



Verification Review of Program Year 2017 Evaluation Results

Report for the Nova Scotia Utilities and
Review Board

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Verification Review
Of Program Year 2017 Evaluation Results

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

I. Introduction & Overview

This report is a savings verification review for Calendar Year 2017 conducted by H. Gil Peach & Associates, LLC for the Nova Scotia Utility and Review Board (Board). The report is focused on verification of electricity energy savings and demand reduction as measured, modeled and estimated by Econoler, the Independent Evaluator for Efficiency Nova Scotia's Demand Side Management (DSM) energy savings and demand reduction programs.

This report reviews, verifies, and if appropriate, recommend adjustments to the savings data and estimates created by evaluation consultants engaged by Efficiency Nova Scotia.¹ For this reason it is focused on impact evaluation. The report also provides limited comments on other parts of the evaluation.

The 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, of evaluation methods and standards, and/or evaluation protocols used in each evaluation. It is also based on review of the program data tracking system, on discussions with staff and delivery agents concerning program procedures and methods for program Quality Assurance/Quality Control (QA/QC). It is also based on selected "due diligence" site visits to check installation counts and quality of work.

In addition, where appropriate, we reference the evolving standards of practice to highlight "better practices" and the fit between the evaluations and evolving standards of practice.

A. Demand-Side Management as Continuous Improvement

It can be useful in approaching evaluation to review how DSM works and where evaluation and savings verification fit.² DSM is a *cycle of repeated activities with the*

¹ Nova Scotia Power, Inc. served as the DSM Administrator for calendar years 2008 and 2009. Responsibility transferred to Efficiency Nova Scotia Corporation in October 2010. Calendar year 2011 represented the first full program cycle with Efficiency Nova Scotia as the DSM Administrator. This is the tenth program year from the 2008 start and the seventh year with full administration by Efficiency Nova Scotia. As a rule of thumb, after the fifth year a major effort such as this is considered mature, so this report covers evaluation of a mature program portfolio.

² If you already know this, you might skip to the summary of evaluation results in the next section.

goal continuous process improvement.³ Figure 1 shows the DSM cycle with four main centers of focus designated by circles.⁴

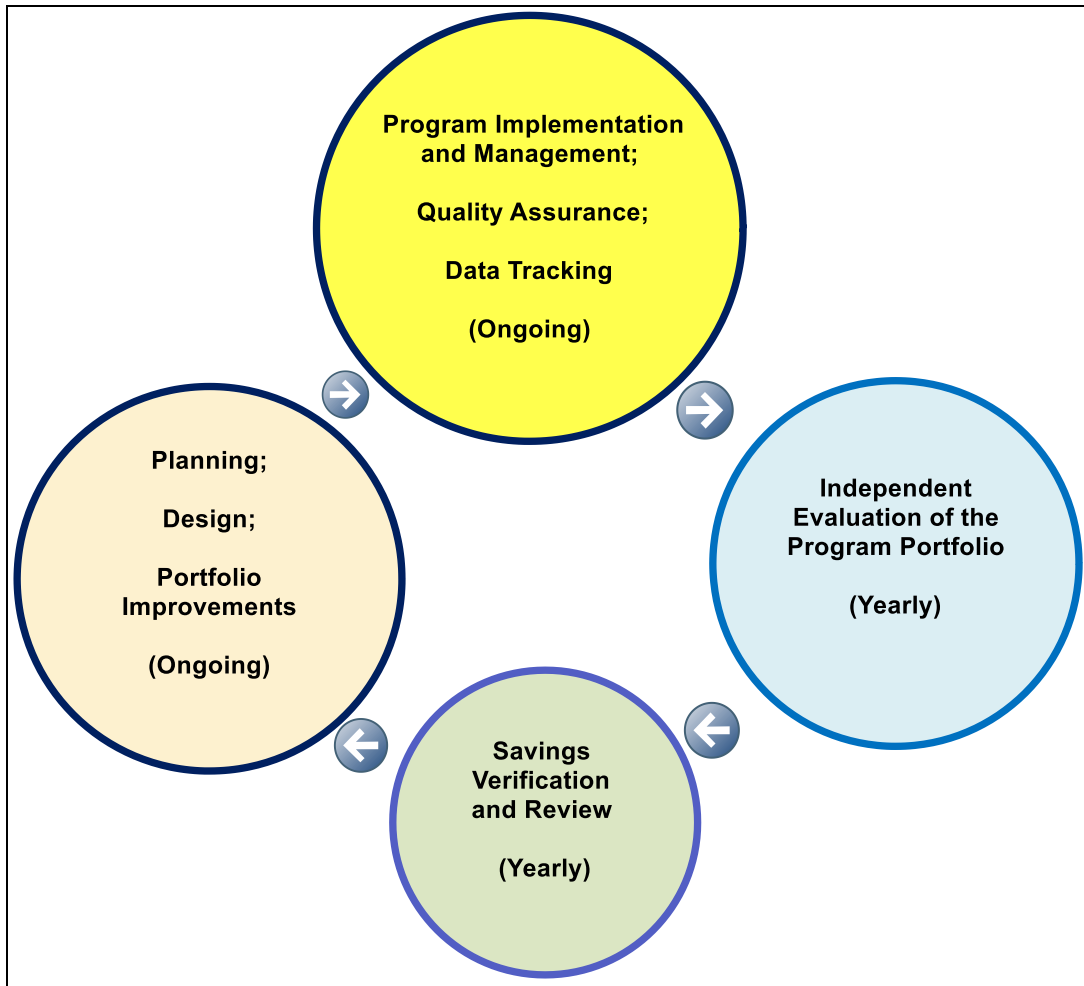


Figure 1: Continuous Improvement: The DSM Cycle.

The arrows in Figure 1 show the clockwise direction of the primary flow of effort within a single DSM cycle. Each step in the Demand-Side Management Cycle feeds information forward to the Planning step, and planning proceeds continuously both

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

⁴ There are other parts not shown. Some of these are: periodic potential studies, the development and use of the Technical Reference Manual, determination of Effective Measure Life (EUL) and benefit/cost testing.

for longer-term planning and near real-time adjustment to realities as they are encountered in practice. In addition, every three to five years there is an intensified major planning effort that sets the pattern for developing the program portfolio until the next major planning effort.

1. Planning

The function of the Plan is to develop program plans and to provide estimates, while incorporating new knowledge, much of which is moved forward from other steps in the process. The Plan provides a high-level blueprint for Implementation in the form of a program portfolio, the results of benefit/cost tests and specific program plans.

2. Implementation

The Implementation step in each cycle feeds information forward to Planning through the development of practical knowledge gained by program managers and delivery agents and the records in the program data tracking system. Work in Implementation means being “at the edge” encountering emergent realities that require constant alertness, anomaly and pattern recognition, and (from time to time) quick adaptation based on new information.

In this way, the programs are adapted from planning perspectives to field realities to move programs forward through (usually incremental) changes to adapt to situations, and development of internal and contextual forces and limits that the planning functions could not have anticipated.⁵ The other steps in the DSM cycle help support Implementation.

3. Evaluation

The Evaluation step produces independent results assessment in a yearly formal evaluation report. However, it should also be feeding timely information back to the Implementation step throughout the year to provide opportunity for in-progress program corrections (without waiting for the full evaluation report). Evaluation

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

produces independent measurements, observations, site inspections, surveys, interviews, literature reviews and analyses (for example, of electrical measurements, hours of operation, interaction effects, the assessment of free-riders and spillover effects). It develops program baselines and program results. Sometimes there are also special studies (for example, a socket study) to support the evaluation process.

4. Savings Verification

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

B. Evaluated Net Demand Reduction at the Generator

Efficiency Nova Scotia conducts a portfolio of six programs which, taken together, include eleven program components. Econoler also separately evaluates Codes & Standards, which is considered outside the portfolio and for which Efficiency Nova Scotia receives no credit.⁶ In Table 1, evaluated values for net peak demand reduction at generator are shown for DSM portfolio programs and for program components, as well as for Codes & Standards.

Econoler reports a DSM portfolio net peak demand reduction of 23.679 MW at the generator. In addition, Econoler reports a net peak demand reduction of 4.028 MW at the generator for Codes and Standards. The total net peak demand reduction is 27.707 MW.

As shown in Table 1, net demand reduction at the generator (MW) is split about 47% to the Residential sector and 53% to the business, non-profit and institutional program sector (BNI).

For 2017, about 85% of net demand reduction at the generator comes from the DSM portfolio and about 15% from Codes & Standards.

⁶ Although Efficiency Nova Scotia supports Codes and Standards, Codes and Standards are seen as coming primarily from the federal or provincial levels.

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Table 1: Net Demand Reduction at Generator.

2017 Net Evaluated Peak Demand Reduction (at Generator)				
Program	Portfolio Residential Component	Demand Reduction (MW)		Program
Rebates	Appliance Retirement	0.443	3.001	Rebates
	Instant Savings	2.558		
Existing	Home Energy Assessment	1.981	7.183	Existing
	Green Heat	3.073		
	Efficient Product Installation	2.129		
New	New Home Construction	0.954	0.954	New
	Residential Subtotal	11.138		
Program	Portfolio BNI Component	Demand Reduction (MW)		Program
Rebates	Business Energy Rebates	7.286	7.286	Rebates
Custom Incentives	Custom	3.637	3.892	Custom Incentives
	Energy Management Information Systems	0.255		
	Strategic Energy Management (SEM)*	0.000		
Direct Installation	Small Business Energy Solutions	1.363	1.363	Direct Installation
BNI Subtotal		12.541		
Overall DSM Portfolio Total		23.679		
Codes & Standards		4.028		
Total (DSM Portfolio plus Codes & Standards		27.707		
Table Notes				
*Due to year to year timing, there were no SEM results in 2017.				
Source: Data from Table 6: 2017 Evaluated Results and Tracked Peak Demand Savings at the Generator , P. 13 in 2017 DSM Program Evaluation Executive Summary, March 16, 2018.				

