

2014 DSM EVALUATION REPORTS

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ECONOLER

TABLE OF CONTENTS

OVERALL EXECUTIVE SUMMARY	3
APPLIANCE RETIREMENT	74
INSTANT SAVINGS	138
HOME ENERGY ASSESSMENT	271
GREEN HEAT	314
LOW INCOME HOMEOWNER.....	389
NEW HOME CONSTRUCTION.....	407
RESIDENTIAL DIRECT INSTALL	471
RENTAL PROPERTIES AND CONDOS SERVICE.....	607
SOLAR	651
LED HOLIDAY LIGHT EXCHANGE	664
HOME ENERGY REPORT	686
RESIDENTIAL FINANCING	772
BUSINESS ENERGY REBATES	800
CUSTOM RETROFIT	944
CUSTOM NEW CONSTRUCTION	1031
BUSINESS ENERGY SOLUTIONS	1066
CODES AND STANDARDS.....	1210

EVALUATION OF 2014 DSM PROGRAMS

EXECUTIVE SUMMARY

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

BER	Business Energy Rebates
BNI	Business, Non-Profit and Institutional
CATI	Computer-assisted Telephone Interviewing
CBSM	Community-based Social Marketing
CEE	Consortium for Energy Efficiency
COP	Coefficient of Performance
DA	Delivery Agent
DLC	Design Lights Consortium
ECM	Electronically Commutated Motor
CFL	Compact Fluorescent Lamp
CRA	Corporate Research Associates
DSM	Demand-side Management
DSMDS	Demand-side Management Data System
EBC	Existing Building Commissioning
EMIS	Energy Management Information Systems
ENSC	Efficiency Nova Scotia Corporation
HVAC	Heating, Ventilation and Air-Conditioning
IPMVP	International Performance Measurement and Verification Protocol
LED	Light Emitting Diode
MEPS	Minimum Energy Performance Standards
M&V	Measurement and Verification
NECB	National Energy Code for Buildings
NRCan	Natural Resources Canada
NTGR	Net-to-Gross Ratio
POP	Point-of-Purchase
SEER	Seasonal Energy Efficiency Ratio
TRM	Technical Reference Manual
UARB	Utility and Review Board
UMP	Uniform Methods Project
VSD	Variable Speed Drive

DEFINITIONS

Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Billing calibration	An activity consisting of adjusting the expected energy savings based on the relative difference between the results of the building energy simulations and the actual energy consumption of the building.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Market effects	The impact of the program on the market (such as increased product availability, practices, and prices) that extends beyond changing the program participants' behaviour. This includes spillover among non-participants.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary Savings	Energy or demand savings established on a unity basis. This unity can be either a product (e.g. an 8-watt LED lamp), a capacity (e.g. one-ton capacity of an air-source heat pump) or a participant (e.g. one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

INTRODUCTION	1
1 EVALUATION OBJECTIVES AND METHODOLOGY	3
1.1 Evaluation Objectives	3
1.2 Methodology	3
1.2.1 In-depth Interviews	4
1.2.2 Surveys	4
1.2.3 On-site Visits	6
1.2.4 Unitary Savings Review	7
1.2.5 Project Files Review	7
1.2.6 Billing Calibration	8
2 DSM PORTFOLIO PERFORMANCE	9
2.1 Overall Targets and Results	9
2.2 Individual Impact Evaluation Results	11
2.3 Net-to-gross Ratio	19
2.4 Evolution of Program Component Performance	22
2.5 Portfolio Analysis	23
2.6 Overall Performance	24
3 OVERALL RECOMMENDATIONS	26
3.1 Program Manual	26
3.2 Tracking System	27
4 INDIVIDUAL PROGRAM COMPONENTS' PERFORMANCE	29
4.1 Residential	29
4.1.1 Instant Savings	29
4.1.2 Green Heat	31
4.1.3 Residential Direct Install	33
4.1.4 Home Energy Report	36
4.1.5 Residential Financing	38
4.2 Profit Business, Non- and Institutional	40
4.2.1 Business Energy Rebates	40
4.2.2 Custom Retrofit	44
4.2.3 Custom New Construction	48
4.2.4 Business Energy Solutions	49
4.2.5 Codes and Standards	53
APPENDIX I BIBLIOGRAPHY	54
APPENDIX II NTGR CALCULATIONS	59

LIST OF TABLES

Table 1: Types of Evaluation Conducted by Program Component or Initiative	2
Table 2: 2014 In-depth Interviews	4
Table 3: 2014 Surveys	6
Table 4: 2014 On-site Visits	7
Table 5: 2014 Savings Targets and Evaluated Results	10
Table 6: 2014 Evaluated Results, Targets and Tracked Energy Savings at the Generator.....	12
Table 7: 2014 Evaluated Results, Targets and Tracked Demand Savings at the Generator	13
Table 8: 2014 Free-ridership, Spillover and NTGRs.....	21
Table 9: Program Performance by Net Energy and Peak Demand Savings at the Generator, 2011- 2014	22
Table 10: Individual Program Components' Contributions to Total Portfolio Savings in %.....	23
Table 11: General Recommendations on ENSC Program Manuals	27
Table 12: Recommendations for Instant Savings	30
Table 13: Recommendations for Green Heat	32
Table 14: Recommendations for Residential Direct Install	35
Table 15: Recommendations for Home Energy Report	37
Table 16: Recommendations for Residential Financing.....	39
Table 17: Recommendations for Business Energy Rebates.....	41
Table 18: Recommendations for Custom Retrofit.....	46
Table 19: Recommendations for Custom New Construction	48
Table 20: Recommendations for Business Energy Solutions	50
Table 21: Recommendations for Codes and Standards	53

INTRODUCTION

This document provides a summary of the 2014 evaluations conducted for the Efficiency Nova Scotia Corporation (ENSC) demand-side management (DSM) programs. Established in 2010, ENSC is an organization in charge of helping Nova Scotians improve energy efficiency of their homes and workplaces.

