR2024-Behaviour-5. Overall, we recommend that the program be continued, but not as a direct energy savings program. Rather, it should be redesigned and evaluated as a marketing and promotional program designed to (1) support recruitment for the Administrator's measure-based programs and (2) to foster overall awareness and motivation for energy efficiency among customers. Without substantial improvement, its independent contribution to energy savings at a household level is too small to be credible as an energy saving program, and the same assertion is reasonable at the utility system level.

SVR2024-Behaviour-6. If the program is continued, the process evaluation now planned is a good idea. One important factor to examine would be how the program could be improved in terms of its impact for the customer at the household level to produce meaningful energy savings. In addition to attempting to cause participation in the Administrator's measure-based programs (currently very weak effect), another goal of Efficiency Insights is to promote energy-saving habits and practices. But what behaviors will produce *real energy savings* at the household level? There has been no attempt to check systematically yet on what practices are being adopted, and *what practices would have measurable effect of a reasonable size*, and *what percentages of participant households vs. control households are adopting different behaviors*. That information might be very helpful for optimizing program design.

SVR2024-Behaviour-7. Although we know that the practical effect on energy savings so far is not meaningful either at the household level or at the system level, there could be meaningful changes in some households that get washed out in averaging. So it would be useful to partition household results by kWh savings (effect size) and focus on homes in both the treatment and control groups with relatively high energy savings (after eliminating the possibility of double counting due to program participation overlaps) *to find out if there are*

actions that are practical and effective rather than simply signaling weak attempts to become more energy efficient.

3. Residential Behaviour Program - Summary

The table below summarized our review of the behaviour program evaluation. Green indicates good practice, and red indicates evaluation issues.

Table 9: 2024 Residential Behavior Program - Summary.

2024 Residential Behavior Program - Summary	
Program Setup	The basic program design "Separate Sample Pretest-Posttest" or "Difference in Differences" design is sound.
	The choice of an opt-out design is reasonable and provides some advantages
Random Assignment	Random assignment of customers to Treatment and Control groups is reasonable and is the standard procedure.
	In order to keep balance in subgroups, the Evaluator chose not to do an initial random assignment to Treatment and Control groups. Instead, the Evaluator first partitioned cases into three classifications of household energy use (high, medium, low). Second, within each classification, households were assigned to Treatment and Control groups for analysis. No overall comparison of Treatment and Control groups was carried out. However, analysis by subgroup can be considered sufficient.
Establishing Usage Subgroups	Creation of energy usage subgroups (high, medium, low) is reasonable.
	However, the process of selection of cutoffs for the groups should be described and the cutoffs should be given. Cutoffs were provided by the Evaluator on request.
Accounting for Attrition	Attrition of households between assignment to groups in March and the program launch in May 2024 is well analyzed and developed in presentation.
	Attrition between program launch in May 2024 and end of year on December 31, 2024, is not well analyzed or developed in the evaluation, but was provided by the Evaluator on request.
Equivalence Check	The equivalence check is well analyzed and presented.
Independent Evaluation	Econoler has carried out a fully independent third-party evaluation and has met the requirements of the two most relevant evaluation protocols.

2024 Residential Behavior Program - Summary	
Effective Useful Life	The one-year value for program energy savings is conservative and reasonable.
Data Preparation	The evaluator carried out standard data cleaning appropriately.
Switching Out Solar Choice Homes	Solar homes could not be included in the calculations because NSPI does not track output of home solar energy systems. This data element is missing. This is typical of utilities concerning output of third-party solar.
Keeping Opt-Outs	Actual opt-outs and other households treated as opt-outs were kept in the analysis to avoid unbalancing the treatment and control groups. The Evaluator has adequately cited this procedure to the Universal Methods Project and the SEE Action protocols.
Initial Calculation of Energy Savings	The initial calculation of cumulative savings based on daily metered data and adjusted for control group savings (but not yet adjusted for household participation in other (measure-based) DSM programs is sound.
	The analysis is influenced by the large sample size of households and the small savings per household. This issue was not considered in the analysis. We recommend avoiding the use of p-values or statistical significance in this analysis. Instead, the focus should be on practical effect size (kWh savings) at both the household level and the system level. The evaluator should provide a business case for why the small savings per household or at the utility level justify funding the program as currently designed.
Savings Deductions for Participation in Other Residential Programs	The Evaluator conducted an analysis to distinguish energy savings attributable to participation in the measure-based programs from the savings due to the behavior program itself.
	The method used by the Evaluator is practical and adequate.
Sample Size and Statistical Significance	There is no discussion of the problem of large sample size associated with residential behaviour programs. Next time, a discussion of the relation of sample size and statistical significance in large samples should be added to the evaluation.
Sampling and Independence of Cases	Significance testing yields greater precision as the number of cases in the analysis increases if the cases are fully independent of each other. The equivalence analysis conducted by the Evaluator is sufficient for this evaluation.