In Figure 2, the DSM program components are sorted by amount 2017 net peak demand reduction. MW values are presented in the graph and the components are listed in rank order. The top three portfolio components (Green Heat, Custom and Business Energy Rebates yield programs yield 13.996 MW of demand reduction at the generator, or about 59% of the 22.679 MW first year portfolio demand reduction.⁷

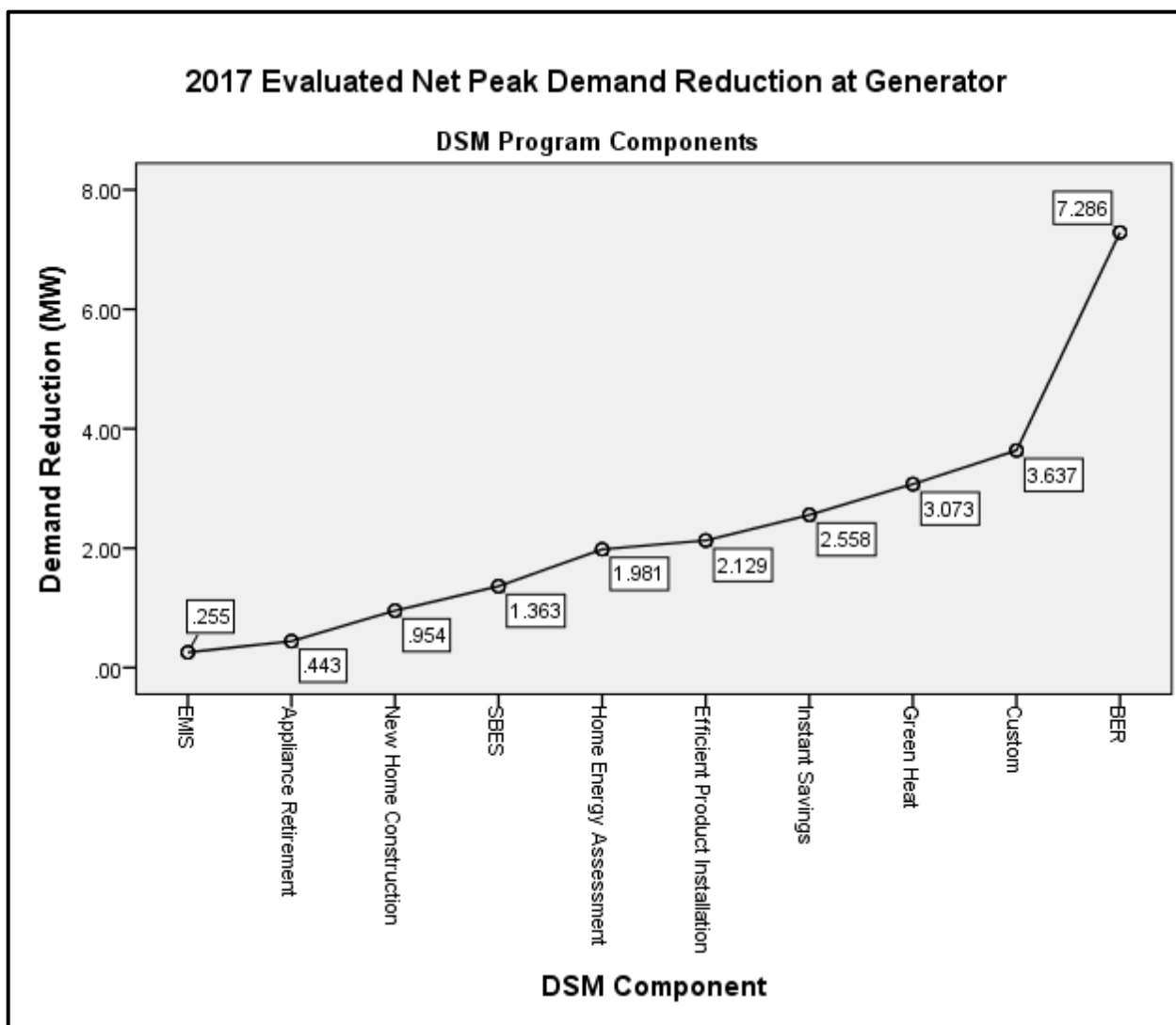


Figure 2: Rank Order of Program Components for Net Peak Demand Reduction.

⁷ In rough percentages, the top 30% of DSM portfolio components produce almost 60% of 2017 net peak demand reduction.

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

In Table 2, evaluated values for net energy savings (GWh) at generator are shown for DSM portfolio programs and for program components, as well as for Codes & Standards.

Econoler reports a DSM portfolio net energy savings of 130.789 GWh at the generator. In addition, Econoler reports a net energy savings of 21.914 GWh at the generator Codes and Standards. The total net energy savings for 2017 is 152.663 GWh.

As shown in Table 1, the DSM portfolio net energy savings at the generator (GWh) is split about 41% to the Residential sector and about 59% to the business, non-profit and institutional program sector (BNI).

In Figure 2, the DSM program components are sorted by amount 2017 net peak demand reduction. MW values are presented in the graph and the components are listed in rank order. The top three portfolio components (Green Heat, Custom and Business Energy Rebates yield programs yield 13.996 MW of demand reduction at the generator, or about 59% of the 22.679 MW first year portfolio demand reduction.⁸

Using the information from Table 2, the DSM components are ranked by net first year energy savings (GWH) as shown in Figure 3. On a first-year net energy savings analysis, four programs – Business Energy Rebates, Custom, Instant Savings and Residential Efficient Product Installation are top ranked. Code & Standards is considered a DSM initiative outside the portfolio. For the portfolio, the top four programs yield 105.01 GWh or about 80% of the 130.749 GWh net portfolio energy savings at the generator.⁹

D. Evaluated Lifetime Net Energy Savings at the Generator

Ecololer has also provided evaluated lifetime net energy savings at the generator (Figure 4). These estimates of lifetime net energy savings for each DSM component take into account the savings-weighted measure lives within each program component. The size of the additional savings from a lifetime perspective is

⁸ In rough percentages, the top 30% of DSM portfolio components produce essentially 60% of 2017 net peak demand reduction.

⁹ Or, roughly and in percentages, the top approximately 40% of DSM portfolio programs produce 80% of net first-year energy savings.

indicated in Figure 4, both as a multiple of first-year net energy savings at the generator and as additional GWh to the first-year net energy savings at the generator.

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

2017 Net Evaluated Energy Savings (at Generator)				
Program	Portfolio Residential Component	Annual Net Savings (GWh)		Program
Rebates	Appliance Retirement	3.094	22.637	Rebates
	Instant Savings	19.543		
Existing	Home Energy Assessment	7.007	27.864	Existing
	Green Heat	2.980		
	Efficient Product Installation	17.877		
New	New Home Construction	3.371	3.371	New
	Residential Subtotal	53.872		
Program	Portfolio BNI Component	Annual Net Savings (GWh)		Program
Rebates	Business Energy Rebates	46.583	46.583	Rebates
Custom Incentives	Custom	21.005	22.407	Custom Incentives
	Energy Management Information Systems	1.402		
	Strategic Energy Management (SEM)*	0.000		
Direct Installation	Small Business Energy Solutions	7.887	7.887	Direct Installation
BNI Subtotal		76.877		
Overall DSM Portfolio Total		130.749		
Codes & Standards		21.914		
Total (DSM Portfolio plus Codes & Standards		152.663		
Table Notes				
*Due to year to year timing, there were no SEM results in 2017.				
Source: Data from Table 5: 2017 Evaluated Results and Tracked Energy Savings at the Generator , P. 15 in 2017 DSM Program Evaluation Executive Summary, March 16, 2018.				

