SAVINGS VERIFICATION REPORT

OF THE DSM ADMINISTRATOR'S 2011 DEMAND SIDE MANAGEMENT PROGRAMS

MARCH 2012

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DSM SAVINGS VERIFICATION REPORT

I. Executive Summary

This report is a savings verification review conducted by H. Gil Peach & Associates, LLC for the Nova Scotia Utility and Review Board (Board). It reports on verification of savings estimated by Econoler, the Independent Evaluator for the Demand Side Management (DSM) Administrator's fourth year (calendar 2011) programs. The purpose of this report is to review, verify, and if appropriate, recommend adjustments to the savings data and estimates created by evaluation consultants engaged by the DSM Administrator.[1]

The examination is based on careful review of the evaluation for each program in the DSM portfolio, including review of each evaluation's implicit design, of evaluation methods and standards employed in each evaluation, and selected checking of calculations. 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) and selected "due diligence" site visits to check installation counts and quality of work. In addition, the savings verification consultant watches the evolving general standards of practice in DSM and DSM evaluation to highlight best practices.

The purpose of this report is to review, verify, and if appropriate, recommend adjustments to the savings data and estimates created by evaluation consultants engaged by the DSM Administrator

Demand-Side Management

In understanding how DSM works, probably the most important thing is to see it not as a single activity but as a *cycle of repeated activities subject to continuous process improvement*. Figure 1 emphasizes the DSM cycle with four parts and with each part contributing knowledge to improve the other parts from cycle to cycle. The arrows in this diagram show the direction of the primary flow of activity within a DSM cycle.

[1] Nova Scotia Power, Inc. served as the first DSM Administrator. Responsibility transferred to Efficiency Nova Scotia Corporation in October 2010. Calendar year 2011 represents the first full program cycle with Efficiency Nova Scotia as the DSM Administrator.

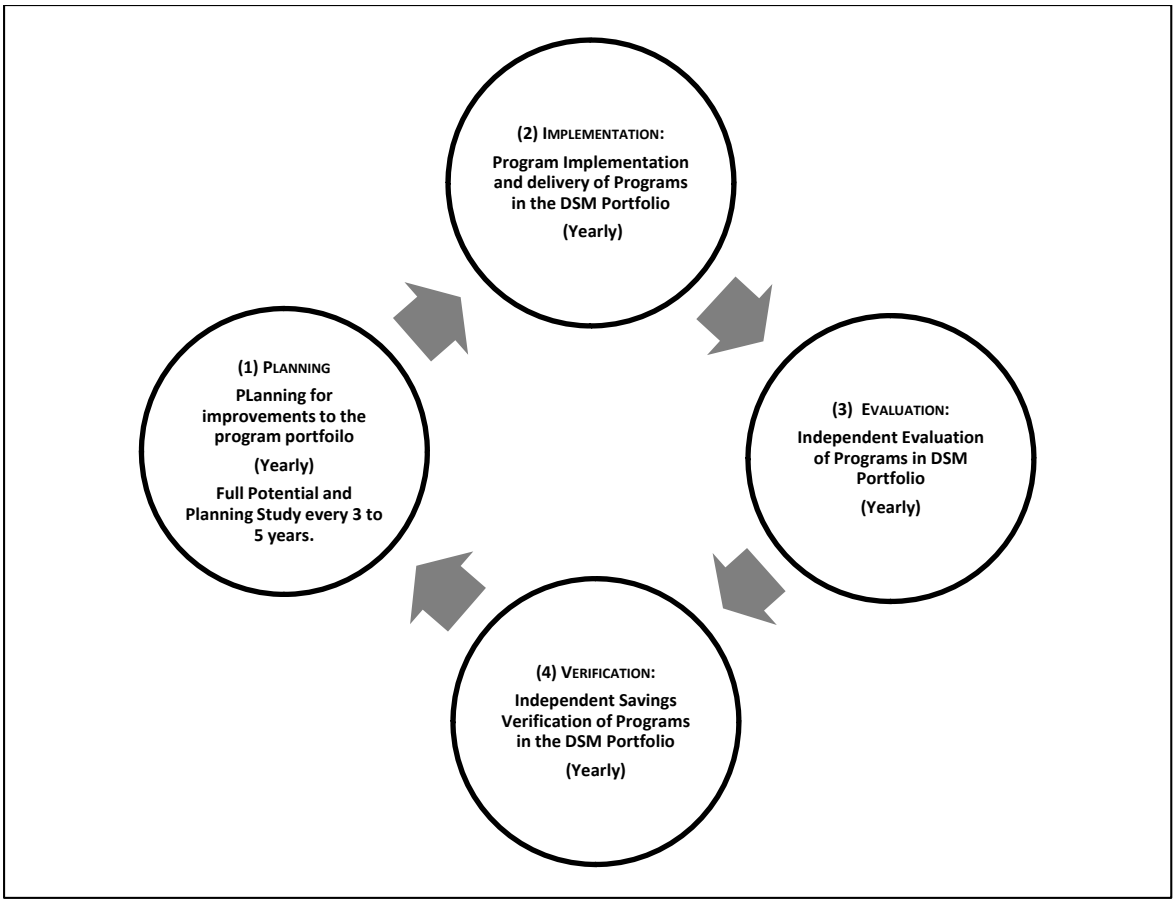

Figure 1: The Demand Side Management Cycle.

Each step in the Demand-Side Management Cycle feeds information forward to the Planning step, which proceeds continuously but is also implemented in a major planning study every three to five years to use in developing the next set of cycles.[2] For example, the Implementation step in each cycle feeds information forward to Planning through the records in the program data tracking system and the development of practical knowledge and through insights gained by program administrators into the realities of a variety of program types gained through experience. Over a few cycles, the program managers acquire deep and practical knowledge of specific sets of markets, technologies, codes, and practices.

[2] 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.

The Evaluation step should also feed timely information back to the Program Implementation step in order to provide opportunity for program corrections within the same cycle. However, Evaluation is primarily directed toward providing independent program assessments for the next Implementation step and for Planning.

Both the Program Implementation step and the Evaluation step feed information forward to the Savings Verification and Planning steps, for example, through the results of electrical measurements. The Evaluation step adds results of independent measurements of auxiliary variables (such as hours of operation, interaction effects, assessment of free-riders and spillover effects) and results from observations, site inspections, surveys, interviews and analysis/calculations. As noted, the 2011 program year is the fourth year of DSM programs in Nova Scotia. The 2012 program year will be the fifth year. After the fifth year, it is reasonable to consider the DSM Administrator's operation of the program portfolio as essentially a set of mature programs, though occasionally new programs will be introduced.