2024 Residential Behavior Program - Summary	
Effect Size (at household level)	The results of this evaluation at the household level are too small to have any meaning. Very low household effect size is typical of residential behavioral programs, which suggests that they should be characterized as enabling (marketing and promotional) programs. Next time, this problem should be brought forward in the evaluation and discussed.
Effect Size (at utility system level)	At the utility system level, the effect size for the first year is 6.27 GWh. For system planning purposes, this effect size may not be of practical value at the system level unless NSP provides additional information. The Evaluator should consider that the 6.27 GWh encompasses the entire NSP system, including all feeders, one year, and about 75% of residential households. The Evaluator conducted a thorough technical analysis but should have identified small savings as a potential issue and consulted with NSP (the utility responsible for system planning).

J. BNI Efficient Products Rebates (BER)

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

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

Point-of-sale rebate evaluated savings declined 7.7% in 2024 compared to 2023 levels with 177,358 individual measures sold compared to 240,886 in 2023. The largest decline in measure incentives was for LED Linear Lamps, which experienced a 41% decline. However, since these measures have below average savings per measure, the average savings per measure declined only moderately. In addition, the 2024

comprehensive evaluation of this program component slightly raised the total Net to Gross Ratio (NTGR) for instant rebates from 81% in 2023 to 84% in 2024 which also helped to reduce the level of year-on-year declines in evaluated savings.

Applications for rebates were received for 262 individual projects that were generated by 199 unique business participants, an 18% increase over 2023 levels. Of all projects completed, lighting and high-efficiency motors projects accounted for eighty-two percent (82%) of total evaluated energy savings for application rebates.

For the 2024 program year the Evaluator conducted a comprehensive impact evaluation for the instant rebate portion of the BER program and a condensed impact evaluation of the application rebate program. The difference between comprehensive and condensed evaluations between these two program components consisted of a participant survey and interviews with product distributors for the instant rebate evaluation that was conducted in addition to the condensed evaluation protocol that was also applied to the application rebate program activity. The condensed evaluation activity consisted of a tracking sheet review and effective useful life (EUL) update. Surveys of both market actor (distributor) and end-user (participant perspectives were used to determine free-ridership levels for instant rebate activity while spillover rates for these products were adopted from 2023 values. Net savings for application rebates was determined using 2021 free-ridership and 2022 spillover to determine NTGR values. A calculation of avoided emissions using methodologies developed in prior years' evaluations.

A series of nine recommendations were provided by the Evaluator that resulted from both the comprehensive interview series for instant rebates and the condensed evaluation of the application rebate program. The majority of these recommendations involved changes in delivery, tracking, and marketing of program activities to make program implementation more effective. Two of the recommendations involved the need for the determination of a new baseline for LED lamps and fixtures that are currently being incentivized within the program. Since market practices are now LED aligned, we recommend that the application rebate and instant rebate program should reflect the following:

Recommendations

SVR2024-BNI Efficient Products – 8. Change baselines for BER and IR rebates to reflect current market practices that have indoor DesignLights Consortium-Standard products as the new baseline with incentives offered for comparable DesignLights Consortium-Premium products, where available as a suitable option. No further study is necessary.

SVR2024-BNI Efficient Products – 9. A document review of in-situ meter studies of multi-wattage LED lighting products should be conducted, preferably within a similar market/region and with a focus on the most popular products distributed as a percentage of total incentive dollars spent for the program. If no applicable documentation exists, then E1 should consider commissioning a lighting study for these products.

K. BNI Custom Incentives Program (Custom Component)

For 2024, the BNI Custom Incentives Program consists of two components, Custom and Strategic Energy Management (SEM). The Custom program is comprised of four parts: Retrofit, New Construction, Pay-for-Performance and Building Optimization. Custom is reviewed in this section.

Custom/Retrofit. The Retrofit component of the Custom program helps with technical and financial support for scoping and feasibility studies and then helps implement efficiency improvements using site-specific and needs-appropriate options. In 2022 rooftop solar was added to the measures for commercial retrofit projects and this measure contributed 10% of retrofit program tracked savings in 2024. The compressed air leak audit measure provided a substantial percentage of retrofit program savings in 2024 (42%). yielding total tracked savings at the generator of 11.967 GWh, with 69.6% of those savings produced at two locations that are owned and operated by the same entity. The savings from compressed air audits in 2024 increased by 522% in 2024 as compared to 2023 with the overwhelming majority of this increased savings produced by these two sites.

In 2024, the savings associated with the operations of the two large sites produced 364% of the total tracked energy savings for all compressed air audit measures in 2023, even though these programs were implemented at these same locations during that period.

In 2024 savings associated with compressed air leak audits resulted in higher total tracked savings than the cumulative savings generated by high-efficiency motor retrofits, solar PV retrofits and all HVAC retrofit projects combined. Eighty-eight Retrofit projects were included in the Retrofit project portfolio in 2024. Of these projects, 13 were started but not completed and 14 had been initiated in prior program years and completed in 2024. In addition to solar PV systems, program measures included refrigeration, air compression, air compression leak detection, efficient motors, HVAC, and process equipment. Some building envelope measures were also included but provided only limited (2%) tracked savings.

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

Custom/New Construction. The New Construction component of the Custom program provides technical assistance and financial incentives to assist BNI participants to construct new buildings with energy efficient savings that are above current building code. Increases in finance costs and labor shortages for new construction activities have reduced participation rates somewhat in 2024. New Construction had 27 completed projects in 2024 (up from 15 in 2023) with the majority (89%) of these building new multi-unit residential living spaces.