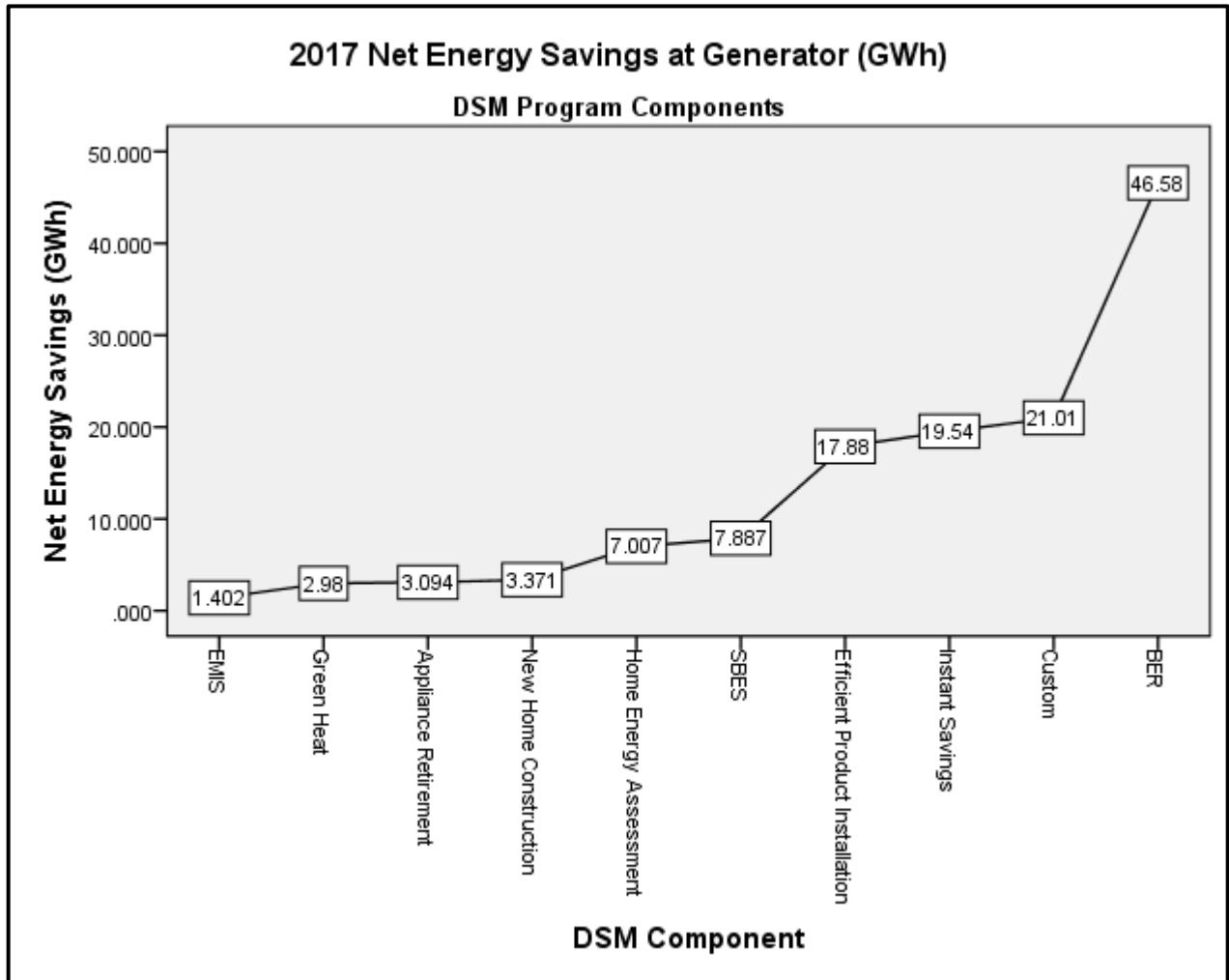


Figure 3: Rank Order of Program Components for Net First-Year Energy Savings.

Rank-ordered net lifetime energy savings is shown in Figure 5. The top four program components are Business Energy Rebates, Custom, Instant Savings and Residential Efficient Product Installation (the same top programs as for the 2017 first-year net energy savings). The top four program components contribute 1,180 net lifetime GWh to the overall DSM portfolio total of 1,621 GWh, or about 73% of the total.

Net Evaluated Lifetime Energy Savings (at Generator)				
Program	Portfolio Residential Component	Annual Net Savings (GWh)		Program
Rebates	Appliance Retirement	23.050	202.166	Rebates
	Instant Savings	179.116		
Existing	Home Energy Assessment	140.139	351.352	Existing
	Green Heat	53.925		
	Efficient Product Installation	157.288		
New	New Home Construction	101.242	101.242	New
	Residential Subtotal	654.760		
Program	Portfolio BNI Component	Annual Net Savings (GWh)		Program
Rebates	Business Energy Rebates	547.135	547.135	Rebates
Custom Incentives	Custom	313.977	318.089	Custom Incentives
	Energy Management Information Systems	4.112		
	Strategic Energy Management (SEM)*	0.000		
Direct Installation	Small Business Energy Solutions	100.854	100.854	Direct Installation
BNI Subtotal		966.078		
Overall DSM Portfolio Total		1620.838		
Table Notes				
*Due to year to year timing, there were no SEM results in 2017.				
Source: Data from Table 5: 2017 Evaluated Results and Tracked Energy Savings at the Generator , P. 15 in 2017 DSM Program Evaluation Executive Summary, March 16, 2018.				

Figure 4: Net Evaluated Lifetime Energy Savings at Generator (GWh).

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

DSM Component	Net		Lifetime Multiple (%)	Lifetime Additional (GWh)
	Annual	Lifetime		
	(GWh)	(GWh)		
Appliance Retirement	3.094	23.050	745%	20
Instant Savings	19.543	179.116	917%	160
Home Energy Assessment	7.007	140.139	2000%	133
Green Heat	2.980	53.925	1810%	51
Efficient Product Installation	17.877	157.288	880%	139
New Home Construction	3.371	101.242	3003%	98
Business Energy Rebates	46.583	547.135	1175%	501
Custom	21.005	313.977	1495%	293
Energy Management Information Systems	1.402	4.112	293%	3
Small Business Energy Solutions	7.887	100.854	1279%	93
Total	130.749	1620.838	1240%	1,490

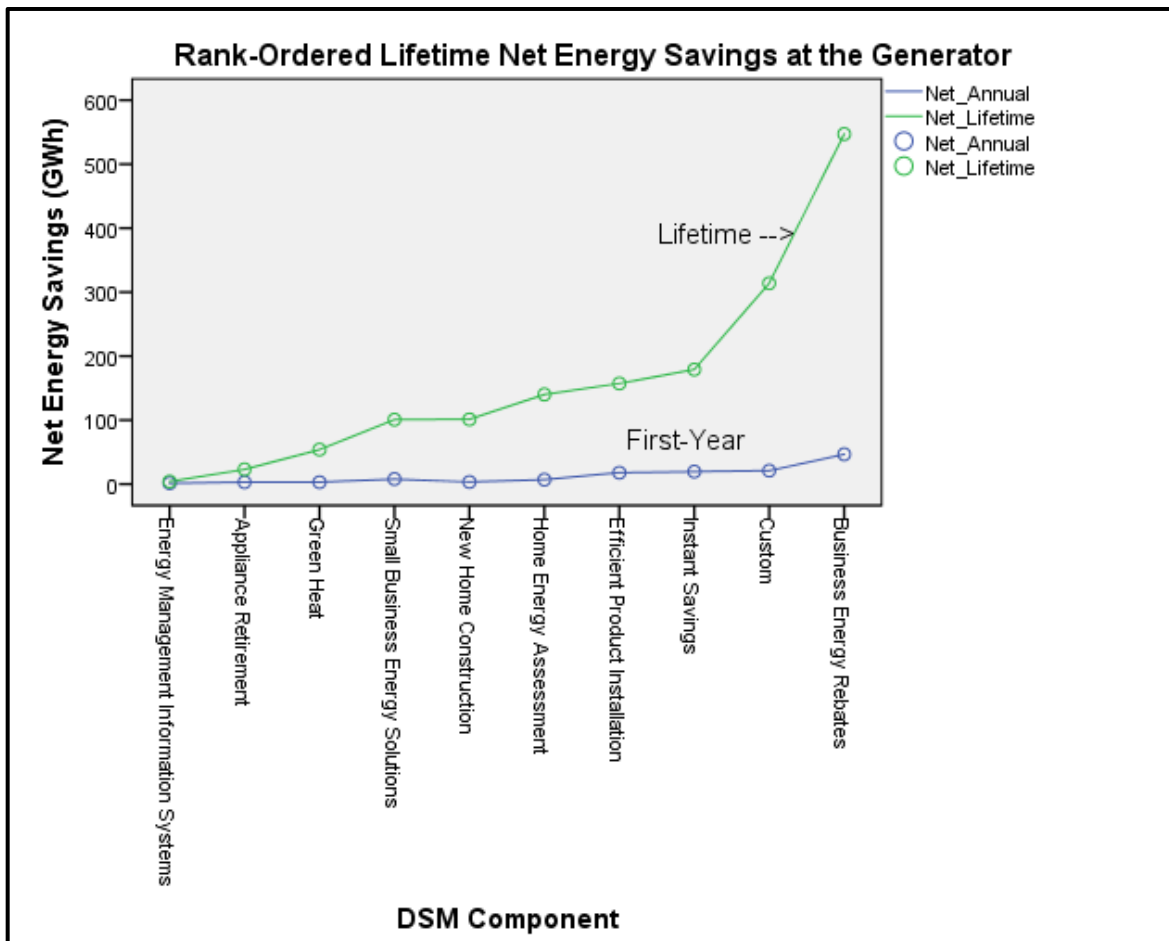


Figure 5: Rank-Ordered Lifetime Net Energy Savings.

This evaluation of net lifetime energy savings developed by Econoler is very useful in understanding more fully the results of the DSM program effort. A Technical Brief from Lawrence Berkeley Laboratory (LBL)¹⁰ puts the specific concerns this way:

[U]nderstanding how long measures, programs and portfolios last (lifetimes) – and the degree to which savings change over time (persistence) – is critical to estimating the benefits of efficiency, calculating cost effectiveness and prioritizing long-term versus short-term efficiency actions.

As the technical brief points out, “program administrators use these factors”.¹¹ They are used in the Planning step of the DSM Continuous Improvement Cycle (Figure 1). In fact, when measures, programs and portfolios leave the Planning step and are moved to Implementation the *ex-ante* values for these factors have already been estimated. Together, they form the basis for passing (or failing) the internal screening test required to move a proposed program from Planning to Implementation.

Understanding net lifetime energy savings supports a deeper valuation, and introduces the concept of shifting our sense of time for an eventual shift of valuation systems. This shift is a dialectical change within a mathematical framework.¹² There is a jump in understanding when the time dimension is added. *This is important because appreciation of the true value of a program component occurs over the lifetime of the program component, while cost often occurs in the first year.* Program performance is not a single year performance. For customer value and value in resource planning, DSM components are meant to engage the future.

¹⁰ Hoffman, Ian M., Steven R. Schiller, Annika Todd, Megan A. Billingsley, Charles A. Goldman, Lisa C. Schwartz, "Energy Savings Lifetimes and Persistence: Practices, Issues and Data." Berkeley, California: Lawrence Berkeley National Laboratory, Electricity Markets & Policy Group Technical (hereinafter "LBL Technical Brief"), P. 1.