The 2011 Programs

In the 2011 program year the DSM Administrator operated fifteen different programs, including both full-scale programs and pilot programs (Table 1).[3] As shown in Table 1, the program portfolio consists of three groups: residential programs, efficient product programs and commercial & industrial programs.

The residential programs include two appliance programs (appliance retirement and appliance replacement), a retail markdown program with cooperating stores, a LED holiday lighting exchange, a low-income renter program and a multi-unit residential renter program.

The efficient products programs include a direct install program, a retrofit program (EnerGuide for Existing Houses), a fuel substitution pilot, a low income program and a new residential construction program (Performance Plus).

The commercial & industrial programs include Business Energy Rebates, an upstream lighting program (Smart Lighting Choices), a custom program (both retrofit and new construction) and Small Business Energy Solutions.

[3] In addition, work was carried out to support development of custom new construction. Efficiency Nova Scotia also conducted outreach, education and marketing and all of the internal development and ongoing administrative, managerial, relational and operative functions appropriate to an independent organization.

Table 1: DSM Portfolio for Program Year 2011.

2011 PROGRAMS		
No.	**Name**	**Acronym**
Residential Programs		
1	**Appliance Retirement**	ARet
2	**Appliance Replacement**	ARep
3	**Retail Markdown Program**	RMP
4	**LED Holiday Light Exchange**	LHLE
5	**Low Income Renter Program**	LIR
6	**Multi-Unit Residential Renter Program**	MURR
Efficient Products Programs		
7	**Efficient Products - Direct Install**	EP-DI
8	**EnerGuide for Existing Houses**	EEH
9	**Fuel Substitution Pilot**	Fuel
10	**Low Income Program**	LI
11	**Performance Plus**	PP
Commercial & Industrial Programs		
12	**Business Energy Rebates**	BER
13	**Smart Lighting Choices**	SLC
14	**Custom Program**	C&IC
15	**Small Business Energy Solutions**	SBES

The 2011 Evaluation of DSM Programs

The 2011 program evaluation was carried out by Econoler. This is the first year Econoler has served as the independent evaluator. Econoler's full evaluation report is a document of 1,474 pages consisting of an impact evaluation for each of the fifteen programs, a process evaluation for fourteen of the fifteen programs and an executive summary. In addition, during 2011, Econoler developed a Net-to-Gross methodology and ENSC commissioned and completed a socket study and an independent review of the energy impacts of the New Page paper mill improvements.

The 2011 Savings Verification Study

The focus of the Savings Verification study is on energy savings and demand reduction impacts. We also reviewed the process evaluations and were observant over the year regarding organization and procedures, but our focus is on impact. In preparing for this study, members of the savings verification team had several meetings with the DSM Administrator's management, specialists and program managers and staff. The DSM Administrator provided full access to the records of each program, both written and electronic. We also conducted "due diligence" site visit inspections[4] and reviewed data tracking information.

This year we were interested in the new factors that Econoler introduced across the evaluations and particularly in the adjustment for interaction effects, the changes in measure values and the changes in Net-to-Gross estimation. These have been implemented clearly and they are well explained and well documented by the Evaluator. It was also decided that the approach would be informed and supported by as many on-site check visits by the savings verification team across the programs as could conveniently be scheduled, consistent with budget. Such visits were sometimes conducted with the DSM Administrator staff and sometimes independently.

The 2010 savings verification approach includes the following steps:

- Review of the kinds of information available in the Program Tracking files developed and maintained by the DSM Administrator. During 2011 the Program Tracking files represented a central location for electronic program records, though some programs operated using their own record systems. Not all programs made active use of the Program Tracking System and we look forward to more active use of the new system by program managers in 2012 as the system becomes more usable.

- Review of the Econoler evaluation estimates for annual energy savings and demand reduction. We reviewed the fit between program tracking numbers and evaluated results with a focus on the evaluated savings. Note that the annual energy saving and demand reduction figures are *annualized values* regardless of what time of the year measures 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.

- We reviewed the free-ridership and spillover methods for 2011 and find them well designed and well implemented.

[4] Due diligence site visits are selected by the savings verification team and do not constitute statistical samples.

- We reviewed the interactive effects factor and other adjustment factors across the programs for 2011.

- We reviewed the changes to unitary measure values introduced in 2011 and find the changes to be clear, well thought through and well documented.

- The evaluation and the savings verification study are at the generator level.

Primary Findings and Recommendation

There are two primary findings and one primary recommendation in this 2011 Savings Verification study.

Finding SV1 We find that Efficiency Nova Scotia Corporation's implementation and ongoing administration of all programs in the 2011 program portfolio was well executed and successful. While there was, of course, ongoing organizational and staff learning, there were no major problems in the management and execution of the programs that would rise to the level of inclusion in this report.

This finding is based on the Econoler evaluation, our review of program documentation and tracking databases, interviews with the DSM Administrator's executive management, specialists, program managers, and staff as well as discussions with delivery agents and "due diligence" site visits.

Finding SV2 Econoler's 2011 program evaluations were conducted within industry accepted evaluation frameworks and within appropriate professional scope, given the time constraints of the regulatory schedule.

Econoler's evaluations make good contact with the realities of ENSC's programs, leading to relevant findings and recommendations. In particular, we note that in cases where problems were encountered in assessing some of the programs Econoler did not simply model energy impact results but conducted small "true-up" studies to calibrate modeling tools. Econoler has also introduced to the analysis several conditioning factors (for example, the interaction factor). In tracing the derivation of these factors, we find that in each case and for each program they are well thought through. Also Econoler's citations to

methods and projects are relevant. And, for the first time in the series of evaluations there is substantial citation to Canadian sources, providing more relevant source data.

For 2011 we have no adjustments to recommend to the savings data and estimates created by the Evaluator.

Recommendation SV1 We recommend acceptance of the Econoler evaluation results for energy savings and demand reduction for 2011, without adjustment.

Additional findings and recommendations are presented below and in the sections for the individual programs.

Specific Action Items

Improvements in evaluation methods to improve validity (balanced by reasonable cost) as well as some improvements in related areas are listed below as action items. Response to each of the following recommendations should be summarized by the DSM Administrator and progress reported to the NSUARB.