The Building Optimization component of the Custom program completed 2 single-year projects and 2 multi-year projects. This program component provides technical assistance to increase building energy consumption performance, both for peak demand savings and for overall energy reduction activities. One of the single-year projects involved the HVAC reprogramming of 15 individual schools, with a slightly increased evaluated savings for these sites compared to the tracking sheet results.

For 2024 the Evaluator performed a comprehensive impact evaluation of the New Construction component of the Custom program that included free-ridership and spillover assessments, and a process evaluation. Continuing a multi-year trend, evaluated free ridership for this program component has declined from 39% in 2022 and 32% in 2023 to 28% in 2024. This significant shift in program effectiveness has not been explained in terms of changes in operational environment or program implementation.

Evaluation of the New Construction component of the Custom program found that enhanced engineering review of tracked measure savings produced good results, including high participant satisfaction a decreasing free ridership.⁵⁸ In this regard, the

⁵⁸ Free ridership for BNI New Construction programs is typically higher than for non-new construction

continuing program works effectively as a market transformation activity, especially for multi-unit housing construction, as it works to gradually shift preferences of potential buyers and increases motivation for builders to produce higher-efficiency buildings. The Evaluator recommendations for this program regarding increased education and outreach for sector actors reflect this.

As a result of the comprehensive evaluation of New Construction, the evaluator provided nine recommendations in 2024. The recommendations provided are associated with marketing and tracking of evaluations with the exception of a specific process-related recommendation that suggests an overarching program implementation review by Efficiency Nova Scotia to update the program logic model in a way that explores, documents and addresses recently observed market barriers that work to reduce the effectiveness of program operations.

An additional recommendation is guiding increased partnerships with builders and the integration of institutional knowledge provided by Efficiency Nova Scotia staff for specific building design specifications (e.g., electrification). This should increase program participation in future program cycles.

Finally, the Evaluator recommends that the program be aligned to the most recent building codes (NECB 2020) which are adopted in April of 2025. This review strongly supports this (New Construction Recommendation #7) evaluator recommendation.

Custom/Overall. Overall, net evaluated program energy savings for the Custom portfolio (not including SEM) were 80.2% of tracked savings at the generator and demand savings were 77.6% of tracked savings.

Evaluation Issues (Compressed Air). There are four evaluation issues for the BNI Custom Incentives Program. Each of the four issues concerns compressed air leakage detection at two sites, though not projects at other sites. First, the Evaluator appears not to have followed the relevant evaluation protocol for compressed air projects. This calls evaluation results for compressed air into question. Second, the pattern of reported savings does not appear to be valid, and this should require the Evaluator to investigate and provide an explanation.

(1) **Protocol Issue.** The Uniform Methods Protocol, provided by the U.S. Department of Energy is the current standard for implementation and evaluation

programs since incentive values are relatively inconsequential when compared with total building construction costs.

of compressed air leak detection and management activities for Demand Side Management evaluations.⁵⁹ As shown in Figure 18, while ultrasonic leak detectors are recommended to detect leaks, for the separate task of determining the size of leakage rates they are “inherently inaccurate”. According to the Universal Methods Project (UMP) protocol⁶⁰, they function based on correlation with the sound produced by a leak rather than by direct measurement.

Ultrasonic leak detectors are an effective tool for identifying and locating leaks in a compressed air system but should not be relied upon for quantifying the rate of leakage. The accuracy of these devices is dependent on operator experience and proximity to source; **they are inherently inaccurate as leakage rates are not directly measured and instead are correlated based on the amount of sound produced by a given leak in decibels. The best practice for quantifying rate of leakage is to conduct leak-down tests prior to and immediately following leak repairs to determine the actual system impact.** [Emphasis added]

Figure 19: Ultrasonic Leak Detectors (emphasis added).

Instead, the protocol recommends direct measurement pre-repair, repair, then direct measurement post repair. Since the Evaluator did not conduct an independent evaluation of these sites using these methods and is inherently relying on inaccurate measurement, we recommend that savings from these sites not be accepted.

- (1) A standardized leak-down test, pre-measurement.
- (2) Repair
- (3) A standardized leak down test, post-measurement.

Figure 20: What Should Have been Done.

Generally, we expect that when an Evaluator does not conduct an independent evaluation following the appropriate protocol, they will report the problem to the DSM Administrator and work out a solution to permit site access and independent evaluation consistent with the protocol. If, as in this case, the

⁵⁹ Benton, Nathanael; Patrick Burns, and Joel Zahlan. (2021). Chapter 22: Compressed Air Evaluation Protocol. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Golden, CO; National Renewable Energy Laboratory. NREL/SR-7A40-77820.