The Econoler team was retained by ENSC to conduct these evaluations, and collaborated with two partner entities; Corporate Research Associates (CRA) and Equilibrium Engineering. Econoler was the team leader, responsible for coordinating all the evaluation activities, as well as preparing and reviewing all the deliverables. CRA performed the annual and quarterly participant and builder surveys, conducted interviews with partners and participants, and reported on the data collected from these activities. Equilibrium Engineering conducted the on-site visits, reviewed tracking sheets, assisted Econoler with certain parts of the impact evaluation and analyzed and reported on these activities.

The evaluation revealed that ENSC's DSM program portfolio achieved a total of 151.888 GWh in net energy savings and 27.077 MW in net peak demand savings at the generator. In addition to the savings generated by ENSC's DSM programs, Codes and Standards was found to have achieved net energy savings of 31.433 GWh and net peak demand savings of 5.164 MW at the generator.

The Econoler team has obtained these results by conducting process, market or impact evaluations of 17 program components and initiatives offered in 2014 by ENSC. The table below presents the type of evaluation conducted for each program component. For a number of program components, the 2014 evaluation did not involve a full-scale impact evaluation. Instead, the evaluation involved validating ENSC's tracked savings and ensuring that the evaluation parameters corresponded to those established in previous full-scale impact evaluations. For some of those program components, the 2014 evaluation also encompassed re-evaluating some key parameters, such as free-ridership or internal spillover.

Table 1: Types of Evaluation Conducted by Program Component or Initiative

Program Component or Initiative	Type of Evaluation			
	Process	Market	Impact	
			Full-scale	Tracked Savings Validation
Appliance Retirement	-	-	-	X
Instant Savings	X	X	X	-
Home Energy Assessment	-	-	-	X
Green Heat	X	X	X	-
Low Income Homeowner	-	-	-	X
New Home Construction	-	-	-	X
Residential Direct Install	X	X	X	-
Rental Properties and Condos Service	-	-	-	X
Solar	-	-	-	X
LED Holiday Light Exchange	-	-	X	-
Home Energy Report	X	X	X	-
Residential Financing	X	X	-	-
Business Energy Rebates	X	X	X	-
Custom Retrofit	X	X	X	-
Custom New Construction	-	-	X	-
Business Energy Solutions	-	X	X	-
Codes and Standards	-	-	X	-

The purpose of this report is to present the evaluation results of the 17 program components and initiatives offered in 2014 by ENSC. The following sections summarize the evaluation methodology, the DSM portfolio performance in terms of savings, and the recommendations to enhance the program component portfolio. An in-depth analysis of individual program component performance is also featured in this report.

1 EVALUATION OBJECTIVES AND METHODOLOGY

This section presents the objectives of the 2014 evaluation as well as the methodology used and the activities carried out to evaluate ENSC's DSM program components.

1.1 Evaluation Objectives

The objectives of the 2014 evaluation of ENSC's DSM program components were to:

- › Assess the effectiveness of program component design and delivery
- › Determine the extent to which program component implementation is proceeding as planned (i.e., that technologies have been installed and are working as expected)
- › Determine the gross energy and demand savings at the generator
- › Determine the net-to-gross ratio (NTGR)
- › Determine the net energy and demand savings at the generator

1.2 Methodology

To carry out the 2014 evaluation, the Evaluator first reviewed all relevant documentation and placed a particular focus on the modifications that ENSC made to the program components to implement the recommendations made in previous evaluations. Subsequently, a series of data collection activities were undertaken by the Evaluator to complete the process, market and impact evaluations, including in-depth interviews, surveys, on-site visits, billing calibration as well as unitary savings and project files reviews.

1.2.1 In-depth Interviews

The 2014 evaluation methodology included in-depth interviews with ENSC staff, partners, participants and associations. Between August 2014 and January 2015, the Econoler team conducted 48 in-depth interviews with various stakeholders. A summary of the interviews completed for each program component is presented in the following table.

Table 2: 2014 In-depth Interviews

Program Component	In-depth Interviews Completed in 2014						
	Program Managers	Delivery Agents	Distributors	Participants	Retailers	Bank	Associations
Instant Savings	1	1	-	-	14		-
Green Heat	1	-	-	-	-	-	-
Residential Direct Install	1	2	-	-	-	-	-
Home Energy Report	1	1	-	-	-	-	-
Residential Financing	1	-	-	10	-	1	-
Business Energy Rebates	1	-	8	-	-	-	-
Custom Retrofit	1	-	-	-	-	-	-
Codes & Standards	-	-	-	-	-	-	4
Total	7	4	8	10	14	1	4

1.2.2 Surveys

Using contact information provided by ENSC, CRA conducted annual and quarterly surveys with participants and builders and conducted an intercept survey with compact fluorescent lamp (CFL) and light emitting diode (LED) lamp buyers at retail stores.

Annual Surveys

Between October and December 2014, using computer-assisted telephone interviewing (CATI) technology, CRA conducted annual surveys with participants and builders for most of the program components.