Recommendation SV2 Efficiency Nova Scotia and the Evaluator should continue to increase direct measurement including employment of energy usage information contained in Nova Scotia Power's customer information system, direct electrical measurement and passive monitoring.

In an electrical energy and energy efficiency context, physical measurement provides a higher realm of data than simulations (modeling) alone. Physical measurement also produces results of a different nature than the results of social science. Modeling and social science methods and insights are valuable and sometimes necessary, especially where more direct measurement is not possible. Additionally, they can provide useful qualifications to interpretation of physical results. Sometimes they can offer efficient shortcuts and cost savings. However, we recommend continuing effort to move measurement more in the direction of direct electrical

measurement and passive (instrumented) monitoring and less in the direction of modeling and social science except where justified by some stated and motivated specific advantage.

The general principle is that the closer DSM programs can be assessed in terms of actual energy usage (whether by short term metering or by use of usage and billing data from the customer information system), the more valid, stable, inter-subjective, transparent and accurate the impact evaluation results.[5]

The DSM Administrator or the Evaluator at the direction of the DSM Administrator should continue to advance suggestions for electrical measurement and passive monitoring for each program where movement towards more electrical measurement and passive measurement is possible, and indicate those programs where it is not possible.

This direction towards increased electrical measurement is also aimed at clear results that can be easily understood by the public as well as be experts.

Recommendation SV3 *The DSM Administrator should continue to insure that the evaluator is assigned to make at least some site visits to each program and subprogram each year as a check.*

The evaluation principle in this recommendation is that the evaluator should be engaged in the physical materiality of each program through at least a few site visits.

Recommendation SV4 *The DSM Administrator should implement the various recommendations of the Evaluator to increase number of evaluation site visits for certain programs.*

[5] Good scientific measurement should be conducted through an operationally definable process and show reliability and precision so that any person repeating the analysis will arrive at essentially the same result. It should also be valid or true measurement so that, if done correctly, it will arrive at the true value of what is being measured. In aggregate systems of measurement the quality of the system results depends on all of the components meeting these three conditions. Models are, by contrast, just mathematical exercises unless trued-up to actual measurement and calibrated. S.S. Wilks, "Some Aspects of Quantification in Science," Pp. 5-12 in Woolf, Harry (ed.), *Quantification, A History of the Meaning of Measurement in the Natural and Social Sciences*. Indianapolis & New York: Bobbs-Merrill, 1961.

In some cases, based on experience in 2011, the Evaluator has put forward recommendations to increase the number of on-sites for a program. In each case, the need for more on-sites is well documented by the Evaluator. We support these recommendations as they will improve the accuracy of measurement of energy savings.

Recommendation SV5 *Beginning with the next set of evaluations (for 2012), a policy on dual baselines should be stated and implemented for each program.*

This will require consideration of effective useful life (EUL) and remaining useful life (RUL) for each measure and whether or not a code or customary standard is in place to determine replacements in the absence of a DSM program. Currently savings is valued as the difference in energy use and demand between new equipment and equipment replaced.

The Effective Useful Life (EUL) is "an estimate of the median number of years that efficiency measures installed under a program are still in place and operable." Old equipment (to be replaced) also has an Effective Useful Life.

The Remaining Useful Life (RUL) of a piece of equipment that is replaced by a program is estimated by asking, at the time the equipment was replaced, about how many years were left in its useful life (without major repairs which may have led to replacement). Another way to put this question is, "How long would the old equipment have met the technical and performance needs of the facility? Another way to ask is, "Was the condition of the existing equipment fully functional?"

Generally, if the equipment was replaced on failure (that is, it has no RUL), the incremental savings is the difference between the energy use of the new DSM equipment and either the current code for the old equipment or the common practice replacement for the old equipment. If the equipment replaced has a number of years of RUL when it is changed out (early replacement) then the incremental savings is the difference between the energy use of the new DSM

equipment and the old equipment for the duration of the RUL; then it shifts to the difference between the new DSM equipment and either code or common practice in replacement.

This description is an approximation to provide a general outline of considerations of EUL and RUL. The DSM Administrator or the evaluator should put forward a policy to be followed for EUL and RUL in evaluations for each program.

Recommendation SV6 *To improve clarity of presentation and to support review, the DSM Administrator should direct the Evaluator to attach one sample worksheet showing calculations step by step that support calculations and results for at least one individual example project for each program, subprogram and pilot.*

These example work papers would be included as a separate appendix to the 2012 evaluation. This will assist readers in following the calculation steps in the text of each program evaluation.

The Evaluator provides an excellent presentation of derivation of various factors at the aggregate level within the 2011 program evaluations. Providing a single example calculation at the individual site level or other micro level, as appropriate, would further clarify exact procedures and provide an example calculation that could be checked by the reader.

Recommendation SV7 *The DSM Administrator should perform an on-site check of a random sample of 30 to 60 previously installed power bars distributed across the programs that provide power bars to document how they are being used.*

In 2011, the Evaluator found a problem in the misuse of power bars in one program (Multi-unit Residential Renter Program) using a sample size of five. This is small sample from which it is not possible to draw conclusions but which can serve as an indication of a possible problem and trigger the need for a larger sample to further determine the size of the problem.

In context, power bars have drawn conflicting evaluation results in evaluations elsewhere. A small study may be able to determine if there are kinds of clients who will not use power bars correctly and perhaps suggest program rules for limiting their distribution. If education is a workable solution, the sample could also be used to develop a subset of cases in pre/post design to test that solution also.

Since the problem has been found in one program it should be looked for across programs.

Recommendation SV8 *To the extent possible, the Evaluator should carry out a full non-equivalent control group design (two baseline years, post year, treatment group and comparison group) to develop the energy savings from the residential programs for which this design is appropriate.*

These are the EnerGuide for Existing Houses Program, the Low Income Program and the Fuel Substitution Pilot.[6] This recommendation corresponds to and extends Evaluator Recommendation EEH-R5. If Econoler prefers a different method of analysis, it could be developed alongside.