<http://www.nrel.gov/docs/fy21osti/77820.pdf>

⁶⁰ Text in Figure 19 from Ibid., Section 5.2, P. 18.

methodology used to determine savings was not performed correctly according to the protocol, and their measurement cannot be duplicated by the evaluator, *then these savings are removed from the program activity.*

Also, in their evaluation the evaluator should explain why the standard protocol was *not followed*, so they are *unable to independently certify the energy savings.*

The problem here is not superficial; it goes to the foundation of quantification. The evaluator needs to conduct an independent operationally definable process of measurement, which reproduces claimed savings reported by the program and is valid in the sense of producing true measurements. This is the true-up that evaluation is meant to perform, and without it there is no independent evaluation and there also can be no verification of evaluated energy savings.⁶¹

(2) Chain of Events. The methodology used by the client to measure tracked savings prior to evaluation by the Evaluator is flawed in that there is no leak-down test performed that directly measures changes in system leakage produced by the repair activity. The current methodology provides a picture and location of a leak, using a method of leak size measurement that is strictly avoided according to the Uniform Method Protocols. The result of this methodology produces estimates that are unverifiable in any way. One device is used to locate each leak, assess its size by a method not permitted by the UMP protocol, and once repaired, the leak disappears so there are no records of the leaks having existed, and no way to check how much they were leaking, and of course, there is the problem of payment without having the required independent third-party measurement and verification.

(3) Pattern of Reported Savings. As background, we note that verification activity we conducted by the savings in late 2024 identified serious structural issues with the implementation of compressed air leakage management being conducted at two sites that produce the majority of the savings for this measure in the program portfolio. We noted that the implementation methodology of this program at these sites does not produce verifiable and measurable results according to the relevant protocol.

(a) Observations of total claimed savings for the two locations showed that the cumulative annual claimed savings over the previous four years were a

⁶¹ Wilks, S.S., "Some Aspects of Quantification in Science," Pp. 5-12 in Woolf, Harry, *Quantification*. Indianapolis & New York: Bobbs-Merrill, 1961.

*substantial portion of total energy demand for compressed air at the facility.*⁶² This is contrary to observations and evaluations of other sites that often have no or little leak detection activity after many years of operation. The leakage rate appears far too high. We expect the leakage rate to decrease, and here it does not. This may be a function of special conditions at the site, since this does not occur at other sites, but it is something the Evaluator should examine and explain.

(b) Leakage rate has increased. There has been an unexplained recent surge in claimed savings at these two locations, as compared to prior years. This surge should be examined by the Evaluator and explained. Our expectation is that, over time, these site-wide observed savings should decline, precipitously, over the course of a multi-year implementation, not increase suddenly.

(4) **Maintenance Issue.** It is not clear why an organization with multiple similar sites located worldwide would not have already incorporated leak detection and repair into its facility in a way that meets current standards. This is a kind of problem that occurs in other DSM programs, where utilities provide DSM funding but individual facilities are required by their corporate management to follow intelligent corporate maintenance and replacement standards, which often incorporate energy efficiency, so that after a start, it is not necessary to continue DSM funding. In our experience in Detroit with Detroit Edison engineers in a joint compressed air project at Ford, GM, and Chrysler, everything that worked in the project was fairly quickly incorporated by client energy engineers into worldwide practice, so that continued utility funding was not required. We note similar experience in other areas with large hotel chains, and with an international religious organization – corporate is quick to incorporate things that work and modify standards., so that after a start the utility can withdraw. The Evaluator should review the client’s policies and manuals to see if the activities would or would not have been done in the absence of the program.

(5) **Proprietary data issue.** It is not unusual for some organizations to try to keep operational data proprietary and confidential, as a strategic policy. This is customary for some organizations. However, in contrast, evaluation requires both

⁶² We would show a numerical demonstration here, but the necessary numbers are restricted by the customer as proprietary information. Even though the two sites in question have had ongoing programs for four years, by comparison, worst-case conditions in untreated facilities, would normally experience only a 20% or 30% savings from a newly implemented program, with subsequent reductions in achieved savings for each following year until a ‘wear and tear’ threshold is met.

site access for direct measurement and access to usage data, and records of interventions to improve energy efficiency. If an organization will not permit the Evaluator to conduct an independent evaluation by restricting access to the site or by withholding necessary data, or by providing data but not permitting its use in public reports, the Evaluator should report this in its evaluation.

Recommendations

SVR2024-Compressed Air – 10. We strongly recommend that the compressed air program be redesigned to follow UMP protocol requirements.

SVR2024-Compressed Air – 11. The Evaluator should examine and explain the unusual patterns in reported savings.

SVR2024-Compressed Air-12. Prospective clients for this programs that do not permit site access to the independent Evaluator for direct on-site measurement and/or do not permit access to necessary energy usage data or the use of that data in public reports should be dropped from the program.

L. BNI Strategic Energy Management (SEM)

Strategic Energy Management (SEM) is an approach for integrating energy management into business practice – so that a focus on continually advancing energy-efficiency becomes an integral aspect of workplace awareness and cooperative activity. This kind of approach has previously been used to uplift awareness and attention to quality assurance and in workplace safety campaigns. Generically, SEM focuses on changes in daily operations (with management support) that engage staff in energy efficiency thought, alertness, and activities as they perform cooperative work. In a specific project it may be that only certain categories of workers are designated by management to be involved, such as engineers. The origin of North American 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.⁶³ In more recent program iterations, facility management methods of cultivating continuous system-wide efficiency gains have spread under the SEM guidelines from the traditional manufacturing and industrial process environments and now encompasses other large-scale facilities such as

⁶³ See <https://www.investopedia.com/terms/k/kaizen.asp>

hospitals and universities. This is now being performed through contracted professional “efficiency managers” who provide technical assistance and expertise for the development of new facility efficiency retrofits.