Although the content of the surveys varied from one program component to another, the survey instruments were used to collect information regarding the following major aspects:

- › Internal spillover and free-ridership
- › Program component awareness
- › Participant motivations, concerns and barriers
- › Satisfaction with the program component

- › Recommendations for improvement
- › Energy efficiency behaviours

Quarterly Surveys

In 2014, using CATI technology, CRA conducted quarterly surveys with Business Energy Rebates (BER), Business Energy Solutions and Residential Direct Install participants. These surveys consisted of contacting a sample of participants after each three-month period.

This type of survey was implemented in 2013 to shorten the time period between when participants took part in the program component and when they were contacted for evaluation purposes. This approach allowed for a more precise assessment of free-ridership and satisfaction levels.

Intercept Survey

As part of the Instant Savings evaluation, an in-store intercept survey was conducted with participants who purchased eligible CFLs or LED lamps during the spring and fall campaigns. The spring survey focused on CFLs and LED lamps, whereas the fall survey focused only on LED lamps since CFLs were no longer discounted. The interviews were conducted in-stores at five of the participating retail banners in April, May, October and November 2014.

The intercept survey was meant to generate feedback on the following aspects of Instant Savings:

- › CFL and LED lamp purchases
- › Free-ridership
- › Program component awareness
- › Discount awareness
- › Awareness of products rebated and purchase intentions

The following table presents a summary of the surveys completed for each program component as well as the number of respondents in each survey.

Table 3: 2014 Surveys

Program Component	Surveys Completed in 2014			
	Participants			Builders
	Annual	Quarterly	Intercept	
Appliance Retirement	204	-	-	-
Instant Savings	-	-	294	-
Home Energy Assessment	100	-	-	-
Green Heat	53	-	-	-
New Home Construction	48	-	-	28
Residential Direct Install	500	110	-	-
Rental Properties and Condos Service	19	-	-	-
Home Energy Report	340	-	-	-
Business Energy Rebates	27	68	-	-
Custom Retrofit	11	-	-	-
Business Energy Solutions	62	129	-	-
Total	1,364	307	294	28

1.2.3 On-site Visits

For the 2014 evaluation, the Econoler team visited a total of 222 participant sites. These visits were conducted between September and November 2014. The objective of the on-site visits was to collect data to allow establishing or validating some of the parameters used in the savings calculations, namely installation rates, interactive effects, internal spillover and other technical characteristics of the measures implemented. For direct installation program components, some of these visits were conducted when the delivery agent (DA) was performing the installation work so as to validate the installation process. As for Instant Savings, the visits were conducted in retailer's stores to observe and capture the in-store client experience.

The complete results of the on-site work are provided in the individual program component's evaluation reports.

Table 4: 2014 On-site Visits

Program Component	On-site Visits Completed in 2014
Instant Savings	20*
Green Heat	5
Residential Direct Install	53**
Business Energy Rebates	58
Custom Retrofit	22
Custom New Construction	9
Business Energy Solutions	55**
Total	222
* For Instant Savings, the visits were conducted in retailers' stores. ** This figure includes the on-site visits conducted both during and after the installation.	

1.2.4 Unitary Savings Review

For all the evaluated programs where savings were established on a unitary basis, the Evaluator reviewed the savings presented in the tracking system. First, their consistency with the result of the previous evaluation was validated. The Evaluator then updated those savings. In some cases, the Evaluator relied on calculations presented in other jurisdictions' Technical Reference Manual (TRMs), while in others the product specifications were used to obtain customized savings based on engineering calculations. Information gathered from surveys, such as the Atlantic Quarterly Survey, was also sometimes useful for ensuring that the calculations accurately represent the use made of the products. For programs that offered a very large variety of products (e.g., Instant Savings), the most popular products were sampled to establish the average properties of each product category. The unitary savings for BER Instant Rebates, Business Energy Solutions, Instant Savings, Green Heat, Residential Direct Install and LED Holiday Light Exchange were reviewed using this methodology.

1.2.5 Project Files Review

For those programs whose savings were established based on custom calculations for each measure installed, the Evaluator reviewed savings for a sample of projects. To ensure the accuracy of the calculations used, this revision included a review of the project documentation (specifications sheets, modelling reports, screening tool, etc.), which was generally coupled with an on-site visit to better understand the context in which the measure was operating. Where appropriate, the Evaluator made modifications to the equations used or the value of the parameters. The resulting adjustments were sometimes extrapolated to the whole program's tracked savings or the savings of non-sampled

projects of the same category (e.g., lighting projects). This methodology was applied to Custom Retrofit, Custom New Construction and BER Mail-in Rebate. For Custom Retrofit's sub-components (Energy Management Information Systems and Existing Building Commissioning), only a project file review (and no on-site visit) was conducted, and therefore the Evaluator did not make any adjustments to the savings, and instead focused on making qualitative recommendations.

1.2.6 Billing Calibration

For 2014, ENSC collected actual energy consumption and demand data for the buildings which participated in Custom New Construction from 2011 to 2013 evaluations, and provided them to the Evaluator to make a comparison with the proposed case energy consumption and demand figures simulated before project implementation. As part of this year's impact evaluation, seven past participants of Custom New Construction were selected to validate the accuracy of the building energy simulations against actual billing data. This verification process is based on best practices for energy performance measurement and verification (M&V) in new constructions, such as those defined in the International Performance Measurement and Verification Protocol (IPMVP). However, the Evaluator was unable to make a conclusive declaration about the accuracy of the New Construction energy simulations due to the small sample size and the limited availability of both the billing data and the monthly simulation results for the sampled projects.

2 DSM PORTFOLIO PERFORMANCE

This section presents an analysis of the impact evaluation results for all the program components. Those results were also used for making a comparison to the targets, as well as to analyze the evolution of savings over the past few years.