Recommendation SV9 **[Related to Evaluation Recommendation ARet-R3]** Econoler recommends metering refrigerators and freezers at the recycling facility. *We support the metering recommendation but recommend the metering be conducted or be overseen by Econoler or by Efficiency Nova Scotia.*

The principle here is that where reasonably possible, metering should not be carried out by program vendor with an inherent interest in results. If this is not possible, then

[6] Campbell, Donald T & Julian C. Stanley, *Experimental and Quasi-Experimental Designs for Research.* Chicago: Rand-McNally College Publishing Company, 1963; Cook, Thomas D. & Donald T. Campbell, *Quasi-Experimentation Designs & Analysis Issues for Field Settings.* Boston: Houghton-Mifflin Company, 1979; Shadish, William R., Thomas D. Cook & Donald T. Campbell, *Experimental and Quasi-Experimental Designs for Generalized Causal Inference.* Boston: Houghton Mifflin Company, 2002; for possible problems noted by Econoler in the 2011 Evaluation, see California Evaluation Framework, TecMarket Works, June 2004, Pp. 142-143.

Efficiency Nova Scotia or Econoler should oversee and be involved with the metering process and/or observe on a random basis.

Recommendation SV10 **[Related to Evaluation - C&IC-R1]** For the Commercial & Industrial Custom Program, the Evaluator recommends clearly defining the M&V requirements before signing the PDA. The intent of this recommendation is to standardize the Monitoring and Verification (M&V) requirements for this program and to the extent possible insure that the plans fit within the provisions of the International Performance Measurement and Verification Protocol (IPMVP).

We recommend that this recommendation not be implemented for 2012.

The reasons for not supporting the Evaluator's recommendation in this area are practical.

(1) This program has been excellent in its emphasis on direct electrical measurement since it began and in the end has demonstrated adequate measurement in practice.

(2) IPMVP is not so much a reliable governing set of guidelines as a set of fairly open frameworks that permit a wide variety of approaches. IPMVP is a useful touchstone and a good sensitizing set of documents and frameworks that operated at a very general level. It does not add much to what is already known in an industrial setting.

(3) Industrial clients have to meet production schedules. They will look for simple, quick but adequate measurement that makes sense to management. This should be satisfactory for DSM measurement purposes, based on experience to date. Introducing this up front requirement is theoretically a good idea but in practice might interfere to some degree with program uptake and industry relations.

Recommendation SV11 **[Related to Evaluation - C&IC-R2]** For the Commercial and Industrial Custom Program, the Evaluator recommends changing to third-party Monitoring and Verification (M&V) for projects above a certain size. Econoler recommends separating the M&V function from the contractor installing improvements. This is a generic and generally good type of evaluation recommendation. It is grounded in the problems of personal and organizational interest and in the problem of appearances.

We recommend that this recommendation not be implemented for 2012.

(1) This change is contrary to the way most large firms approach improvements in their plants. Generally, plant management is highly competent and there will be in-house engineers or electricians. Management tends to know which contractors they trust based on experience and reputation *within their specific industry.* If they trust a particular contractor with access to the plant and with the work, they often prefer to trust the contractor with the measurement. In any case, what makes the large commercial and industrial sectors different from other sectors is that they have high internal measurement expertise and experience. Also, the measurement process is simple – usually direct electrical measurement of isolated circuits or the use of lighting sensors.

(2) In general, it is more productive to follow industrial practice and respect the traditions of industrial plants. Efficiency Nova Scotia Corporation has had an ongoing role in working with companies in the measurement process so there is interaction and oversight by Efficiency Nova Scotia in determining and in implementation of the measurement process. The program is working well and the measurement process is sufficient.

(3) This contrasts with the practice in other sectors such as residential and small commercial where customers do not have measurement expertise and experience and where third party measurement is preferred.

(4) Often the industry engineers specify measurement (with Efficiency Nova Scotia Participation) and in some cases industry engineers may do the measurement or oversee it. And Efficiency Nova Scotia engineers are interactive in the whole measurement process

Recommendation SV12 **[Related to Evaluation - CINC-R1]** For the Commercial and Industrial Program, the Evaluator recommends conducting a separate complete evaluation for the new construction area. This would provide a direct focus in on new construction. As the Evaluator notes, new construction will gradually grow (there was only one project in 2011).

We recommend that Efficiency Nova Scotia treat this Evaluator recommendation as long term consideration rather than for 2012.

Recommendation SV13 For the 2012 Evaluation, the report should include a list of abbreviations (for example, to define the acronyms “PM” and “DA”) and any special terminology used in the report (for example: interaction effect, diversity factor, line loss factor) so that these are all available in a special section. The explanations should be in plain language to make these easily understandable for the general reader. In addition, the general style of the evaluation – which is good for the 2011 Evaluation – could be further improved for accessibility for readers who do not have substantial industry background.

Recommendation SV14 For the 2012 Evaluation, the report should include a table or tables with the following kinds of headings so that all of the adjustments to each program can be reviewed in one place, probably in the executive summary or in an appendix. The Evaluator should determine the format and table headings but, ideally, one could envision starting with an initially estimated savings on the left and then follow through the factors (as a chain of multiplication) to arrive at the final result on the right. Putting these in one place will help the reader understand the process of determining the final savings.

Free Rider (%)	Spillover (%)	Interactive Effects (Melded)	ENSC	Evaluation			ENSC	Evaluation		
			Net Savings (GWh)	Gross Savings w/ Interactive Effects (GWh)	Net-to-Gross	Net Savings (GWh)	ENSC Net Savings (MW)	Gross Savings w/ Interactive Effects (MW)	Net-to-Gross	Net Savings (MW)

Recommendation SV15 For the 2012 Evaluation, the report should contain a section with all of the citations to studies that support adjustment factors, linked to the programs to which the studies provided adjustment factor grounding. This will help readers in understanding the adjustments and extent of their grounding in the sources.

Recommendation SV16 The DSM Administrator should consider whether or not to add to the Evaluators' scope an additional step.

Since the Potential Study is geared towards cost/kWh, the evaluator could report the obtained cost/kWh for each program and pilot and show that information in comparison to the planning cost/kWh for the program.

This might provide a better gauge for the reader in understanding program performance in relation to plans and projections. It would simply ask the Evaluator to also bring costs into the evaluation in a way that parallels the cost/kWh rankings in the potential study with a ranking of programs by cost/kWh achieved in practice.

II. The Individual Program Evaluations

The developments of the Econoler estimates of energy savings and demand reduction attributable to each DSM program were carefully reviewed. As indicated above (Recommendation SV1), our opinion is that the estimates are reasonable, and are good approximations of actual savings.

In the course of work, the Evaluator created a number of recommendations for the program and for future evaluations. With the exception of a very few evaluator recommendations that we do not recommend (above), there are a number of evaluator recommendations for which we recommend support.