In 2023 the Energy Management Information System (EMIS) program was absorbed as a subprogram within SEM and now functions as an additional measure that may be adopted by the SEM program. For this program cycle and into the future, SEM is now considered a component of the Custom program grouping.

Evaluation. In 2024 the SEM program experienced an increase in total participants from 2023 (12 total) but experienced a large increase (32.4%) in tracked savings. This increase can be attributed to two participants that contributed 69% of all SEM program savings. The result of this large single participant savings pushed the average participant gross savings well above 2023 values, when it would have otherwise declined significantly. The overwhelming majority of measure-level savings for SEM can be attributed to either compressed air leak repairs (53%) or the adjustment of equipment operation schedules (34%). In 2024 the evaluator followed recommendations from 2023 that set the Net to Gross Ratio (NTGR) for SEM at 1, meaning that no spillover or free ridership occurs in program operations.

For 2024, the Evaluator conducted a comprehensive impact evaluation of SEM. The impact evaluation entailed interviews with program delivery agents, called “Business Development Managers,” service providers and participant decision makers. In addition, a program logic model review was conducted with updates to the tracking sheet. The evaluator found that pre and post measurements at the measure level for project implementation were conducted in accordance with international evaluation protocols.

Seven of 12 total participant organizations initiated projects that produced savings in the 2024 SEM program cycle. Of the seven participants with savings, 6 were continuing participants and 1 was a new participant in 2024.

Evaluated net energy savings and net peak demand for the SEM program exceeded 2024 program targets with 4.478 GWh of savings and 0.537 MW of peak demand. These values exceeded program targets by 6% and 14%, respectively.

Evaluation Issues. None.

M. BNI Small Business Energy Solutions Program (SBES)

Small Business Energy Solutions (SBES). SBES is available to businesses that use less than 350,000 kWh annually. There are two paths within the program, the audit path, and the do-it-yourself (DIY) path. For 2024 there was also a Commercial Direct Installation (CDI) pilot that was initiated in 2021 and remains in the pilot program stage.

Most participants (89%) were on the DIY path, a similar percentage of total participants as in 2023. There were 493 projects across the audit path, DIY path, and CDI pilot, a 6% increase in participation levels from 2023. Of the total program count, only 21 projects were developed through the Audit path (4%). This represented a 47% increase from 2023 levels. Evaluated net energy savings was 10.854 GWh, a 46% increase from 2023 levels. The evaluated net demand reduction at peak was 2.155 MW, an increase of 45% from 2023 levels. In 2024, 61,673 individual measures were incentivized through the SBES program.

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 do not receive energy audits since participants have already identified measures to install. DIY customers are provided with quotes and invoice guidelines, product worksheets and a referral to the Efficiency Preferred Partner (EPP) Network. Participants can select measures or choose to employ a contractor to help with the decision on which measures to install. This year's program participation levels are normal and in alignment with previous years' operations.

Evaluation. The evaluation approach consisted of a condensed impact evaluation for the SBES program with a condensed impact evaluation applied to the Commercial Direct Install (CDI) pilot program. For the impact evaluation, the Evaluator conducted a tracking sheet audit, adjusted savings for small (<65,000 Btu/h) heat pumps, brushless DC motors and adjusted peak coincidence factor values for LED lamps installed through the CDI program. The evaluator also performed desk reviews. A non-participant spillover survey was performed, and 30 small businesses were interviewed to develop Efficiency Nova Scotia attribution for non-participant efficiency activity. This survey produced no statistically significant results. It was a good-faith effort by the evaluator to follow recommendations from 2023 regarding this issue. It appears clear that to assess non-participant spillover, a much larger sample would be needed. Alternatively, if provided, a statistical analysis of delivered products over a multi-year period, compared with program delivery of these products over the same period would provide insight into long-term market transformation.

Evaluation Issues. None.

N. Demand Response (DR)

There are two demand response programs, Residential Demand Response and Business-Nonprofit-Institutional (BNI) Demand Response. Demand response concerns capacity (Watts, kW, MW, GW) rather than energy (kWh, GWh). The Evaluator defines demand response as in Figure 21.⁶⁴

Demand response. Demand response measures generate savings in the form of available capacity of a load reduction in response to events called by the electric utility (Nova Scotia Power) to reduce the load at strategic moments. These events can be called at any time and for any duration, although they are usually called for one to four hours during peak periods.

Figure 21: Definition of Demand Response.

Residential Demand Response has 353 participants for 2024; BNI has 76 participants.

1. Residential Demand Response (Eco Shift Pilot Pathway)

For Residential Demand Response (DR), Efficiency Nova Scotia created a tracking sheet. The Residential DR tracking sheet is limited to a spreadsheet with participant raw thermostat and whole-house consumption data.⁶⁵ The Evaluator reviewed the tracking sheet and established that the data needed to compute DR results was complete and accurate. Although other devices are also included in Residential DR, for the 2024 evaluation, Econoler decided to limit quantification of DR capacity to a single device, the Mysa thermostats. Other residential devices are not included in the evaluation analysis due to insufficient numbers and data connectivity issues.⁶⁶

The Evaluator relied on a unitary available DR capacity value...the average available DR capacity per (Mysa) thermostat.