2.1 Overall Targets and Results

ENSC programs encompass many components, which all share the same market. For instance, the Existing Residential program includes the Home Energy Assessment, Green Heat, Low Income Homeowner, Residential Direct Install, Rental Properties and Condos Service and Solar components. While the Evaluator conducted an individual evaluation of each component, this section presents a comparison of the overall program evaluation results against the targets established by ENSC at the program level.

In June 2014, the revised (mid-course) program-component-level savings targets were shared with ENSC's DSM Advisory Group. Although the mid-course targets presented to the DSM Advisory Group included changes to individual program component targets, the overall total energy and demand savings targets were identical to those approved by the Nova Scotia Utility and Review Board (UARB) for 2014. The following table presents the "as-filed" and mid-course targets of each program component category for comparison with the evaluated results.

Table 5: 2014 Savings Targets and Evaluated Results

DSM Program	"As-Filed" Targets		Mid-course Targets		Evaluated Results	
	GWh	MW	GWh	MW	GWh	MW
Residential						
Residential Efficient Products Rebates ^a	19.3	3.1	17.5	2.8	13.493	2.520
Existing Residential ^b	16.9	4.0	34.2	8.1	36.957	8.924
New Residential (New Home Construction)	6.8	1.7	5.9	1.5	4.572	1.175
Energy Savings Actions (Home Energy Report)	15.0	3.5	15.4	3.6	25.437	2.892
Residential Subtotal	58.0	12.3	72.9	16.0	80.459	15.511
Business, Non-Profit and Institutional (BNI)						
Efficient Products Rebates (Business Energy Rebates)	31.2	5.5	27.0	4.8	24.610	4.880
Custom Incentives ^c	40.3	7.8	23.9	4.6	33.644	4.116
Direct Installation ^d	8.4	1.5	14.0	2.5	13.175	2.570
BNI Subtotal	79.9	14.8	64.9	11.9	71.429	11.566
Portfolio Total	137.8	27.1	137.8	27.9	151.888	27.077
^a Including Appliance Retirement, Instant Savings and LED Holiday Light Exchange ^b Including Home Energy Assessment, Green Heat, Low Income Homeowner, Residential Direct Install, Rental Properties and Condos Service (tenant units) and Solar ^c Including Custom Retrofit (and its subcomponents) and Custom New Construction ^d Including Business Energy Services and Rental Properties and Condos Service (common spaces)						

The ENSC's portfolio of DSM program components achieved 151.888 GWh in total energy savings at the generator, which were 10 percent higher than the 2014 UARB-approved target. The total portfolio peak demand savings of 27.077 MW were however slightly lower than the established target. These results show that the majority of individual programs did not achieve their goals, but the excellent results of Custom Incentives and Energy Savings Actions compensated those shortfalls. In addition to the savings generated by ENSC's DSM programs, Codes and Standards achieved net energy savings of 31.433 GWh and net peak demand savings of 5.164 MW at the generator.

2.2 Individual Impact Evaluation Results

Table 6 and 7 summarize the evaluated savings, the net savings targets revised in June 2014 and the savings tracked internally by ENSC for each program component offered in 2014. Specific observations regarding each program component and initiative are also provided.

Table 6: 2014 Evaluated Results, Targets and Tracked Energy Savings at the Generator

DSM Program	DSM Component	2014 Energy Savings (GWh)						
		Evaluated					ENSC	
		Initial Gross Savings	Installed/ Adjusted Gross Savings	Installed/Adjusted Gross Savings with Interactive Effects	NTGR	Net Savings	Targets (Net Savings)	Tracked (Net Savings)
Residential Efficient Products Rebates	Appliance Retirement ^a	6.553	6.553	6.553	0.60	3.941	4.1	3.941
Residential Efficient Products Rebates	Instant Savings	10.754	10.754	9.478	0.99	9.360	13.4	15.026
Existing Residential	Home Energy Assessment ^a	7.020	7.020	7.020	0.75	5.785	4.8	5.785
Existing Residential	Green Heat	2.299	2.299	2.299	0.64	1.472	1.3	1.580
Existing Residential	Low Income Homeowner ^a	2.311	2.311	2.311	1.00	2.311	1.9	2.311
New Residential	New Home Construction ^a	5.861	5.861	5.861	0.78	4.572	5.9	4.572
Existing Residential	Residential Direct Install	32.972	30.876	26.455	0.93	24.607	23.0	24.960
Existing Residential	Rental Properties and Condos Service ^a - Tenant Units	3.750	3.655	3.277	0.83	2.720	3.0	2.720
Existing Residential	Solar ^a	0.093	0.093	0.095	0.65	0.062	0.2	0.062
Residential Efficient Products Rebates	LED Holiday Light Exchange	0.202	0.202	0.192	1.00	0.192		0.246
Energy Savings Actions	Home Energy Report	-	-	-	-	25.437	15.4	-
Residential Subtotal		71.815	69.624	63.541	-	80.459	72.9	61.203
Efficient Products Rebates	Business Energy Rebates	32.899	32.988	32.216	0.76	24.610	27.0	23.911
Custom Incentives	Custom Retrofit, EBC, EMIS	29.353	29.244	29.244	0.92	26.988	19.3	27.314
Custom Incentives	Custom New Construction	7.122	6.656	6.656	1.00	6.656	4.6	7.122
Direct Installation	Business Energy Solutions ^b	17.487	16.585	15.743	0.84	13.175	14.0	12.372
BNI Subtotal		86.861	85.473	83.859	-	71.429	64.9	70.719
Portfolio Total		158.676	155.097	147.400	-	151.888	137.8	131.922
Codes & Standards		31.433	31.433	31.433	-	31.433	-	-

^a The 2014 evaluation did not involve a full-scale impact evaluation, but rather a validation of ENSC's 2014 tracked savings based on the parameters obtained from the 2013 evaluation and a reassessment of some key parameters.