¹¹ LBL Technical Brief, P. 1.

¹² According to the principles of dialectics as summarized by Mario Bunge, “Every quantitative change ends up in some qualitative change and every new quality has its own new mode of quantitative change.” (P. 42). “[I]n every process a stage comes when some new property emerges, which has in turn its own mode of quantitative variation” (P. 55). Bunge, Mario, *Scientific Materialism*. Dordrecht, Boston & London: D. Reidel Publishing Company, 1981. See also: Mitroff, Ian I. & Richard O. Mason, *Creating a Dialectical Social Science*, Theory and Decision Library, Volume 25. Dordrecht, Boston & London: D. Reidel Publishing Company, 1981. We assert that when included in a single mathematical diagram, these paradigm jumps can take the form of step functions.

E. Evaluation of Market Transformation

Evaluation of market transformation¹³ has two parts. First, analysis of resource acquisition programs that, over time, develop market effects that develop into possible market transformation. This involves measures cost-justified for direct first-year energy savings, but that happen to develop market transformation possibilities over time. The second part of evaluation of market transformation can be centered on analysis of programs planned from the start as market transformation programs.

In the 2017 Evaluation, Econoler developed analysis of market transformation for certain selected measures that have been offered in resource acquisition program components by Efficiency Nova Scotia for several DSM cycles. The sense in this review is that Econoler selected the correct measures and conducted careful and considered analysis. For these reasons, the market transformation analysis in the Econoler evaluation is useful and fully adequate for the 2017 program year.

The Econoler evaluation does not analyze market transformation implicit in the forward edge of new construction program components, for example in promotion of types of aggressively energy efficient residential houses such as Passive House. The small numbers of these homes being constructed is edge technical work. This work cannot be done on a mass basis with current funding and cost tests, but can be explored on a limited pilot basis. Simply because new construction has this kind of forward edge, Efficiency Nova Scotia is doing limited innovation that implicitly reaches towards development of explicit market transformation programs. A constraint, of course, is that standard cost tests don't work for edge programs.¹⁴

¹³ For a brief overview of the market transformation approach, see Chapter 5: A Market Transformation Perspective, in International Energy Agency, *Creating Markets for Energy Technologies*. Paris: Organization for Economic Cooperation and Development/International Energy Agency, 2003.

¹⁴ In Robert S. Kaplan & Robin Cooper, *Cost & Effect, Using Integrated Cost Systems to Drive Profitability and Performance*, practical cost structures for new product development (essentially applied research & development) are made explicit. To get to viability, you build and gradually improve the product and run pilots. The insight is that no new products would get to the stage of market viability if all costs associated with the product were allocated back to the product as a cost center. Instead, companies allocate costs of new products under development to other cost centers, such as a generic product development budget under corporate administration. The argument can be made that for four or five Passive House homes per year, a more creative cost center could be developed to move certain costs out from the current costing model to provide higher incentives. It seems also reasonable that the savings weighted measure life for edge housing might be more like 150 or 300 years. That is part of the point of it. Passive House is a place where energy efficiency and climate defense join.

F. Addressing Climate Mitigation & Climate Adaptation

Evaluation of climate change aspects of DSM has two parts. First, evaluation of the role of program components in climate mitigation. Second, evaluation of the role of program components in climate adaptation and resiliency.

For 2017, the Econoler evaluation develops the climate mitigation value stream in terms of reduction of greenhouse gas emissions for the DSM program components. Within a DSM perspective, climate mitigation (lowering emissions of greenhouse gases) is not the most important value stream (we focus primarily on first year energy and demand reduction impacts), but it is a situationally meaningful value stream that derives from the implementation of DSM programs and plays into the contextual social valuation of DSM accomplishments. The Econoler evaluation fully computes this value stream by documenting emissions that are offset by the programs. For this reason, the mitigation analysis in the Econoler 2017 is useful and fully adequate.

The Econoler evaluation does not analyze climate adaptation. That is appropriate for 2017 because climate adaptation is not within defined scope in 2017. Even though it haunts our consciousness in all technical work and seems to be the remote endpoint of all effort, climate adaptation is not operationally expressed within the terms and conditions for DSM program components or evaluation. Yet, climate adaptation is a potential value stream within DSM, just as DSM is a value stream within climate adaptation. Time scales are different: the value stream from climate adaption aspects of DSM *is inherently intergenerational*, while DSM can function well on a short-term time horizon due to limited measure lives.¹⁵ The climate adaptation value stream is more similar to the value of disaster preparedness and the value of keeping civil infrastructure functional under stressed conditions.¹⁶ Also, it appears that all DSM measures except new construction or aggressively extensive whole building retrofit have no institutional or behavioral “lock-in” problems.¹⁷ These “lock-in” problems occur when a technical choice is inherently a long-term commitment that

¹⁵ The “look-ahead” for a DSM Integrated Resource Plan is often 20 or 30 years, while the “look-ahead” for climate adaptation is easily 220-600 years.

¹⁶ The integration of a DSM value stream for climate adaptation is not a formal recommendation, but is a matter for thought.

¹⁷ Ürge-Vorsatz, Diana, Cynthia Rosenzweig, Richard J. Dawson, Roberto Sanchez Rodriguez, Xuemei Bai, Aliyu Salisu Barau, Karen C. Seto and Shobhakar Dhakal, “Locking in Positive Climate Responses in Cities.” *Nature Climate Change*, March 2018, 8:3, Pp. 174-177.,

may produce desired results but, at the same time, also produce long-term negative consequences.¹⁸

G. Highlighted Evaluation Standards

In this section we highlight five guidelines or standards for evaluation: independence, avoiding the risk of circularity in using automated evaluation, transparency, avoiding the risk of circularity in using a Technical Resource Manual, and the desirability of familiarity with current evaluation guidelines.

1. Independent Evaluation

The primary standard in Demand Side Management evaluation is that evaluation must be conducted by an independent evaluator to guarantee the integrity of reported savings and to prevent conflict of interest. There has always been a separation of function between program implementers and program evaluators and a concern to place a wall between them.

The standard in Demand Side Management evaluation is that evaluation must be conducted by an independent evaluator to guarantee the integrity of reported savings and to prevent conflict of interest.

In response to problems encountered and as DSM programs began to mature, regulators across jurisdictions required evaluation to be conducted by outside independent evaluators. By 1992, the requirement for independent evaluations was a general regulatory requirement.¹⁹ The Econoler evaluation is an independent evaluation that meets this standard.

¹⁸ A useful insight from using a climate adaptation perspective is that it highlights the risk in adoption of “low-hanging fruit” type program strategies, because from a longer time perspective fast returns can prevent deeper savings later when the low-hanging fruit is gone. See Úrge-Vorsatz, Diana, op. cit., P. 174. In other words, one would structure program priorities and evaluations differently if one had a 220 to 600-year time horizon than if one had a 30-year or current year time horizon.

¹⁹ A DSM Administrator will always have an evaluation manager and may have a few evaluation staff because it is necessary to maintain technical competence in this specialty area to choose evaluators and to manage evaluations.

2. Automated M&V vs. Automated Evaluation

Automated M&V and Automated Evaluation are different concepts with very different implications. Today, and looking forward, there is a financial interest and there is a separate technical interest in the development of automation or semi-automation of program directed M&V. For example, to facilitate “going to scale” by attracting private capital (as opposed to ratepayer funding), there are experiments with “M&V 2.0”²⁰. At the same time, some jurisdictions are talking about the prospect of “going to scale” with energy efficiency driven by climate concerns rather than financial interest.²¹ There has also long been a purely technical interest in doing finer analysis with better data, and potentially automating much of the process.

A promising series of applied research projects at Lawrence Berkeley Laboratory is exploring possibilities for automating M&V for whole building approaches (text box).²²

Streamlined or Automated M&V strategies provide a means to estimate savings for whole building focused energy efficiency approaches. There is growing recognition that whole building focused approaches to energy efficiency hold great promise in realizing deep and persistent energy savings in commercial buildings.

Automated metering infrastructure with at least hourly data (and preferably sub-hourly data) would be required.²³ To work well, some form of Energy

²⁰ Studies of whole building approaches suggest that M&V improvement is possible. See, for example, Granderson, J., Price, P., Jump, D., Addy, N., Sohn, M. (2015). Automated Measurement and Verification: Performance of Public Domain Whole-Building Electric Baseline Models. Applied Energy 144:106-13 (<http://eis.lbl.gov/pubs/lbnl-187596.pdf>).

²¹ For jurisdictions, the need to go to scale is rooted in a climate adaptation perspective, but this is often in the background and the focus is more on capital efficiency of electric systems (including both sides of the meter). At least one jurisdiction is approaching energy efficiency as a subcategory of capital efficiency.

²² Lawrence Berkeley Laboratory, Building Energy Information Systems and Performance Monitoring Tools, 2014-2016 Assessment of Automated M&V Methods, Summary of Work (<http://eis.lbl.gov/auto-mv.html>).

²³ Some vendors will claim that they have proprietary and confidential methods based on engineering models perhaps combined with big data analytics that enable development of results without automated metering infrastructure. However, as a general principle, whenever an evaluation approach is put forward as proprietary and confidential it should be ruled out. Evaluation has the purpose of validation and validation requires a transparent process open to inspection by all parties.

Management Information System would also be preferable. And, automated M&V may become a valuable technical tool for program managers.

However, if extended from M&V (“M&V 2.0”) to evaluation (“Evaluation 2.0”) robotic (algorithmic) approaches, while they may be valuable to develop insights, may also create collateral damage. They may miss problems of data and analysis that professional evaluators deal with; and, further, we assert that that much care must be taken to insure such approaches are not easily gameable (to invite unchecked misstatement of energy savings).²⁴ The future will likely be a synthesis including pieces of new approaches. But in evaluation, we assert that the goal is truth in measurement, and methods must be based on physical measurement, where possible.²⁵ If robotic algorithms are developed for M&V, it will be important to preserve the independence of the evaluator, including the evaluator’s independence in control of methods of analysis for evaluation.