Figure 22: Analysis Limited to Mysa Thermostats.

The Evaluator developed a computer model (hourly regression model) to predict average hourly load for homes with Mysa thermostats. The model yields an expected

⁶⁴ Definition of demand response, Econoler Demand Response Program Final Report, P. iii.

⁶⁵ Econoler, Demand Response Final Appendix Report, P. 1.

⁶⁶ These are Sinopé thermostats, electric vehicles, and EV chargers.

whole-house energy use⁶⁷ per hour during each specific hour for which a load event is called. This predicted use is then compared to actual use for each hour, and the difference is used to quantify available DR capacity of the set of homes at the system level.

The regression model takes into account time of week and outdoor temperature. The use of “hour of week” requires ($24 * 7 =$) 168 specific regression equations, one for each hour in a week. Use of “hour of week” allows influence of outdoor temperature at each time of the week and so incorporates customer selection of thermostat setpoints at different hours on different days.⁶⁸

Initially there were 272 participants (homes) in the database (there is often more than one thermostat per home), but only 247 with AMI data. Households with EV chargers (40) were dropped, as were homes with data problems, resulting in analysis using 199 participants. The Evaluator recommends repeating the analysis for 2025 to improve accuracy and ensure consistency from year to year.⁶⁹ There were events called by Nova Scotia Power during the 2023-2024 Winter Peak season.⁷⁰

2. BNI DR

For BNI, the Evaluator first reviewed Efficiency Nova Scotia BNI tracking sheets to ensure consistency, resulting in a small correction (magnitude 2%-3%) to Efficiency Nova Scotia tracking values. By agreement between Efficiency Nova Scotia and Nova Scotia Power, available DR capacity is based only on events called from December to February, excluding weekends and holidays.

Customers are classed as being better suited to morning events or better suited to evening events. If there are two events called in a particular day, some participants may only be called for morning or for afternoon. The total DR capacity computed is the sum of each participant’s available DR capacity.

For their participation to be included in DR capacity calculation, customers have to participate in a called event (they cannot just be on an approved list). As the Evaluator notes, “[b]y averaging load reductions at the participant level first (as required by the available DR capacity definition) rather than averaging events, this will yield a higher

⁶⁷ The evaluator selected analysis of whole-house energy use over device-level data, “Whole-house data were preferred to device-level data as they allow for inclusion of interactive effects from equipment such as other heating systems not controlled by participating smart thermostats....” Analysis is based on AMI data. Econoler, Demand Response Final Appendix Report, P. 2.

⁶⁸ Econoler, Demand Response Final Appendix Report, P. 2.

⁶⁹ Econoler, Demand Response Final Appendix Report, P. 13.

⁷⁰ Econoler, Residential Demand Response Final Report, Table 5, P. 2.

average available DR capacity if some participants are not called on all events.⁷¹

BNI DR is subject to several guidelines. These business rules concern additive adjustment, scalar adjustment, adjustments to the lookback window, consideration of abnormal conditions, a cap on adjustments, a requirement for symmetry of adjustments, the flagging of certain abnormal events for more detailed consideration, and event exclusion rules).

For Residential DR, the evaluated result is 0.057 MW, and for BNI DR, the evaluated result is 8.034 MW. The evaluation approaches to both DR programs are logical and complete as to method. The choice of whole-house energy use over device-level data is within the scope of the Evaluator.

Recommendations

SVR2024-Demand Response – 13. In the next evaluation, include an analysis of the relative importance or lack of importance to the possible capacity shortfall problem to Nova Scotia Power, the roles of the load research shop at NSP (and other parts of NSP involved with capacity) and Efficiency Nova Scotia. Identify the organization responsible for initiating events, explain the reasons for calling events, list the trigger reason for each event in the tables, detail the benefit received by participants (if any), and provide information on any cost to customers to participate in the program (if any).

The Demand Response programs' value has not been demonstrated, referring to the very small kW demand reduction at either the household or utility system level. Future evaluations should clarify the practical benefits of each program for households and the utility system, beyond being a learning experience. Specifically, detail how Residential DR and/or BNI DR responses impact utility operations for Nova Scotia Power. They appear much too weak to have a bottom-line effect. If these programs are merely pilots without significant demand reduction goals, explain their purpose and value. The Evaluator should justify the business case (bottom-line value) for these programs in the evaluation since, unlike measure-based programs, the weak demand reduction effect does not highlight its value.

SVR2024-Demand Response – 14. Provide a discussion on the advantages/disadvantages and trade-offs in selecting either the whole-home approach or the device-level approach in the residential analysis.

⁷¹ Econoler, Demand Response Final Appendix Report, P. 15.

XI. Summary of Recommendations

A. General Recommendations

There are four general recommendations.

SVR24-G-1. The Savings Verification study recommends acceptance of the 2024 evaluation estimates for energy savings and demand reduction *except for four programs*. These are the Residential Behavior program (6.270 GWh; no demand reduction), the Residential Demand Response program (no energy savings, 0.057 MW), the BNI Demand Response program, (no energy savings, 8.034 MW) and the compressed air part of the BNI Custom Incentive Program (Custom).