^b Rental Properties and Condos Services common spaces measures are claimed under Business Energy Solutions.

Table 7: 2014 Evaluated Results, Targets and Tracked Demand Savings at the Generator

DSM Program	DSM Component	2014 Demand Savings (MW)						
		Evaluated					ENSC	
		Initial Gross Savings	Installed/ Adjusted Gross Savings	Installed/Adjusted Gross Savings with Interactive Effects	NTGR	Net Savings	Targets (Net Savings)	Tracked (Net Savings)
Residential Efficient Products Rebates	Appliance Retirement ^a	1.042	1.042	1.042	0.60	0.627	0.7	0.627
Residential Efficient Products Rebates	Instant Savings	1.699	1.699	1.497	0.99	1.479	2.1	2.149
Existing Residential	Home Energy Assessment ^a	1.727	1.727	1.727	0.75	1.423	1.2	1.423
Existing Residential	Green Heat	0.928	0.928	0.928	0.64	0.594	0.4	0.705
Existing Residential	Low Income Homeowner ^a	0.539	0.539	0.539	1.00	0.539	0.4	0.539
New Residential	New Home Construction ^a	1.506	1.506	1.506	0.78	1.175	1.5	1.175
Existing Residential	Residential Direct Install	7.683	7.194	6.164	0.93	5.734	5.4	5.814
Existing Residential	Rental Properties and Condos Service ^a - Tenant Units	0.874	0.852	0.764	0.83	0.634	0.7	0.634
Existing Residential	Solar ^a	0.000	0.000	0.000	0.65	0.000	0.1	0.000
Residential Efficient Products Rebates	LED Holiday Light Exchange	0.435	0.435	0.414	1.00	0.414		1.228
Energy Savings Actions	Home Energy Report	-	-	-	-	2.892	3.6	-
Residential Subtotal		16.433	15.922	14.581	-	15.511	16.0	14.294
Efficient Products Rebates	Business Energy Rebates	7.919	6.668	6.472	0.75	4.880	4.8	5.728
Custom Incentives	Custom Retrofit, EBC, EMIS	2.071	1.777	1.777	0.90	1.599	3.6	1.885
Custom Incentives	Custom New Construction	2.616	2.517	2.517	1.00	2.517	1.1	2.619
Direct Installation	Business Energy Solutions ^b	4.520	3.213	3.069	0.84	2.570	2.5	3.218
BNI Subtotal		17.126	14.175	13.835	-	11.566	11.9	13.450
Portfolio Total		33.559	30.097	28.416	-	27.077	27.9	27.744
Codes & Standards		5.164	5.164	5.164	-	5.164	-	-

^a The 2014 evaluation did not involve a full-scale impact evaluation, but rather a validation of ENSC's 2014 tracked savings based on the parameters obtained from the 2013 evaluation and a reassessment of some key parameters.

^b Rental Properties and Condos Services common spaces measures are claimed under Business Energy Solutions.

The following sub-sections report on the comparison between the evaluated savings and the tracked savings for each program component fully evaluated in 2014. Please note that this section does not report on program components that required only validating the tracked savings of ENSC or a process evaluation.

Instant Savings

In 2014, Instant Savings generated 9.360 GWh in net electricity savings, and 1.479 MW in net peak demand savings. The evaluated net energy savings were found to be 38 percent lower than the corresponding tracked value, while the evaluated net peak demand savings were 31 percent lower than the tracked value. The variation between the evaluated demand savings value and the tracked value was smaller, because the demand-to-energy ratio used for peak demand savings calculation increased from 0.143 in 2013 to 0.158 in 2014.

Many elements can explain why the evaluated savings, both gross and net, have been lower than the corresponding tracked values. First of all, the baseline wattage for LED lamps, the best-selling product, was adjusted to take into account the percentage of participants who bought LED lamps to replace CFLs, rather than incandescent lamps. This adjustment reduced the unitary savings of LED lamps by 57 percent, and therefore had a significant impact on the evaluated gross savings. Some other products also saw their unitary savings decrease (e.g., heavy-duty timers and clothes washers) based on new calculations that more accurately represent the baseline available on the market and/or the use made of those products.

Additionally, the NTGR calculated this year for regular CFLs was lower than the value established in the 2013 evaluation due to an increase in the free-ridership level.

Green Heat

The evaluation of Green Heat demonstrated that in 2014, the program had a total of 235 participants and generated net energy savings of 1.472 GWh and net peak demand savings of 0.594 MW.

The net energy savings calculated through this evaluation are seven percent lower than those calculated based on the data in the tracking report. There are three factors that explain this difference: (1) the NTGR calculated through this evaluation is slightly lower than the NTGR established in the 2013 evaluation; (2) the reduction in unitary savings for geothermal heat pumps; and (3) the adjustments made to deal with the cases in which heat pumps were used as the primary heating system before the conversion.

The net peak demand savings calculated through the evaluation are 16 percent lower than those calculated based on the data from the tracking report. This difference in net peak demand savings is bigger than that in the net energy savings. This can be explained by the heat pump unitary savings revision which resulted in a slight increase of unitary energy savings and a decrease in unitary peak demand savings.