In the discussion of individual programs below, we note only the Evaluator recommendations in the areas of impact assessment methods and results that we support. Those Evaluator recommendations that do not fall into these categories (for example, recommendations for improving the program manuals and for improving program marketing and promotion) are not discussed in this report.

(1) Residential Appliance Retirement Program (ARet)

This Appliance Retirement Program involves the pickup and disassembly of old refrigerators, freezers, room air conditioners and dehumidifiers for all of Nova Scotia. This program provides for removal of appliances from client homes for recycle. Clients receive a rebate of $35 for each refrigerator or freezer and a rebate of $10 for a room air conditioner or dehumidifier, subject to the limitation that appliances must be at least ten years old.

A metering study was conducted during 2011 that took several adjustment factors into account. This study was used construct unit savings values for refrigerators and freezers and Ontario Power Authority values were used to construct unit savings values for dehumidifiers and air conditioners. Econoler's calculations of unit savings values for appliances are well grounded and reasonable. Demand savings are calculated by means of an energy-to-demand ratio that is based on program estimates, a convention that assumes program planners' estimation of targets was correct. This is a reasonable convention for the 2011 Evaluation.

Electric interactive effects were assumed to be zero, which is reasonable for this program. Free ridership and internal spillover were computed based on survey data. Net savings were correctly computed. Evaluated net savings exceeded those tracked by ENSC by 71% and are correct.

We support two of the Econoler recommendations for this program.

Evaluation ARet-R2 Econoler recommends collecting capacity in liters per day for dehumidifiers and Btu per hour for room air conditioners. We support this recommendation to improve data accuracy.

Evaluation ARet-R4 Econoler recommends on-site metering for a sample of dehumidifiers and room air conditioners in homes during the summer. We support this recommendation as it requires measurement under actual household conditions.

(2) Residential Appliance Replacement Program (ARep)

Appliance replacement serves multi-unit residential apartment buildings and is a resource acquisition program. It combines provision of new energy efficient refrigerators and freezers at low price combined with pickup and disassembly of old primary refrigerators and a $200 rebate. Econoler reviewed the unitary savings estimates for this program using metered results from the Residential Appliance Retirement program and the theoretical energy consumption of the new appliances installed based on the Energy Star qualified product list.

Unit values for refrigerators and freezers are based on the metering study conducted during 2011 for the Appliance Retirement program. Econoler's calculations of unit savings values for refrigerators and freezers are reasonable and well grounded. The same is true for the estimate for mini-fridges though metering study results were not available so Energy Star tabled data was used. Demand savings were calculated by means of an energy-to-demand ratio that is based on program estimates, a convention that assumes program planners' estimation of targets was correct. This is a reasonable convention for the 2011 Evaluation.

Electric interactive effects were assumed to be zero, which is reasonable for this program since most units were replaced in buildings without electric heat. Free ridership and internal spillover were not computed because the number of participants was not large enough to justify a phone survey; the Net-to-Gross ratio was set to one. That assumption is one reasonable solution to the absence of program-level data. Granting the assumptions in the calculation, the method for computing net savings is correct. Evaluated net savings are about 200% of those tracked by ENSC and are correct.

We support one of Econoler's recommendations for this program:

Evaluation ARep-R2 Include a field in the tracking sheet to validate the Energy Star qualifications of product. This will help ensure accurate calculation of energy savings.

(3) Retail Markdown Program (RMP)

The Retail Markdown Program is a resource acquisition and market transformation program cooperative with retail stores and combines promotion with a buy down of price of energy efficient products which range from light bulbs to refrigerators and clothes washers. An Air Miles pilot promotion was included in this program area.

Interactive effects for this program were found to be sizable with a weighted value of minus 18.5%. Addition of an in-service rate and a replacement ratio also lowered savings. The analytic steps and sources cited for adjustment of savings are appropriate. The Net-to-Gross ratio inputs were generated both through the survey approach used throughout the 2011 evaluation and through in-depth interviews with retailers to assess effects on store practices. Demand savings were calculated by means of an energy-to-demand ratio that is based on program estimates, a convention that assumes program planners' estimation of targets was correct.

We support two of Econoler's recommendations for this program:

Evaluation RMP-R2 Conduct an exit survey sample. This is an excellent recommendation for firming up measurement for the program. The measurement problem for the Retail Markdown Program is that the participants are not known so a random digit dialing survey method is used to gather information on participants. Interview at time of purchase will greatly improve quality of timely information over that obtained through random digit dialing interviews much later, and is consistent with new best practice.

Evaluation RMP-R3 Increase the number of retailer interviews planned for the evaluation. As Econoler notes, the program has a direct influence on the perceptions and plans of retailers. This dimension of the program should be captured. If a retailer stocks more varieties of energy efficient products and provides less

shelf space for standard products there may be a meaningful spillover effect to capture.

(4) LED Holiday Light Exchange Program

The lighting exchange is a seasonal program. One set of LED bulbs is exchanged for the trade in of two sets of older energy wasting bulbs. The addition of an interactive effects factor and adjustment for diversity and line loss reduced the evaluated savings for this program below the tracking savings. The analytic steps and sources cited for adjustment of savings are appropriate.

(5) Low Income Renter Program (LIR)

The Low Income Renter pilot program was started in 2011 in cooperation with municipal and provincial housing authorities in different locations in Nova Scotia. To be eligible to participate, a household must live in an apartment in selected subsidized housing locations and must either pay their own power bill (or a portion of the bill) or be charged a separate fee by the housing authority that corresponds to their use of electricity. The energy savings measures installed are a set of low cost measures such as CFLs, LED nightlights, hot water tank wraps, pipe insulation, faucet aerators and low-flow showerheads.

Interactive effects were calculated for lighting, pipe insulation and hot water tank wraps. They were considered negligible for the other measures. The analytic steps carried through and the sources cited for adjustment of savings are appropriate. The Net-to-Gross ratio was assumed to be equal to one. Demand savings were calculated by means of an energy-to-demand ratio that is based on program estimates, a convention that assumes program planners' estimation of targets was correct. This is a reasonable convention for the 2011 Evaluation.

We support two of Econoler's recommendations for this program:

Evaluation LIR-R3 Increase the number of on-sites to validate product installation. This type of program requires validation to insure that measures are not removed; if there is a removal problem, it must be documented and quantified. This is best done through on-sites and the Evaluator should determine the required sample size.