- For the BNI Custom Incentive Program (Custom), the portion of energy savings and demand reduction attributed to the compressed air leak audit projects we recommend not accepting the value reported by the Evaluator, since there was no independent evaluation following the UMP Protocol. The Evaluator made an adjustment to an older value, and reported it for 2024, but the protocol for independent assessment of compressed air was not followed.
- For the Residential Behavior Program and the two Demand Response programs, the Evaluator conducted independent evaluations and correctly followed the relevant protocols. However, for these programs *the practical size of the savings and demand reduction is not large enough to be of practical value at either the household level or at the utility system level*. The Evaluator correctly followed the relevant protocols, but a problem with the protocols is that they do not take into account the very large sample size problem. For very large sample sizes statistical significance loses meaning and it is necessary to, instead, gauge performance using practical significance. The Evaluator correctly notes that these programs look OK from the perspective of statistical significance, however, the Evaluator should have flagged these programs for not producing practical energy savings or demand reduction.

SVR24-G-2. The Evaluator should flag programs which the evaluation demonstrates to produce only tiny savings (savings that may be statistically significant and are too small to have a practical significance). For these programs, the Evaluator should either recommend closing the program in order to spend available energy efficiency dollars more effectively, or provide an explanation for the program, making the business case explaining its value.

SVR24-G-3. The Evaluator should flag any program evaluations that do not permit following the relevant evaluation protocol(s), or that do not provide energy use information to the evaluator, or that provide energy use information but require it to be treated as proprietary and confidential, so that readers can be aware of any restrictions on the evaluation.

SVR24-G-4. The Evaluator should include full worksheets or computer printout information for all significance tests, specifying for each test, whether the comparison is one-tailed or two-tailed, the p-value of the test, the power of the test, and the significance level criterion used in the analysis.

B. Program Specific Recommendations

There are recommendations for only five of the program evaluations, Residential Behavior, BNI Efficient Product Rebates, the compressed air leak detection part of BNI Custom Incentives, and the two Demand Programs (Residential and BNI). The other programs have not evaluation issues.

1. Residential Behaviour Program

SVR2024-Behaviour-5. Overall, we recommend that the program be continued, but not as a direct energy savings program. Rather, it should be redesigned and evaluated as a marketing and promotional program designed to (1) support recruitment for the Administrator's measure-based programs and (2) to foster overall awareness and motivation for energy efficiency among customers. Without substantial improvement, its independent contribution to energy savings at a household level is too small to be credible as an energy saving program, and the same assertion is reasonable at the utility system level.

SVR2024-Behaviour-6. The process evaluation now planned is a good idea. In addition to attempting to cause participation in the Administrator's measure-based programs, another goal of Efficiency Insights is to promote energy-saving habits and practices. But what behaviors will produce *real energy savings* at the household level? There has been no attempt to check systematically yet on what practices are being adopted, and *what practices would have measurable effect of a reasonable size*, and *what percentages of participant households vs. control households are adopting different behaviors*. That information might be very helpful for optimizing program design.

SVR2024-Behaviour-7. Although we know that the practical effect on energy savings so far is not meaningful either at the household level or at the system level, there could be meaningful changes in some households that get washed out in averaging. So it would be useful to partition household results by kWh savings (effect size) and focus on homes in both the treatment and control groups with relatively high energy savings (after eliminating the possibility of double counting due to program participation overlaps) *to find out if there are actions that are practical and effective* rather than simply signaling weak attempts to become more energy efficient.

2. BNI Efficient Products Rebates

SVR2024-BNI Efficient Products – 8. Change baselines for BER and IR rebates to reflect current market practices that have indoor DLC-Standard products as the new baseline with incentives offered for comparable DLC-Premium products, where available as a suitable option. No further study is necessary.

SVR2024-BNI Efficient Products – 9. A document review of in-situ meter studies of multi-wattage LED lighting products should be conducted, preferably within a similar market/region and with a focus on the most popular products distributed as a percentage of total incentive dollars spent for the program. If no applicable documentation exists, then E1 should consider commissioning a lighting study for these products.

3. BNI Custom Incentives Program (Custom Component – Compressed Air Leak Detection)

SVR2024-Compressed Air – 10. We strongly recommend that the compressed air program be redesigned to follow UMP protocol requirements.

SVR2024-Compressed Air – 11. The Evaluator should examine and explain the unusual patterns in reported savings.

SVR2024-Compressed Air-12. Prospective clients for this programs that do not permit site access to the independent Evaluator for direct on-site measurement and/or do not permit access to necessary energy usage data or the use of that

data in public reports should be dropped from the program.

4. BNI Demand Reduction Programs

SVR2024-Demand Response – 13. In the next evaluation, include an analysis of the relative importance or lack of importance to the possible capacity shortfall problem to Nova Scotia Power, the roles of the load research shop at NSP (and other parts of NSP involved with capacity) and Efficiency Nova Scotia. Identify the organization responsible for initiating events, explain the reasons for calling events, list the trigger reason for each event in the tables, detail the benefit received by participants (if any), and provide information on any cost to customers to participate in the program (if any).