Residential Direct Install

Residential Direct Install had a total of 13,945 participants in 2014, and achieved net energy and peak demand savings of 24.552 GWh and 5.721 MW respectively. In addition to the regular Residential Direct Install savings, 438 participants took part in the Community-based Social Marketing (CBSM) Pilot, which encouraged them to use less warm water to do laundry. This pilot initiative generated 0.055 GWh in energy savings and 0.013 MW in peak demand savings at the generator.

The evaluated values calculated for the program are slightly lower than those calculated from the tracking system. This can be explained by the differences in some of the parameters used by ENSC and the Evaluator to estimate gross and net savings:

- › Econoler revised some of the unitary savings values used by ENSC in the tracking system, which had a significant impact mostly on faucet aerators, low-flow showerheads and hot water tank wraps. These adjustments resulted in a small decrease in the initial gross savings. However, ENSC's tracked initial gross savings factored in the installation rates, which explains why they are still lower than the evaluated value.
- › Installation rates were updated for all the products installed through the program. Those installation rates were generally lower than the values tracked based on the 2012 evaluation.
- › The NTGR measured during this evaluation is higher than the one used by ENSC. For non-low-income participants, the level of free-ridership decreased from 19 percent to 15 percent, while the internal spillover increased from 3 percent to 6 percent. This compensated for the negative adjustments made to gross savings and resulted in an evaluated net savings value close to the tracked value.

LED Holiday Light Exchange

In 2014, a total of 117 events were held for LED Holiday Light Exchange. The evaluation demonstrated net energy savings of 0.192 GWh and net peak demand savings of 0.414 MW resulting from the distribution of 6,343 LED holiday light sets in 2014.

The net energy savings evaluated for LED Holiday Light Exchange are lower than those tracked by ENSC. This result can be explained by the reduction of the unitary savings value from 35.2 kWh to 29 kWh due to a change in the proportion of incandescent sets replaced and a reduction of the average wattage. These assumptions are based on the in-field survey conducted in 2014 by ENSC. Econoler considered it to be reliable and in line with the literature review of other jurisdictions' practices. In addition, an interactive effect factor of -5.0 percent was used but was not considered in the tracked savings.

Based on these assumptions, the net demand savings evaluated were 66 percent lower than those tracked by ENSC because the diversity factor has been estimated at 50 percent by Econoler, based on the probability that the LED holiday lights were turned on during the peak electricity demand. The

peak demand savings per set exchanged decreased from 176 W to 125 W due to the revised unitary savings and the addition of the interactive effect factor.

Home Energy Report

Since its inception in 2013, a total of 93,119 participants have taken part in the paper-based component of Home Energy Report, and 10,669 participants have taken part in the web-based component. In terms of net energy savings for 2014, the Home Energy Report paper-based component achieved 25.336 GWh and the web-based component achieved 0.100 GWh. Hence, Home Energy Report's total net energy savings amounted to 25.437 GWh in 2014. In addition, 2.892 MW of peak demand savings was achieved in 2014.

To calculate the net savings of Home Energy Report in 2014, the Econoler team first reviewed the methodology used by Opower for calculating the paper-based component savings. The energy savings achieved by the paper-based component are considered net savings, since they have already included the program's influence on participants' decisions, by using a control group comparison. As for the web-based component, the Econoler team defined the unitary savings values for seven specific tips provided on the web portal. The web-based participant survey was used to estimate how many participants put the suggested tips into practice and questions were asked to determine the level of influence that Home Energy Report had on participants' decisions to implement the suggested tips. These questions regarding the level of Home Energy Report's influence were part of the self-declared approach used to calculate net energy savings for the web-based component.

Business Energy Rebates

The impact evaluation has shown that in 2014, the number of participants in BER Mail-in increased slightly compared to previous years (198 regular participants and 122 promotional rebate participants), while the savings grew significantly. The mail-in rebate approach generated net energy savings of 11.073 GWh in 2014. For the instant rebate approach, the net energy savings were 13.537 GWh in 2014, which is a sizable decrease in comparison with last year; this reduction can be largely attributed to the fact the sales of LED downlights were lower than in 2013.

For BER Mail-in, the net energy savings established by this evaluation for 2014 were slightly higher than those tracked by ENSC, while evaluated peak demand savings were lower than their tracked counterparts by 16 percent. The evaluated gross energy savings were higher than the tracked value, because savings associated with the two biggest measure categories, e.g., heating, ventilation and air-conditioning (HVAC) and lighting, increased as a result of the adjustments that the Evaluator made to their savings calculations. A lower NTGR in 2014 reduced the evaluated net savings. The adjustment made to gross peak demand savings was downward, since diversity factors were not taken into account in the tracking sheet. This had a significant impact on some categories with high savings, such as lighting.

For BER Instant Rebates, the evaluated net energy savings were higher than the tracked savings, by three percent. This is in part due to the negative interactive effects, which are much lower than last year's calculated value (-13.3% for indoor lighting in 2013, compared with -5.6% in 2014). The adjusted gross peak demand savings were significantly lower than expected, because the diversity factor decreased to 83 percent in 2014. This can be explained by the fact that fewer outdoor lighting products were installed this year, and more products were installed in commercial facilities which would be turned off during peak demand hours. The NTGR was also significantly lower in 2014, in part because the highest-selling products in BER Instant Rebates, which were selected to establish the NTGR, have changed, and their respective NTGR have become lower.

Custom Retrofit

In 2014, the Custom Retrofit component had a total of 100 projects implemented, which was lower than the previous years. Custom Retrofit generated net energy savings of 20.292 GWh and net peak demand savings of 1.599 MW in 2014. The Existing Building Commissioning (EBC) and Energy Management Information Systems (EMIS) components respectively generated 1.690 GWh and 5.006 GWh. No peak demand savings were claimed for those two components. Custom Retrofit, EMIS and EBC combined achieved net electricity savings of 26.988 GWh and peak demand savings of 1.599 MW for 2014.