Evaluation LIR-R4 Collect additional information to allow for a more precise evaluation of savings. Information such as wattage of lamps replaced, use of air conditioning and type of hot water heat is necessary to firm up energy savings from this program.

(6) Multi-Unit Residential Renter Program (MURR)

This direct install pilot program was started in 2011. Measures installed through the program are the same set of low-cost measures as installed through the Low Income Renters Program (aerators, showerheads, pipe insulation, CFLs and the like.). This is an appropriate package for individual apartments when the multi-unit building is not addressed through a whole building approach. This program had 100% non-removal of CFLs (a removal rate of zero) observed during on-sites but power bars were observed being used incorrectly on three out of the five on-site visits for this program.

We support one of Econoler's recommendations for this program:

Evaluation MURR-R2 Improve measure sustainability by providing better information on the use of power bars.

Power bars have proved to be a problem in other jurisdictions in that many people simply treat them as extension cords. Yet, when used correctly they produce sufficient energy savings to be cost-effective. For this reason we support Econoler's recommendation and look forward to Econoler's analysis of power bar use for 2012 to see if they should or should not remain in the programs; and, if so, if they should be restricted to people who show that they understand their proper use.

(7) Efficient Products – Direct Install Program (EP-DI)

The Efficient Products – Direct Install Program provides business and multi-unit residential buildings with free installation of energy-efficient products. Measures include CFLs, LED exit lamps, chandeliers, dimmable CFLs, power bars with integrated timers, hot water tank wraps, commercial programmable thermostats, multi-unit building programmable thermostats and occupancy sensors for lighting control. In addition, within this program a new pilot program was started at the end of November 2011, the Retail LED Direct Install pilot.

The melded Net-to-Gross effect was 0.95; with 1 for the LED Direct Install pilot and 0.94 for the melded Efficient Products-Direct Install Program measures. Melded free ridership was 15.4% and melded spillover was 9.5%. Assessments for the individual measures were carefully constructed with reference to actual conditions. Interactive effects were calculated for different measure situations.

One problem in assessing interactive effects using Hydro-Quebec reference data is that the reference data is for buildings with electric heat, so the Evaluator recommends collecting information on heat type and air conditioning use for all buildings in the program and from the general Commercial & Industrial survey. Demand savings were calculated by means of an energy-to-demand ratio that is based on program estimates, a convention that assumes program planners' estimation of targets was correct. Econoler's calculation methods are well developed and well grounded with regard to source information and realties of the actual buildings in the program.

We support two of Econoler's recommendations for this program:

Evaluation EP-DI-R1 Improve the tracking sheet to allow for a better validation of savings. Consistent filling in of the tracking information to provide facility type and rate code would be useful in assessing energy savings impact.

Evaluation EP-DI-R3 Require additional information during survey campaigns with commercial and industrial customers as well as from each program participant building. Increase the number of site visits to better calculate savings. The collection of information on when spray valves are used, time of use, volume of hot water tanks insulated and similar technical details would greatly improve the accuracy of savings estimates as would an increase in number of on-sites.

(8) EnerGuide for Existing Houses Program

The EnerGuide for Existing Houses program provides support to homeowners to reduce use of electrical energy and fuel consumption. Financial assistance for fuels other than electricity is provided by the Province of Nova Scotia and Efficiency Nova Scotia Corporation manages all parts of the program. EnerGuide supports major energy saving improvements such as solar domestic hot water heaters and furnaces as well as building shell improvements. However the most recommended measures are programmable thermostats, pipe insulation and electric water heater tank insulation.

Due to time constraints and other factors, the best analysis that could be performed this year was a fitting of twenty-five homes with electric heat and enough actual energy usage data from Nova Scotia Power. This "true-up" was then used to adjust the estimate of kWh per EnerGuide point and program savings were estimated using this modeling approach. The result was to lower savings per EnerGuide point by 25%.

Econoler found that certain prescriptive measures need to be added outside the EnerGuide point system (two levels of drain water heat recovery, electric hot water heater pipe insulation, electric hot water heater tank wrap, programmable thermostats, and solar domestic hot water). Demand savings were based on the program planning ratio of energy to demand and then adjusted for the effect of electric thermal storage units. Free ridership was 31% and spillover 1%.

We support three of the Econoler recommendations:

Evaluation - EEH-R4 Collect the building energy consumption data for each house.

We support this recommendation because it is better to use actual data as seen by the utility rather than a simulation. Simulations such as HOT2000 are a good back-up when analysis of real data is not possible. Both HOT2000 and the similar programs in use in the US do not produce the most accurate energy savings results.

Evaluation - EEH-R5 Conduct a more thorough billing analysis to evaluate the overestimation of energy consumption by HOT2000 with better precision. This type of analysis requires multiple years of data, including a baseline. It is essential to carry out this study to better calibrate HOT2000 for use in those situations where it must be used.

Evaluation - EEH-R6 Revise HOT2000 Models on a random basis. Econoler would review a random small percentage of HOT2000 household models. This would require energy advisors to keep additional detail records. We support this recommendation so as to be able to validate input data.

(9) Fuel Substitution Pilot (Fuel)

The Fuel Substitution Pilot was started in 2011. This program allows participants to substitute a non-electrical heat system or domestic hot water system for all or a portion of their current electric heating system. Free-ridership was found to be 42% and spillover was equal to zero. The high free-ridership result is likely an artifact of early pilot status and, as noted by Econoler, the high percentage of clients who learned about the pilot though equipment dealers (50%).

We support two of the Evaluation recommendations:

Evaluation - Fuel-R3 Improve the tracking sheet with additional information. Econoler recommends including capacities of the old and new system and clear project status information. This kind of information will improve ability to evaluate energy savings

Evaluation - Fuel-R4 Conduct a billing analysis to evaluate energy consumption for heating. Following the principle of direct measurement (where possible), the Fuel Substitution Pilot is a program in which direct measurement through utility energy usage data from the customer information system is possible with a full baseline and full post measurement.

(10) Low Income Program

The Low Income Program serves low-income homeowner households with two categories of energy efficiency measures. Scope 1 measures concern the building envelope. Scope 2 measures are everything else including the usual low-cost measures plus freezers and refrigerators. Water heat measures are also included in Scope 2. Funding is a meld of electricity funds and Provincial funds with electricity ratepayer funding covering electric heat and electric hot water related measures. Efficiency Nova Scotia manages the program and works collaboratively with the Nova Scotia Department of Community Services, Service Nova Scotia Municipal Relations and program outreach agents.