The 2017 Econoler evaluation has no problems of this kind.

3. Transparency

DSM evaluation plans and reports are made public and are open to inspection by any party. Third party review of evaluations helps insure objectivity and promotes credibility, and, when necessary, revision of evaluation results. The 2016 evaluation process has no problems of transparency.

4. Technical Resource Manual

Most jurisdictions eventually develop a Technical Resource Manual (TRM) in which calculation methods, assumptions and (in some cases) default unitary values for energy savings and/or components used in the construction of energy savings and demand-reduction are curated and open

²⁴ Peach, H. Gil, Pam Brandis, Michael J. Maranda, Ryan Miller, Anne West & Howard Reichmuth, “Evaluator as Fool, Reducing Uncertainty Through Evaluation”, Brooklyn, New York: International Energy Program Evaluation Conference, August 2005. <http://www.iepec.org/conf-docs/papers/2005PapersTOC/papers/031.pdf>

²⁵ Separate financial evaluation is not a problem; the problem is the desire to streamline M&V and evaluation so as to remove actual project energy performance – as independently measured – from surety of financial return.

for inspection by all parties. Efficiency Nova Scotia has constructed an electronic TRM (eTRM). We have reviewed the eTRM and find it to be a useful technical advance for program purposes. Econoler independently reviews measure values (such as unitary savings and effective useful life). It will be important to continue this independent check to avoid circularity based on the eTRM.

5. Evaluation Guidelines

Many jurisdictions also have a set of evaluation guidelines.²⁶ Econoler has demonstrated thorough knowledge of the Uniform Methods Project evaluation guidelines which are the most current set of generally accepted guidelines for DSM program evaluation (although discussion continues). These replace older guidelines issued by the California Public Utilities Commission, the Oak Ridge National Laboratory and the Electric Power Research Institute.

6. Process Evaluation

Table 4 provides a picture of the evaluation effort for 2017.²⁷ In reviewing the assignment of level of effort, the process evaluation area appears relatively weak compared with market and impact evaluation. Accordingly, we recommend that Efficiency Nova Scotia and Econoler increase the process evaluation effort for the next evaluation.

²⁶ For example, the New York evaluation guidelines are at:
[http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/\\$FILE/NY_Eval_Guidance_Aug_2013.pdf](http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/$FILE/NY_Eval_Guidance_Aug_2013.pdf).

²⁷ This is a copy of Table 1 from P. 4 in *2017 DSM Program Evaluation Executive Summary*, March 16, 2018.

Verification Review of Program Year 2017 Evaluation Results

Table 4: Evaluation Effort for 2016 & 2017.

Program	Program Component	2016			2017		
		Process	Market	Impact	Process	Market	Impact
Residential Efficient Product Rebates Program	Appliance Retirement		C	C			R
	Instant Savings		C	C		R	R
Existing Residential Program	Home Energy Assessment		C	C		C	C
	Green Heat		C	C	C	C	C
	Efficient Product Installation		C	C		C	C
New Residential Program	New Home Construction		C	C		C	C
Efficient Product Rebates Program	Business Energy Rebates		C	C		C	R
Custom Incentives Program	Custom		C	C	C*	C	R
	Energy Management Information Systems	C	C	C		C	C
	Strategic Energy Management**	C	C	C			
Direct Installation Program	Small Business Energy Solutions	C	C	C		C	C

*The process evaluation specifically targets the Retrofit service of the Custom program component.
 ** Due to the start date of the latest Strategic Energy Management (SEM) cohort, SEM did not have any participants who achieved savings in 2017; therefore, no evaluation was conducted for 2017.

II. Savings Verification Approach

The savings verification review was conducted as follows:

- During the year, we conducted a set of due diligence site visits for each program component. These provide an independent view of each program and of any obvious problems. During the year, the site visits provide opportunity to call attention to anything that needs to be explained or potentially fixed. We keep the Nova Scotia Utility and Review Board aware of any problems encountered.
- During the year we discussed use of the tracking system with Efficiency Nova Scotia staff. This provides an independent sense of how the tracking system is working in practice.
- During the year, we read electronic Technical Resource Manual (eTRM) materials and were provided a demonstration of eTRM.

- In review of the evaluations, we focused on the “installed” annual energy savings and demand reductions. [These are the annualized value of savings and demand reductions from the measures installed, regardless of what day of the year they were put into service. They do not represent the “realized” savings for the calendar year of the program, but are the savings that should be realized when each of the projects operates for a full year.] These numbers come from the tracking system and from the evaluator’s adjustments.
- 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. In a few cases, we did check the math.

III. General Findings

There are nine primary findings for this Savings Verification study:

SVF-1: All 2017 evaluations conducted by Econoler are within accepted industry frameworks.

Each program evaluation is comprehensive: The structure and format of each impact evaluation is consistent and useful. Each has an Executive Summary that accurately reports the contents of the evaluation. Each provides key definitions of terms and acronyms up-front. Each has a good table of contents. Each has an explanatory methodological model diagram, followed by specification and discussion of methods employed in the evaluation. Citations throughout the evaluations to other studies are relevant. For each evaluation for which it applies there is an appendix with a careful and clear delineation of calculation methods, surveys, and other core material used in the evaluation.

SVF-2: Econoler analyzed lifetime net energy savings at the generator. This improves the evaluation by highlighting the full value of Efficiency Nova Scotia programs.

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

energy savings for 2017. This lifetime analysis is useful in understand the full value of the programs.

SVF-3: Market transformation for 2017 is well addressed.

Market transformation concerns are emerging due to several years of operation of program components and certain specific measures. The evaluation appropriately analyzes these developments.

SVF-4: The evaluation appropriately addressed climate mitigation for 2017.

Climate mitigation in terms of emissions offsets are appropriately analyzed by Econoler.

SVF-5: The 2017 evaluations conducted by Econoler are appropriately independent.

Econoler conducted an independent evaluation.

SVF-6: The 2017 evaluation does not rely on any inappropriate robotic analytic mechanisms.

The 2017 evaluation does not rely on automated analysis or any other type of analysis outside the direct choice and control of the evaluator.

SVF-7: The 2017 evaluation process shows appropriate transparency.

All elements of the evaluation are open to mutual inspection.

SVF-8: The 2017 evaluation does not uncritically rely on the eTRM, though sometimes values from the eTRM may be used. The evaluator independently is responsible for unitary savings values and effective measure lives.

The use of a Technical Resource Manual (here an electronic TRM or eTRM) can be of great assistance in program planning and screening. Sometimes an evaluator will also use values from the TRM (such as unitary savings values). This is only appropriate in evaluation if the evaluator independently assesses these values. Otherwise evaluation creates circularity that could turn a program component evaluation into a “rubber stamp”. Econoler has taken responsibility to research values used (for example, unitary savings values and the effective useful life (EUL) for each measure. Since Econoler takes responsibility not to use the eTRM uncritically, there is no circularity in the evaluation results.

SVF-9: Econoler has demonstrated, over a series of years, knowledge of the currently accepted evaluation guidelines and consults this information while retaining independent professional responsibility for the specific evaluation designs and methods employed in the 2017 evaluation.

Econoler has demonstrated command of the currently accepted evaluation guidelines, while taking independent responsibility for design of evaluation and for methods employed.

IV. General Recommendations

1. **Savings Verification Recommendation No. 1:** The Savings Verification study recommends acceptance of the 2017 evaluation results for energy savings and for demand-reduction for all programs.

SVR-1: The Savings Verification study recommends acceptance of the 2017 evaluation results for energy savings and for demand-reduction for all programs.

2. Savings Verification Recommendation No. 2: Process Evaluations.

Process evaluation is a good check on the extent to which the program as planned and as administered by Efficiency Nova Scotia corresponds to the way the program functions in practice. Programs often adjust to realities that cannot be anticipated in the planning stage and first-line workers often have a better understanding of how a program works than an administrator who works out of an office and may only have had direct experience with operations in an earlier program era (or with a different program). Process evaluation can also be the one place from which direct interaction and participant observation can catch “out of the box” patterns that may be unplanned, illogical, but fully operative.

SVR-2: The Savings Verification study recommends increase in the level of effort in process evaluation for the next evaluation.

3. Savings Verification Recommendation No. 3: Non-Lighting Measures

Econoler has one cross-cutting recommendation – that Efficiency Nova Scotia focus on fostering the implementation of non-lighting energy efficiency measures. This is a strategic recommendation, and the Savings Verification study supports this recommendation.

SVR-3: The Savings Verification study recommends that Efficiency Nova Scotia work on marketing and promotion of non-lighting measures for the next DSM cycle .

V. Individual Program Component or Initiative Review

Econoler conducted evaluations of ten DSM components across the residential and BNI sub-portfolios, plus Codes & Standards which is outside the DSM program portfolio (Table 5). For the Savings Verification study, we focus primarily on impact evaluation.

Table 5: List of Individual Evaluations.

DSM Portfolio Program Components	
1	Appliance Retirement Program
2	Instant Savings
3	Home Energy Assessment
4	Green Heat
5	Residential Efficient Product Installation
6	New Residential Program
7	BNI Efficient Product Rebates
8	BNI Custom
9	BNI Energy Management Information Systems (EMIS)
10	BNI Direct Installation Program
Codes & Standards	
11	Codes and Standards

1. Appliance Retirement Program

The Appliance Retirement Program provides pick-up and environmentally sound disposal and recycling of components of household refrigerators, freezers, room air conditioners and small refrigerators or freezers. The program educates customers about the relatively high energy use of older appliances and offers appliance pick-up. It does not replace appliances. In addition, the pick-up and replacement of appliances under the HomeWarming program is included. And, as a pilot project, appliances owned by the Halifax Regional School Board (HRSB) were audited and collected by the Appliance Retirement Program. Savings from these two additions are included in this program.