The evaluated net energy savings were lower than those tracked by ENSC by approximately 1.2 percent. This is not due to the adjustments made to the gross savings, because these adjustments reduced the tracked savings by less than 0.5 percent. In fact, the largest portion of the reduction in net energy savings can be explained by the lower NTGR, since free-ridership level increased by one percentage point this year, while the internal spillover level decreased from one percent to nil this year. For their part, gross peak demand savings were adjusted downward by the Evaluator, by about 14 percent. In most cases, this was due to the adjustments made to the diversity factors, though these adjustments were not as significant as last year. The reduction in NTGR also contributed to evaluated net peak demand savings being lower than the tracked value, by 15 percent.

Custom New Construction

This program component saw a total of 13 projects implemented in 2014, which resulted in net energy savings of 6.656 GWh and 2.517 MW in net peak demand savings at the generator.

The gross energy and peak demand savings at the generator evaluated by the Econoler team were respectively 6.5 percent and 3.9 percent lower than those tracked by ENSC. This difference is mainly due to the adjustments made to the tracked gross savings of one LEED registered project, for which the ratio of cost savings required by LEED energy performance pre-requisite had not been applied. For other projects, adjustment ratios were smaller or, in three out of nine projects visited, nil. This year, ENSC included a diversity factor in their tracked peak demand calculations. As a result, the

Evaluator did not have to make sizeable adjustments to calculate peak demand savings, as was the case in 2013.

Business Energy Solutions

For 2014, Business Energy Solutions had a total of 761 participants. In addition, 51 participants implemented Rental Properties and Condos Service Common Area measures in 105 separate buildings, and 42 participants took part in the LED Blitz pilot, bringing the whole Business Energy Solutions component's total number of participants to 854. With all these initiatives combined, Business Energy Solutions generated net energy savings of 13.175 GWh and peak demand savings of 2.570 MW in 2014. The evaluation presented the savings results separately for lighting and non-lighting measures, as well as for the LED blitz pilot and the Rental Properties and Condos Service common space measures.

The net energy savings evaluated for Business Energy Solutions lighting measures are 4 percent higher than those tracked by ENSC. This difference can be explained by the reduction in interactive effects and the revised NTGR value, which is slightly lower than the tracked value. The increase in savings has been limited by the revision made to the ballast factor. For peak demand savings, the difference between the tracked and evaluated results can be explained by the addition of a diversity factor of 69 percent in the calculation.

The net energy and peak demand savings evaluated for Business Energy Solutions non-lighting measures are 23 percent higher and one percent lower, respectively, than those tracked by ENSC. The main factor explaining the increase in energy savings is the adjustment made to heat pumps operating hours. This adjustment considered 2,750 hours, while ENSC used 2,200 hours in its calculations. The impact of this adjustment is significant, as energy savings from heat pumps account for 89 percent of Business Energy Solutions non-lighting savings.

The net energy and demand savings obtained through the evaluation for the LED Blitz pilot were respectively 22 percent and 23 percent higher than the tracked savings. The main factor explaining this difference was the upward adjustment made to 7-watt MR16 LED lamp unitary savings. Moreover, 7-watt MR16 LED lamps accounted for 38 percent of all the units installed under LED Blitz lighting. The revision of interactive effects for lighting products also accounted for the difference between tracked and revised results.

For Rental Properties and Condos Service common space measures, only tracked savings were presented, as no parameters were revised as part of this year's evaluation.

Codes and Standards

For Codes and Standards, the evaluation has estimated the impact in terms of energy and peak demand savings to be achieved by introducing new regulations into the Nova Scotia market for the

products targeted by federal Amendment 11, Amendment 12b and provincial regulations featuring increased stringency and/or scope on existing minimum energy performance standards (MEPS).

The Evaluator modified the methodology used in past evaluations by focusing its efforts on interviewing Natural Resources Canada (NRCan), using Statistics Canada sources and collecting sales volume from associations. Indeed, the 2013 evaluation revealed a lack of reliable market size data when contacting distributors and manufacturers directly. Following a recommendation from 2013, the Evaluator elected to conduct interviews with industry associations in 2014 instead.

Hence, the impact of new regulations was evaluated for electric motors, general service incandescent reflector lamps, dry-type transformers, large air-conditioners and heat pumps, standby for electronic products, external power supplies, incandescent lamps (75 W and 100 W), LED roadway Lighting, and houses complying with the new energy code. The 2014 overall energy and peak demand savings for Codes and Standards have been estimated at 31.433 GWh and 5.164 MW at the generator.

2.3 Net-to-gross Ratio

As shown in Tables 6 and 7 above, the interactive effects factors and NTGRs were applied to the gross savings impacts in order to estimate net savings impacts. NTGRs were established based on the levels of free-ridership and, in some cases, internal spillover. The estimation of NTGRs for the 2014 evaluation of ENSC's program components was based on a self-reporting approach. The Appendix II presents some examples of how the Evaluator has made the calculations to establish the free-ridership, internal spillover and net-to-gross ratio values in the 2014 evaluation.