The evaluator used the true-up from the Energy Efficient Housing program to adjust kWh savings per EnerGuide point for this program, reducing savings by 25%. Unitary savings for all of the measures were inspected and some were adjusted using appropriate data and methods. Several were adjusted upwards. The weighted interactive effects factor was -9.8%. The Net-to-Gross factor was set to one due to the nature of the program and measures. All of these adjustments are appropriate.

We support two of the Evaluation recommendations:

Evaluation - LI-R1 Assess the installation rate of certain prescriptive measures. Since only 13% of estimated total program energy savings is related to EnerGuide points, estimation of energy savings for the Low income Program is heavily reliant on look-up values for prescriptive measures. Econoler recommends on-sites by the third-party evaluator to validate these measures are in place. Presumably this would involve a random sample of completed homes. This will help firm-up energy savings results. The Evaluator should determine the required sample size.

Evaluation - LI-R2 Review HOT2000 models on a random basis. Econoler would review a random small percentage of HOT2000 household models. This would require energy advisors to keep additional detail records. Econoler suggests targeting outlier cases for validation. This will enable better validation of input data for HOT2000 simulations.

(11) Performance Plus Program (PP)

The Performance Plus Program is the residential new houses program. It provides financial incentives to homeowners and builders to exceed the energy efficiency requirements of the building code. Modeling for this program relies on HOT2000 and a final inspection and blower door test is required. Either the home owner or the builder may take the initiative to participate in the program.

Econoler adjusted the baseline for calculation of EnerGuide points from 80 to 78 based on actual practice as shown in four baseline studies cited, a reasonable adjustment using good source data. Savings per EnerGuide point was lowered by 25% using results of the true-up for the Energy Efficient Houses study. Energy savings estimates for prescriptive measures covered in the Energy Efficient Houses study were also used. The demand savings was estimated using the program planning estimate and adjusted for the presence of electronic thermal storage units. The weighted interactive effects factor was calculated. Free-ridership was 42% and spillover was 0. There was a 5% market effect among builders.

We support four of the Evaluator's recommendations for this program:

Evaluation - PP-R1 Increase the number of in-depth interviews with home builders. Both free-ridership and spillover are better assessed if Econoler has evaluation budget to fully understand the builders in Nova Scotia's building industry. This will firm up the inputs for the Net-to-Gross calculation for this program for 2012. The Evaluator should determine the required sample size.

Evaluation - PP-R3 Include the building energy consumption data of HOT2000 simulations in the tracking sheet. This approach provides more realistic estimation of energy savings and permits later adjustments to recalibrations of HOT 2000.

Evaluation - PP-R4 Revise HOT2000 models on a random basis, structured to include at least one project per energy adviser. Econoler would review a random small percentage of HOT2000 household models. This

would require energy advisors to keep additional detail records. This will enable better validation of input data for HOT2000 simulations.

Evaluation - PP-R5 Add a percentage of heating delivered by electricity. Econoler points out that this information can be collected from the HOT2000 simulations and should be verified by program delivery agents with the households during the on-site audits. This information is essential to permit evaluator to correct EnerGuide point increases for electric heat for homes that have secondary heating.

(12) Business Energy Rebates Program (BER)

The Business Energy Rebates Program provides financial incentives, through prescriptive rebates, to businesses throughout Nova Scotia for the purchase of a wide range of qualified energy efficient equipment for installation on their premises. The program was initiated as a resource acquisition program. However, the long-term focus of the program is to encourage and assist market transformation by influencing the purchasing practices of business customers toward consideration and adoption of energy efficient technologies and equipment. Sometimes the Business Energy Rebate program has been referred to as a "junior C&I Custom program" that focuses on typical applications of smaller energy efficient equipment. The program does not call for a customized approach but might be thought of as "semi-custom."

Savings were carefully developed by the Evaluator in a step by step approach. Free-ridership was 17.6%. Spillover was 0.2%. The Net-to-Gross ratio was 0.83. Interactive effects were calculated where possible but there was some data not provided from the tracking sheets.

We support three of the Evaluator's recommendations for this program:

Evaluation - BER-R1 Improve the tracking sheet to allow for a better validation of savings. Econoler points out that currently the calculation values for savings are contained within a single calculation in the tracking sheet. These should be broken out into components by measure and with baseline values so that the Evaluator can inspect and check at the measure level.

Evaluation - BER-R4 Require additional information from participants to better calculate savings. To enable more precise estimation of energy savings, for example, full load hours should be supplied

for HVAC equipment; temperatures and hours of usage should be supplied for refrigeration equipment; hours of use should be collected for occupancy sensors; information on heating source and use of air conditioning should be supplied for lighting applications. This will support the evaluator's estimation of energy savings and interaction effects.

Evaluation - BER-R5 Increase the number of on-sites to include an acceptable quantity of projects for each category of equipment installed through the program. To firm-up precision in estimating energy savings by equipment type it is necessary to make sure that all categories of equipment are covered with sufficient on-site visits. The Evaluator should determine the sample design and required numbers of cases per category.

(13) Smart Lighting Choices Program (SLC)

Smart Lighting Choices is an upstream lighting program that is designed to produce market transformation in the non-residential lighting sector by working through lighting distributors to buy down the price of energy efficient lighting offered by the distributors. The incentive is paid to the distributor, with part intended to be retained by the distributor as a fee and the balance passed on to the end-user in the form of reduced cost. Smart Lighting Choices for 2011 also contains the Upstream Business Energy Rebates subprogram which started in September 2011 and covers a much wider range of lighting products.

Free–ridership for this program was 19%. Spillover was not calculated. The Net-to-Gross level was 0.81. The weighted interactive effect was -7.7%.

We support both of the Evaluator's recommendations for this program:

Evaluation - SLC-R1 Improve the quality of the distributors' invoices and develop a tracking sheet that monitors program savings for the whole year. As would be expected invoice formats are unique to each distributor, and Econoler has found that they are not systematically completed. A common invoice format and a tracking sheet that spans a year would be useful to in program evaluation.

Evaluation - SLC-R2 Collect additional information through telephone surveys conducted with commercial and industrial customers. In particular, Econoler wants investigation of de-lamping, information on heat source and the use of air conditioning. This would support more precise determination of free riders and spillover and support better estimation of the Net-to-Gross results for this program.