The 2017 evaluation used documentation review, interview with the program manager, three visits to the recycling facility, and interview with HRSB and a unitary

savings review. The evaluator reviewed the metering protocol for the appliances and improved it. The site visits to the recycling facility were to validate the improved metering process. The evaluator used the Uniform Methods Project Refrigerator Recycling evaluation protocol.²⁸ The evaluation included free-ridership, secondary market impacts, induced consumption and internal spillover. Electric interactive effects were included. There was no participant survey in 2017 and no market evaluation.

In this evaluation, the embodied decisions on method and analytic approach are fully within the scope of performance by an independent evaluator. Net energy savings are 12% higher and net peak demand savings are 21% higher than indicated by the Efficiency Nova Scotia tracking system. The improvement in energy savings is mainly due to improvement in measurement by the evaluator and the improvement in demand reduction is partially due to improvement in measurement. For the next DSM cycle, the evaluator recommends continuing metering using improvements introduced in 2017 to narrow variation; plus a few small further improvements in instrumentation and method. The evaluator also recommends improvement to the Efficiency Nova Scotia tracking process by clearly identifying appliances retired through the HRSB pilot. The logic of these recommendations is self-evident.

Although reduced in comparison with the 2016 evaluation, and having that background to rely upon, *this is an excellent evaluation* in that it develops improved measurement and the recommendations for the next cycle continue this approach. It would make a good technical paper for an evaluation conference presentation.

2. Instant Savings

Instant Savings is carried out by Efficiency Nova Scotia as an in-store discount program with a delivery agent and participating retailers. Customers encounter the program through marketing and promotional messages and/or when making purchases in stores. The range of products in Instant Savings is wide, from LEDs to major appliances. There are campaigns for most products in the spring and fall, while appliance rebates are offered throughout the year. In 2017, Efficiency Nova Scotia also piloted indoor air quality (IAQ) devices including air purifiers, dehumidifiers and bathroom fans to assess consumer and retailer response.

Sales and energy savings were somewhat less than in the prior year, primarily

²⁸ See: <http://www1.eere.energy.gov/wip/pdfs/53827-7.pdf>

because Efficiency Nova Scotia introduced a price floor requirement for LEDs to prevent retailers from using extremely low price in their promotions. According to the market evaluation, some retailers “expressed frustration with the introduction of a product price floor in 2017.” The evaluation related the introduction of the price floor, but did not explain its goal or whether the goal was achieved.

The evaluation is based on document review, interviews with eight retailers, an intercept survey with 100 participants and a unitary savings review. Econoler reviewed unitary savings values for LED lamps and fixtures (which generate the most energy savings) and for clothes washers and refrigerators (due to changes in federal baseline regulations for these appliances). In addition, Econoler conducted a literature search, reviewed manufacturer information and Energy Star certified product lists and performed engineering calculations to develop unitary energy savings for the three new (IAQ) products introduced for 2017. The market evolution study showed that LED lighting is still in a growth phase.

Although the impact evaluation was reduced in comparison to the 2016 evaluation,²⁹ the 2017 evaluation generally follows the Universal Methods Project Residential Lighting Evaluation Protocol.³⁰ In this evaluation, the included decisions on analytic approach, methods and quantitative values are fully within the scope of an independent evaluator. The analytic detail and coverage of the evaluation of this program is complete within this context. *This is an excellent evaluation.*

3. Home Energy Assessment

Home Energy Assessment (HEA) provides financial incentives in the form of rebates or zero-interest financing to homeowners to reduce consumption of energy. HEA is focused on shell insulation measures, better electric space-heating systems or certain “green” substitutes or additions (wood or pellet stoves or heat pumps) and water-heating systems (solar domestic water heaters and heat pump water heaters). In this DSM program component, the HEA is employed to optimize a package of measures to reduce the need for grid-supplied electricity for space and/or water-heating. To measure performance, it incorporates “test-in/test-out” (“D” and “E”) residential audits which include blower door testing. These assessments are conducted by delivery agent energy advisors.

²⁹ No mystery shopping and only one wave of intercept survey instead of two.

³⁰ Uniform Methods Project Residential Lighting Evaluation Protocol. See: <http://energy.gov/sites/prod/files/2015/02/f19/UMPCchapter21-residential-lighting-evaluation-protocol.pdf>.

For 2017, the evaluation includes a documentation review, interviews with the program manager and four energy advisors, a phone survey of 70 participants and an effective useful life (EUL) literature review. The method uses HOT2000 simulations for the “D” and “E” audits. Water heating results are developed using unitary savings values. Free-ridership and spillover are included, as are interactive effects. The overestimation ratio developed in 2015 was used in space heating savings calculations. “Unconverted D Assessment Spillover” (households that started in the program with the “D” audit, made improvements, but did not continue for the “test-out” “E” Audit) were included.

The method, decisions and calculations performed by the evaluator are appropriate to this program type and within the scope of an experienced independent evaluator. For the next DSM cycle, Econoler recommends simplifying the incentive structure and conducting a new billing analysis to establish a new overestimation ratio. Simplifying the incentive structure is a good recommendation, if the simplification can be logically developed in relation to prospective energy savings. A new billing analysis is required because Efficiency Nova Scotia is now using a new version of HOT2000, so the correct ratio will likely not be equal to the previous ratio.

In addition, knowing that HEA has at time encountered health problems, we recommend that Efficiency Nova Scotia determine if a renewed focus on health and safety issue training, including mold problems is required. Health and safety issues can affect both homes and the staff and is not covered in the evaluation.

SVR-4: Determine if additional health and safety issue training, including mold problems and fiberglass precautions is required for HEA.

4. Green Heat

The Green Heat Program focuses on replacement and supplementation of heating systems by installation of equipment that uses fuel derived from renewable resources. The program changed August 1, 2017.

Participants pre-approved before August 1, 2017 can choose between a rebate and a zero-interest financing option. The new equipment may either fully replace or supplement existing heating equipment. Incentives are available for central heating systems, as well as to supplement electrical heat with an area heater. The

following categories of heating system are rebated:

- Mini-split Heat Pumps
- Air-Source Heat Pump (Centrally Ducted)
- Air-to-Water Heat Pumps
- Heat Pump Water Heater
- Wood/Pellet Stove or Fireplace Insert
- Wood /Pellet Boiler or Centrally Ducted Forced Air Furnace
- Solar Thermal: Air-to-Air
- Solar Thermal: Domestic Hot Water

After August 1, 2017, Green Heat became a mail-in rebate program, retaining the rebate but discontinuing program financing (however, Efficiency Nova Scotia is coordinating with Nova Scotia Power's on-bill financing program). The pre-approval step now longer exists. Between August 1, 2018 and November 20, 2017 non-electric homes were included in the program. Incentive amounts for heat pumps were changed, and qualifying efficiency levels for some equipment were raised.

The Process and Market evaluation found that dropping the pre-approval step works well for households that add mini-split heat pumps (MSHPs) but presents problems for households that chose more complex equipment types. Customers are concerned that they lack knowledge in selecting contractors and equipment. Eliminating the pre-approval step means that both participants and contractors may, without fully understanding program requirements, select equipment is available in the market (perhaps at lower cost) but that does not qualify for incentives.

In its methodological approach, Econoler reviewed unitary and calculated savings values for each type of equipment category based on information in the tracking system, site visit results, and literature reviews, Econoler also conducted two billing analyses. A billing analysis was conducted with 170 households that installed mini-split heat pumps (MSHPs). A separate billing analysis was carried out for 33 houses which had been participants in previous years and had installed an air source heat pump (ASHP). These billing analyses changed savings values for MSHPs and ASHPs. Free-ridership was also developed. As a further methodological approach, the evaluation presents a thoughtful review of Green Heat market evolution.

For the next DSM cycle, Econoler recommends repeating the air source heat pump (ASHP) billing analysis on a larger sample. This is a logical next step. Econoler also recommends a technical study of the performance of air source heat pumps (ASHPs)

at -15° Celsius which would require that Efficiency Nova Scotia track performance data in this temperature range. This would be a sensible step to anchor performance estimation. Given the poor performance of older generations of heat pumps in the range of 0° Celsius and below, it is important to develop a thorough understanding and documentation of cold climate heat pumps in Nova Scotia. Econoler would like a focus on certain data which would be valuable in characterizing the market for mini-split heat pumps (MHSPs). This would be useful, since market characterization and market evolution is becoming increasingly important going forward. Responding to customer concerns, Econoler requests Efficiency Nova Scotia to develop a simple, easy-to-understand list of eligible equipment so that both customers and contractors can easily determine which air source heat pump (ASHP) equipment is eligible for the program. This request should be implemented, or alternatively the pre-approval step might be brought back into the program, or, alternatively, eligible contractors might be restricted to a list of contractors that has demonstrated understanding of equipment eligibility.³¹ Econoler also would like a survey of non-electrically heated households with a larger sample size for participants who installed mini-split heat pumps (MSHPs). This would produce information relevant to inclusion of non-electrically heated homes in this program in the future.