The Demand Response programs' value has not been demonstrated, referring to the very small kW demand reduction at either the household or utility system level. Future evaluations should clarify the practical benefits of each program for households and the utility system, beyond being a learning experience. Specifically, detail how Residential DR and/or BNI DR responses impact utility operations for Nova Scotia Power. They appear much too weak to have a bottom-line effect. If these programs are merely pilots without significant demand reduction goals, explain their purpose and value. The Evaluator should justify the business case (bottom-line value) for these programs in the evaluation since, unlike measure-based programs, the weak demand reduction effect does not highlight its value.

SVR2024-Demand Response – 14. Provide a discussion on the advantages/disadvantages and trade-offs in selecting either the whole-home approach or the device-level approach in the residential analysis.

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XIII. Appendix 1: Questions to ask in DSM Evaluations

Overall, the evaluation is excellent. However, there are some areas that could be worked on. Here is an overall summary.

Table 10: Evaluation Questions - Summary Table.

Asked and Answered for Program Year 2024 General Questions to Ask of Energy Efficiency Program Evaluations		
1	Does the independent evaluator have control over methods and measurement approaches?	Yes
2	Does the independent evaluator have control over methods and measurement approaches?	Yes
3	Is the evaluation oriented to the goal of truth in measurement?	Yes
4	Is the evaluation open, well documented, and transparent?	Yes, but in places could use additional work on transparency, for example in reporting significance tests.
5	If the evaluator uses a Technical Resource Manual, are values and calculation methods critically reviewed?	Yes, with a good review this year.
6	Are appropriate evaluation guidelines or protocols cited and used?	Yes
7	Is impact evaluation supported by process and market evaluation?	Yes, by incorporating some additional surveys in impact evaluations, plus a small number of process and market evaluations each year.
8	Is market evolution critically developed and well reported?	Not every year, but the focus is supposed to be on impact evaluation and the evaluator does in some years fully discuss market evolution.

Asked and Answered for Program Year 2024		
9	Does the evaluator engage with program administration and program technical staff in the design of the evaluation?	Yes
10	Does the evaluation make use of literature reviews and/or consultation with experts, where appropriate?	Yes
11	Are problems identified by the evaluator during fieldwork reported to program managers on a timely basis?	Yes, there is good communication with program managers.
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?	Yes
12	In a complex evaluation, does the evaluator include a list of abbreviations and definitions?	Yes
14	In a complex evaluation, is method and measurement approach explained?	Yes, but could be further developed.
15	For surveys, are the survey questions presented in an appendix to the evaluation?	Yes
16	Is statistical confidence and statistical precision reported for surveys or interview sets?	Yes
17	For programs that require on-site visits, are there enough on-site visits?	Adequate, but could be more.
18	Are there careful project file reviews?	Yes
19	Are there critical unitary savings reviews?	Yes
20	Is analysis of metered energy data conducted correctly and used when it is relevant?	Yes
21	Is there critical review of simulation models when simulation models are used in a program and/or for evaluation?	Yes. Very good work in this area.
22	When metering is done, are potential problems with the accuracy and/or precision of metered results explored and reported?	Yes; Could be more for the Residential Behavioral program and the Demand Response Capacity Programs.
23	Is effective useful life (EUL) well estimated?	Yes, with periodic reviews to keep current.
24	Are avoided GHG emissions calculations conducted correctly?	Yes
25	Is the method of calculation of free-ridership and spillover carefully reported and clarified?	Yes

XIV. Appendix 2: Evaluations with No Evaluation Issues

Most of the evaluations in this study have no evaluation issues. They are:

1. Appliance Retirement Program
2. Instant Savings
3. Green Heat
4. Residential Efficient Products Installation
5. Mi'kmaw Home Energy Efficiency Program
6. Affordable Multifamily Housing
7. Affordable Single-Family Homes
8. BNI Efficient Products Rebates
9. BNI Strategic Energy Management
10. BNI Small Business Energy Solutions

XV. Appendix 3: Statistical vs. Practical Significance

Statistical significance is a measure of the probability that a result in an analysis could have occurred by chance alone, out of many (theoretical) repetitions of a test. It can be represented by a probability value. In statistics classes before 2016, students were taught to focus on learning how to determine statistical significance and less focus was placed on practical significance. Statistical significance tells us nothing about whether a result is sizable enough to be of practical value. Also, sample size drives statistical significance, so with very large samples there will almost always be statistically significant results *as an artifact of sample size and it is useful to disregard statistical significance and, instead, consider practical significance*. **Practical significance** is the real-world importance or relevance of a result. Strong practical significance creates a business case for the program. If a result is large enough to be of meaningful value in a practical context, it has practical significance. For example, in the context of a program with household energy savings (kWh), a statistically significant result might be taken to mean the very tiny kWh saved per household was not due to chance, but if the kWh amount is very tiny per household it is of no practical value to the household. The same is true at the system level - if system savings (GWh) is very small in relation to system GWh. Practical significance is assessed using subject-area expertise and context and/or a business perspective.



Verification Review of Program Year 2024 Evaluation Results