(14) Commercial & Industrial Custom Program (C&IC)

The Commercial and Industrial (C&I) Custom Program was first implemented in the 2008 program year. The program provides financial incentives to large commercial and industrial customers that complete energy studies and audits; then implement electric energy efficiency measures at their facilities. From its start, this has been a well managed program. It benefits from a well-designed sequence of activities and events that must be followed as the project progresses. The program has developed a detailed and well-documented data tracking and recording process and effective policies and procedures. The program has an integral and rigorous monitoring and verification approach including a tracking system for maintaining careful watch over the progress of the work and the estimation of energy savings. A centralized data system was implemented in the summer of 2010 and this program fully used the capabilities of the data tracking system throughout 2011. *As a control tool, the program uses a procedure that tightly minimizes free-ridership.* This program also includes new construction.

Free-ridership is tightly controlled for this program (7%). Spillover is reported to be zero; however, this is unlikely because in firms with multiple locations an industrial improvement at one site is usually copied to the other sites. The Net-to-Gross ratio is 0.93.

The Evaluator has envisioned the new construction included in this program as eventually a separate program. We support two of the Evaluator's recommendation for the new construction area:

Evaluation - CINC-R2 Compare the actual building consumption with the design simulations and make appropriate adjustments (if required).

We support this recommendation as it involves a true-up to empirical metered data to improve estimation.

Evaluation - CINC-R4 Add a limited amount of peak demand savings in project impact calculations.

When reviewing the New Buildings Institute (NBI) simulations, the Evaluator noted that demand savings had been estimated, and recommends adding these in to energy impacts. We support this recommendation since it provides for more accurate assessment.

(15) Small Business Energy Solutions Program – SBES

The Small Business Energy Solutions Program provides direct installation of energy-efficient lighting retrofits to small businesses and includes small government, institutional and health care facilities. Clients pay 20% of cost; Efficiency Nova Scotia Corporation pays 80%. Under specific conditions, clients can finance their portion for twenty-four months on their Nova Scotia Power bills.

The free-ridership level is 12.8% and there is 0.8% spillover. The Net-to-Gross ratio is 0.88. The interaction effects factor is -7.70%

We support two of the Evaluator's recommendations of the Small Business Energy Solutions Program:

Evaluation - SBES-R1 Improve the tracking sheet to allow for a better validation of savings. The current tracking sheet does not detail the measure components. Better detail would enable better savings estimation. Econoler also recommends the data tracking system be set to routinely accept corrections to wattage values developed during evaluations. Improvement of the tracking sheet will improve the ability to do more accurate impact estimation.

Evaluation - SBES-R3 Require additional information during survey campaigns with commercial and industrial customers as well as from participants to better estimate the interactive effects factor and increase the number of on-site visits conducted. Econoler recommends collecting information on heat source and use of air conditioning from all SBES participants and from survey campaigns to enable better estimation of interactive effects. Econoler also recommends increasing the number of on-sites with data-loggers to provide for more reliable installation ratios

and more reliable hours of operation data. These steps will improve accuracy of impact estimation.

(16) New Page Paper Mill

A review was carried out of the New Page paper mill evaluation performed by Energy Performance Services to identify potential deviations from the methodologies required by the *Superior Energy Performance, Plant Measurement & Verification Protocol* (SEP M&V Protocol). The specific protocols used were determined to be consistent with industry best practices found within the *International Performance and Measurement Verification Protocols* (IPMVP).

The evaluation results found within the EPS review of October 17, 2011 were based upon a multivariable regression model developed by Energy Performance Services. While the regression model fit the plant's actual operations data with extremely high precision, (R^2 = .99), the assumptions and operators used within the regression model could not be independently checked. An independent analysis using the operations data provided by the three production lines was performed as a simple check and found overall plant savings that were consistent with the results of the model. This simple check of plant operations data produced the following results:

Optimization of Lines 1 & 2	67,428 MWh/year
Optimization of Line 3 Including Reject Screening	34,916 MWh/year
Other Efficiency Measures*	23,900 MWh/year

It should be noted that the analysis of the plant's operational data was simply a "rough check" of the plant operations data with baseline and measure savings periods that were far less refined than the multivariate regression model used by Energy Performance Services. Since the findings of the check show savings that are reasonably consistent with the model, it is determined that the EPS model results are acceptable.

The evaluation review performed by the Evaluator on February 23, 2012, addressed several additional important questions related to plant performance and operations. Specifically, the majority of plant savings realized were associated with a shift in operational loading from Line 2 to the more efficient Line 1, (from even loading between the lines to 80/20 after the Line 1 retrofit was performed). While consistent with normal industry practices, savings associated with this shift could not be included in the results

if the two lines produced different outputs, (indicating a change in overall plant production and not efficiency-related savings). This important question was addressed by the Econoler review and is therefore consistent with international evaluation protocols.

It is recommended that the savings and load reduction findings of 154.2 GWh and 17.8 MW in the EPS and Econoler reviews be accepted.

III. Discussion of Process Evaluation

This Savings Verification study does not focus on the process evaluation. However, we provide the following definition:

> **Process Evaluation** – A systematic assessment of an energy efficiency program for the purposes of documenting program operations at the time of the examination, and identifying and recommending improvements that can be made to the program to increase the program's efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.
>
> - Northeast Energy Efficiency Partnerships, *Glossary of Terms*, Version 1.0., A Project of the Regional Evaluation, Measurement and Verification Forum, March 2009, Prepared by Paul Horowitz PAH Associates, Facilitated by Northeast Energy Efficiency Partnerships.

Econoler conducted an excellent process evaluation of its type, primarily directed to interviews and including surveys in support of the impact evaluation. This is an appropriate strategy. The activities of a process evaluation typically include:

- Review of program plans and records to identify the goals and objectives of each program
- Identification of the major functions of and strategy for implementing each program
- Observation of office processes and also in-field program delivery (observe and write-up observation on the steps in the implementation process)

- Interviews, field observations of team work in progress, surveys, focus groups

Econoler carried out most of these activities and was particularly good in review of documents and of tracking sheets, providing substantive recommendations for program manuals and tracking. Econoler did not focus on office processes, although they did develop a good program logic diagram for each major program. Priority was put on field processes, the tracking sheets and marketing aspects that could influence performance. These were appropriate priorities for the 2011 program year.

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