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

In this Savings Verification study, we add one additional recommendation, based on experience with customer complaints in previous years (not in 2017). This concerns the independence of post-installation inspection. Sometimes Efficiency Nova Scotia relies on trade allies or delivery agents to inspect the quality of the installation work and equipment installed. This has not been covered in the evaluation. Accordingly, we request that the evaluator be asked to include a sub-section for Green Heat to report on how installation (presence of equipment, proper qualification of equipment, equipment properly installed, equipment in proper operation) is verified and what additional Efficiency Nova Scotia quality control/quality assurance supports the inspection/verification step. What we are looking for is on-site (rather than phone or mail or Internet) verification by an entity independent of the dealer that sold the product or the installation contractor

³¹ We have encountered situations in which customer have relied on the advice of sales persons as to qualification of equipment and do not understand why Efficiency Nova Scotia does not carry through with what they understand is the promised rebate. Sometimes, when relying on the market rather than pre-approval, the sales person or the contractor gets it wrong. Elsewhere, with other program components, customer say they want to rely on the expertise of Efficiency Nova Scotia.

SVR-5: In future evaluations, the evaluator should report on the structure and process of inspection/verification for Green Heat installations, including proportions of inspections carried out by the equipment installer/contractor and those final inspection/verifications carried out directly on-site by Efficiency Nova Scotia or by an independent inspection service reporting to Efficiency Nova Scotia rather than to the equipment seller or installer.

5. Residential Efficient Product Installation

The Residential Efficient Product Installation program component provides direct installation of standard energy-efficient lighting and domestic hot water-heating products free of charge. For 2017, a lighting pilot was included for one new multi-unit residential building.

Econoler's methodological approach includes program documentation review, interview with the program manager, a survey of 100 participants, on-site visits with 110 participants (which verified the products and number of products installed), and a unitary savings review including hours of use. In 2016/2017, Econoler conducted a thorough metering study for 75 households to assess daily hours of operation (HOU) to improve the accuracy of the energy and peak demand savings calculations for residential lighting measures for Nova Scotia. Investigation and estimation of spillover and interactive effects are also included.

Econoler conducted a careful study of products installed and products still in use, and found problems with smart power controllers suggesting that this technology is not being adopted effectively. Interactive effects of LEDs with electric heating and electric cooling are carefully developed and separate correction factors are derived for electric energy effects factor and the peak demand interactive effects factor.

Econoler's analysis of effective useful life (EUL) is particularly detailed and includes evolution of baseline values during the effective useful life of LEDs.

Analysis of free-ridership includes separate estimation for owners and tenants and for low-income.

The products for 2017 were:

- Light Emitting Diode (LED) lamps of many sizes and types
- LED holiday lights
- LED nightlights
- Faucet aerators
- Low-flow showerheads

- Pipe insulation
- Hot water tank wraps
- Smart power controllers for audiovisual equipment

This evaluation provides a good illustration of the complexity of measurement and evaluation. Each measurement or calculation is, in principle, simple. But there are a massive number of measurements and/or calculations and results are in many cases limited by the outcome of other measurements and calculations. Many steps are involved in determining results and the quality of work demonstrated is high, relying on major engineering and evaluation organizations structured in a team approach. It takes several years to achieve command of the levels of complexity and interaction demonstrated here.

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

Econoler recommends for the next DSM cycle documentation of energy-savings potentials relative to non-incandescent lamps (CFLs and halogen). This is a reasonable and inexpensive recommendation to build a knowledge base useful if, as is likely, there is a general movement towards an all LED program approach across utilities.

6. New Residential Program

For New Home Construction, in 2017 Efficiency Nova Scotia had 420 participants in the New Home Construction program and 6 in the Passive House pilot program. The New Home Construction program is designed to encourage homeowners and builders to exceed building code requirements for energy efficiency in new homes. Participation involves review of home plans using HOT2000 simulation software. Results are provided to the builder or the homeowner with recommendations to meet program eligibility requirement. The built home is inspected by an energy advisor, and a blower door test is incorporated.

The current incentive structure was introduced in May 2017 and during 2017, the rating system was changed to an estimation scale based on gigajoules.

Econoler conducted evaluation using a program documentation review, an in-depth interview with the program manager, and phone surveys with 13 participants and with 59 builders (including 19 non-participant builders). Separately, 4 participants from the passive house pilot were interviewed. Free-ridership and spillover were

analyzed. The savings analysis was based on a regression approach, generally involving the difference between “to-code” and “as-built”. The legacy HOT2000 overestimation ratio of 16% was used.

The most common complaints about the program are that the incentives are too low and the program requirements are too complicated. Econoler recommends a process evaluation for the next DSM cycle to address these and other issues. Econoler suggests a benchmarking study of similar programs in other jurisdictions and in-depth consultation with builders and other key actors. We strongly support this recommendation. This program is at the technical edge of energy efficiency and typically comprehensive new construction programs are very different from “low-hanging” fruit programs. This is the technical core of what energy efficiency is about in the residential sector and new construction is also the place in which the energy efficiency and climate adaptation silos most seriously intersect. Work in this program component is subject to the same cost-effectiveness criteria as work in all other DSM sectors, but this sector is at the edge, advancing what is possible, and more like efficiency R&D.

The other recommendation by Econoler is to conduct a new billing analysis to review the overestimation ratio. Since an improved version of HOT2000 is now in place, we agree that it is essential to conduct a new billing analysis.

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

7. BNI Efficient Product Rebates

Efficient Product Rebates for 2017 is identical with Business Energy Rebates (BER). This program provides prescriptive rebates or financing to the business, non-profit and institutional sector (“BNI”). Incentives are provided a combination of mail-in and instant point-of-sale rebates. The point-of-sale rebates are provided through electrical product distributors throughout Nova Scotia. In 2017, the mail-in approach covered 288 projects, by 213 participants while electrical distributors provided 315,687 product rebates.

The prescriptive measures for mail-in rebates are grouped into 13 categories: agricultural, commercial lighting, commercial refrigeration, commercial laundry, commercial kitchen compressed air, heating, IT & datacenters, variable frequency drives, water heating, solar thermal, pumping and pool equipment.

For 2017, this is a reduced evaluation in that there was an extensive unitary savings study for the 2016 evaluation, which was not repeated for 2017. However, data and calculations were checked to insure claimed savings were consistent with the recommended values from the 2016 evaluation. Econoler's approach included an interview with the program manager, a phone survey of 70 mail-in participants; and, for the first time, interviews with 70 instant rebates participants. There were 82 on-site visit project reviews to mail-in rebate participants and there were 8 interviews with electrical distributors who provided Instant Rebates. Interactive effects, free-ridership and spillover were calculated. The free-ridership approach made use of a combination of distributor and participant interviews, which is a current "better practice" approach. Econoler also conducted effective measure life (EUL) reviews. In its study of variables associated with market evolution for this program component, Econoler concludes that "...LEDs continue to be in a growth phase, but are approaching maturity as the BNI sector increasingly adopts these products."

Econoler recommends continued tracking of market indicators and products to identify when some products should be removed from the program; and, that Efficiency Nova Scotia examine BNI sectors that are underrepresented in the mail-in service and develop promotions for those sectors. Also, Econoler recommends improving the structure and completeness for tracking point-of-sale rebate participants to gather data that would permit better estimation of impact, annual hours of use (HOU), free-ridership and spillover. These recommendations follow logically from the analysis. Each is useful for the program component and/or its evaluation for the next DSM cycle. In addition, Econoler provides three recommendations to address specific technologies (strip curtains on a commercial walk-in cooler, motor and VFD measures, and adjustments for commercial kitchen measures (mostly related to hours of use – HOU). These are useful recommendations focused on specific technologies.

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

8. BNI Custom

This Custom Retrofit program for business, non-profit and institutional (BNI) customers provides technical assistance, financial incentives and project financing. Technical support for these projects typically begins with scoping (feasibility studies).

Incentives are based on simple cost payback periods and are tailored to meet the situation of individual customers.

Custom has three primary components: retrofit, new construction and building optimization.³² Retrofit helps with technical and financial support for scoping and feasibility studies, then helps implement technical changes using a customized and flexible approach. New construction provides incentives for new buildings, additions to buildings and major renovation of existing buildings. Building optimization provides a recommissioning process and supports implementation of low-cost/no-cost efficiency improvements.

Retrofit is the biggest contributor within this program sector to net energy savings. For retrofit, Econoler conducted a technical review of project documentation and on-sites for 26 projects. Econoler used a combination of calculations and spot measurements to improve project information. Four of the 28 projects were found to lack M&V data. In these cases, Econoler relied upon manufacturer information, assumptions used by project consultants and engineering estimates. Spillover was assumed to be zero, since it had been zero for the past three years. Free-ridership was set to 9%, the average of the past five years. Ten retrofit consultants and 15 retrofit participants were included in the process evaluation. One of the findings of the process evaluation was high appreciation for the role of Business Development Managers (BDMs) in increasing participation.

For new construction, only 6 projects were completed during 2017. Econoler conducted a detailed technical review for 5 of these. Work included correction of simulation models used by the consultants.

For building optimization, only 6 projects were completed during 2017. Econoler conducted in-depth technical review and on-sites for 4 of these. Econoler found several errors in the expected energy savings modeling and calculations and reduced net energy savings by about 20% and net demand reduction by nearly 50%. These corrections were applied only to the four buildings examined due to small sample size.

Overall, across the three components of BNI Custom, net energy savings was reduced 8% below the tracked value and net peak demand reduction was reduced by 38%.

For the next DSM cycle, Econoler recommends that Efficiency Nova Scotia continue

³² Strategic Energy Management (SEM) is not included since SEM did not report savings in 2017.

and expand outreach efforts through the Business Development Managers (BDMs). Given the process evaluation finding about the BDMs, this is a useful recommendation. Econoler also recommends that Efficiency Nova Scotia conduct an in-depth review of energy models used by consultants. Even though simulations are conducted by experienced energy consultants, problems found in the 2017 evaluation demonstrate the need for a renewed focus on systematic review and corrections. Econoler recommends that Efficiency Nova Scotia provide additional tools and training to staff so that they are better able to conduct technical reviews of energy models. It seems reasonable to try to allocate more resources to support critical review by staff in the Custom program area. In the sub-program for building optimization, Econoler recommends more systematic differentiation between repairs that are the responsibility of a building owner and the kinds of changes that simply improve energy efficiency. The 2017 optimization projects demonstrated a wide range of variability, and it is likely not always clear during optimization when an improvement should be declared the owner's responsibility. It may be that building optimization will always have this scope problem as a typical hazard, due to the wide scope of projects included. But it is reasonable to put a focus on improvement in definition of objectives to try to "rule-out" most of them. Econoler also recommends better documentation for baseline conditions for building optimization projects. This recommendation is based on encounter with some 2017 projects with insufficient baseline documentation. This seems a reasonable and necessary recommendation. Not fully implemented in 2016, Econoler again recommends identification of root causes of low participation in new construction, development of a change tracking mechanism for retrofits, specifying and tracking retrofit effective useful life in the Custom tracking report, and addition of adjustment assumptions to modify model outputs for new construction projects. Each of these recommendations is reasonable.

The evaluation of BNI Custom is appropriate to this program type and within the scope of an experienced independent evaluator. Custom is one of the most technically complex areas for energy efficiency work and an area in which improvements can be long-lasting.

9. BNI Energy Management Information Systems (EMIS)

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

implementation). This sub-program also provides training and organizational support for implementing management information systems and processes. Four EMIS participants reported net energy savings for 2017.

Econoler conducted a program component documentation review, interviews with the program manager and carried out a desk review of all four reporting projects (including participant phone interviews). This included review of updated annual reports and savings calculation workbooks as well as baseline reviews. Free-ridership and spillover were assumed to be zero.

Econoler recommends that Efficiency Nova Scotia take steps to insure the tracking sheet is complete and accurate. This recommendation is based on finding several discrepancies in 2017 and so is both useful and necessary. Econoler also recommends that Efficiency Nova Scotia design baseline regressions and plan M&V to insure accurate savings calculations, even when changes occur in the facility. This recommendation is based on finding that during 2017, one facility had an increase in production time on weekends but production level was not documented. This appears to require more Efficiency Nova Scotia involvement, probably on both a formal and an informal level to keep touch with what is happening at each facility and what is be planned and what is being talked about informally. This recommendation is also useful and necessary and likely would require prioritization of these projects for more staff time to maintain contact (constant touch) to keep relationships and documentation current. Both EMIS and SEM programs likely require a constant touch approach. Econoler also notes a 2016 recommendation that was not fully implemented by Efficiency Nova Scotia: track incremental savings rather than cumulative savings. This will better capture energy savings. Finally, as in 2016, Econoler recommends tracking major changes in facility operations and equipment to adjust baseline as required. This is another useful and necessary recommendation.

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

10. BNI Direct Installation Program

The BNI Direct Installation Program is identical with Small Business Energy Solutions (SBES), 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 path. For 2017, there were 50 projects on the audit path and 367 projects on the DIY path. Those businesses that qualify for the audit path are offered a free energy audit. Those that do not qualify may pay for an energy audit. Participants that follow the DIY path are

provided quotes and invoice guidelines, product worksheets and referral to the Efficiency Trade Network (ETN). Participants can select measures or chose to employ a contractor to help with the decision on which measures to install.

Example measure areas include:

- Agriculture
- Compressed Air
- Custom
- HVAC
- IT & datacenters
- Kitchen
- Laundry
- Lighting
- Motors and VFDs
- Pumps
- Refrigeration
- Water heating

During 2017 two participants follow an alternative Affordable Multifamily Housing pilot track. This track works like SBES but basis decisions on the affordable housing criterion rather than on energy usage.

Econoler reviewed Efficiency Nova Scotia's gross savings estimates using a desk review. This used an interview with the program manager, information from the tracking system, the CIRx screening tool and findings from on-sites. Free-ridership and internal spillover were estimated from a phone survey of 50 DIY participants and 20 Audit-path participants and from the on-sites (35 DIY participants and 15 Audit-path participants). There were also 5 on-sites during audits and a review of effective useful life (EULs).

Econoler recommends that for the next DSM cycle Efficiency Nova Scotia implement an internal procedure to flag for thorough review the most complex custom projects within the BNI Direct Installation program. Econoler notes that the expertise for this review is in-house with staff of the Custom program. While Efficiency Nova Scotia developed new lighting application forms to be used effective January 2018, Econoler requests that Efficiency Nova Scotia carefully monitor how participants complete the forms and how the information is used to calculate savings and peak reduction, with special attention to daily operating schedules and the system peak demand. Econoler also recommends that Efficiency Nova Scotia work to encourage

implementation of non-lighting measures. Each of these recommendations follow from the analysis and are reasonable.

There are also two Econoler 2016 recommendations that carry over. First, consider working with auditors to make the process of developing cost estimates less burdensome for auditors, contractors and distributors. This recommendation applies to the audit path. The situation is that auditors call distributors and contractors for pricing information, to set up a reasonable costing expectation. However, the auditors are not permitted to recommend the distributors and contractors who agree to provide pricing. Econoler suggests that Efficiency Nova Scotia could set up meetings to discuss possible alternative methods for estimating costs. We do not see this as an essential step, in that this system works and a buffer is required to keep the system neutral. Finally, Econoler recommends that in the future, Efficiency Nova Scotia provide copies of the savings calculator for Energy Star certified commercial kitchen equipment. This seems a reasonable recommendation.

11. Codes and Standards

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

To improve energy efficiency, Natural Resources Canada (NRCan) implements minimum energy efficiency standards through amendments to the Energy Efficiency Regulations. In 2006 Canada established a Clean Air Regulatory Agenda. Three recent amendments to the Energy Efficiency Regulations aim "to deliver energy, greenhouse gas (GHG) and air pollutant reductions". The most recent amendment (Amendment 13) was published on December 28, 2016 and came into force on June 28, 2017. Amendment 13 affects twenty product categories. Since it takes time for stock to clear, it was expected that changes in these product categories would first be used for the 2018 Econoler evaluation. However, Econoler found that for two products (clothes washers and refrigerators) stores had already integrated the new standards prior to June 2017 and so these adjustments to minimum efficiency performance standards (MEPs) are included in the 2017 evaluation. In addition, Econoler includes the adjustments previously addressed in the 2016 evaluation.

In addition, Nova Scotia applies MEPS to street lights (Nova Scotia is the first province in Canada to make LED roadway lighting a minimum requirement). Nova

Scotia also enforces an Energy Code applicable to houses, small buildings, large buildings, condos and apartments.

The 2017 evaluation includes:

- Incandescent Lamps
- LED street-lighting
- New building energy code for houses and small building
- New building energy code for large buildings, condos and apartments.
- Clothes washers – Tier 1
- Refrigerators.

For 2017, the evaluation approach was secondary data analysis. First, data sources were selected. The data was collected from the Electro-Federation Canada, the Association of Home Appliance Manufacturers (AHAM Canada), NRCan, Nova Scotia Municipalities, the Canada Mortgage and Housing Corporation (CMHC) and Statistics Canada. Analysis of Codes and Standards requires relevant data plus wide knowledge and understanding of the workings and context of specific markets. The evaluation estimates impact in terms of net energy savings and net peak demand reduction. There were also interviews with retailers and manufacturer associations. Market size was developed for each MEP. Unitary savings and interactive effects were developed and reviewed.

Econoler recommends that for the next DSM cycle, the remaining Amendment 13 standards that would have a sizable impact be included in the evaluation. This is a logical recommendation that would produce useful results.

The methods adopted and analysis developed in this evaluation are within the scope of an experienced and professional independent evaluator.

VI. Summary of Findings

SVF-1: All 2017 evaluations conducted by Econoler are within accepted industry frameworks. (Page 20)

SVF-2: Econoler analyzed lifetime net energy savings at the generator. This improves the evaluation by highlighting the full value of Efficiency Nova Scotia programs. (Page 20)

SVF-3: Market transformation for 2017 is well addressed. (Page 21)

SVF-4: The evaluation appropriately addressed climate mitigation for 2017. (P. 21)

SVF-5: The 2017 evaluations conducted by Econoler are appropriately independent. (P. 21)

SVF-6: The 2017 evaluation does not rely on any inappropriate robotic mechanisms. (P. 21)

SVF-7: The 2017 evaluation process shows appropriate transparency. (P. 21)

SVF-8: The 2017 evaluation does not uncritically rely on the eTRM, though sometimes values from the eTRM may be used. The evaluator independently is responsible for unitary savings values and effective measure lives. (P. 22)

SVF-9: Econoler has demonstrated, over a series of years, knowledge of the currently accepted evaluation guidelines and use this information while retaining responsibility for the specific evaluation designs and methods employed in the 2017 evaluations. (P. 22)

VII. Summary of Recommendations

SVR-1: The Savings Verification study recommends acceptance of the 2017 evaluation results for energy savings and for demand-reduction for all programs. (Page 22)

SVR-2: The Savings Verification study recommends increase in the level of effort in process evaluation for the next evaluation. (P.23)

SVR-3: The Savings Verification study recommends that Efficiency Nova Scotia work on marketing and promotion of non-lighting measures for the next DSM cycle. (Page 23)

SVR-4: Determine if additional health and safety issue training, including mold problems and fiberglass precautions is required for HEA. (Page 27)

SVR-5: In future evaluations, the evaluator should report on the structure and process of inspection/verification for Green Heat installations, including proportions of inspections carried out by the equipment installer/contractor and those final inspection/verifications carried out directly on-site by Efficiency Nova Scotia or by an independent inspection service reporting to Efficiency Nova Scotia rather than to the equipment seller or installer. (Page 29)

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