By conducting quarterly or annual surveys, or in-depth interviews, a level of free-ridership was established for most program components evaluated. The free-ridership evaluation methodology included a set of questions, the responses to which were transposed into a level of program component attribution used to calculate the free-ridership level for each participant. Subsequently, a weighted average, based on each participant's savings, was used to estimate the program component's overall free-ridership level. One exception was Custom New Construction, for which the baseline of each project was adapted to correspond to the participants' initial design intention. Therefore, no additional free-ridership was applied based on the survey results. For Appliance Retirement, the overall approach used to estimate net savings was completely reviewed in 2013 to comply with a new methodology, which follows the Uniform Methods Project (UMP) guidelines for appliance recycling programs, developed by the National Renewable Energy Laboratory. This approach was kept for the 2014 evaluation.

For program components in which internal spillover effects can occur, the impact evaluation included the assessment of this distortion effect. This was done through the annual surveys or the interviews conducted during on-site visits. In all cases, participants were asked if they had implemented additional energy efficiency measures without receiving funding or assistance from ENSC. If so, participants were asked a set of questions designed to identify the additional energy efficiency

measures implemented and to quantify their associated savings. Subsequently, another question was asked to quantify the level of influence the program had on their decision to whether implement these additional measures. The value established regarding this level of influence was used to determine the portion of the additional savings attributable to the program. Then, the level of internal spillover was established by dividing the total quantity of the additional savings attributable to the program by the total quantity of savings achieved by the program for all the survey respondents.

Based on the free-ridership and spillover levels established, the NTGR was calculated using the following equation:

$$NTGR = 1 - \% \text{ free-ridership} + \% \text{ spillover}$$

The table below summarizes the free-ridership and spillover levels used in the 2014 evaluation as well as the resulting NGTR for each program component. For all programs with the exception of Instant Savings and New Home Construction, the spillover levels correspond to internal spillover. For Instant Savings and New Home Construction, this value corresponds to market effects (including external spillover).

Table 8: 2014 Free-ridership, Spillover and NTGRs

Program Component		Free-ridership Levels	Spillover Levels	NTGR
Appliance Retirement ^a	Refrigerators	-	4%	0.60
	Freezers	-		
	Room AC Units	-		
Instant Savings	Regular CFLs	54%	28%	0.74
	LED Lamps	0%	20%	1.20
Home Energy Assessment		31%	6%	0.75
Green Heat		36%	-	0.64
Low Income Homeowner		-	-	1.00
New Home Construction		33%	11%	0.78
Residential Direct Install ^b		15%	6%	0.93
Solar ^c		-	-	0.65
LED Holiday Light Exchange		-	-	1.00
Business Energy Rebates – Mail-In Rebate		25%	-	0.75
Business Energy Rebates – Instant Rebates ^e	T8 Lamps	46%	-	0.54
	LED Outdoor Wallpacks	29%		0.71
	LED Downlights	35%		0.65
Custom Retrofit		10%	0%	0.90
Custom New Construction		-	-	1.00
Business Energy Solutions	Business Energy Solutions	17%	0.3%	0.83
	Rental Properties and Condos Service - Common Spaces	17%	-	0.83
	LED Blitz	-	-	1.00
Rental Properties and Condos Service – Tenant Units ^c		-	-	0.83

^a For Appliance Retirement, the Evaluator complied with UMP guidelines and no free-ridership level was explicitly calculated.

^b The free-ridership level calculated for Residential Direct Install is for the non-low-income participants.

^c Values come from the 2013 evaluation.

2.4 Evolution of Program Component Performance

In 2014, ENSC's program component portfolio achieved a total of 151.888 GWh in net energy savings and 27.077 MW in net peak demand savings at the generator. These figures represent a slight decrease compared to last two years in terms of energy savings. In fact, energy savings were of 163.249 GWh in 2013, 158.058 GWh in 2012 and 141.751 GWh in 2011. As for peak demand savings, the 2014 figure of 27.048 MWh has been the lowest level since 2011 (34.096 MW in 2013, 33.783 MW in 2012 and 28.864 MW in 2011).

In addition to the savings generated by ENSC's DSM programs, Codes and Standards was found to have achieved net energy savings of 31.433 GWh and net peak demand savings of 5.164 MW at the generator, while the figures for 2013 were 13.814 GWh and 2.595 MW and those for 2012 were 16.353 GWh and 4.663 MW.

Table 9: Program Performance by Net Energy and Peak Demand Savings at the Generator, 2011-2014

Program Component	2011		2012		2013		2014	
	Energy GWh	Demand MW	Energy GWh	Demand MW	Energy GWh	Demand MW	Energy GWh	Demand MW
Residential								
Appliance Retirement	7.175	1.144	5.986	0.880	4.059	0.645	3.941	0.627
Appliance Replacement	0.548	0.065	-	-	-	-	--	--
Instant Savings	13.802	1.388	10.767	1.895	26.524	3.793	9.360	1.479
Home Energy Assessment	4.805	1.543	7.184	2.370	2.588	0.602	5.785	1.423
Green Heat	1.570	0.785	1.549	0.857	1.524	0.665	1.472	0.594
Low Income Homeowner	7.636	1.632	2.209	1.026	1.678	0.398	2.311	0.539
New Home Construction	2.454	0.861	4.942	1.478	5.890	1.545	4.572	1.175
Residential Direct Install	4.809	1.078	37.043	8.446	37.275	8.499	24.607	5.734
Rental Properties and Condos Service	0.651	0.104	2.314	0.534	2.100	0.359	2.720	0.634
Solar	-	-	0.107	0.000	0.093	0.000	0.062	0.000
LED Holiday Light Exchange	1.447	3.618	0.349	0.753	0.303	0.653	0.192	0.414
Home Energy Report	-	-	-	-	-	-	25.437	2.892
Residential Subtotal	44.246	12.114	70.136	17.705	79.934	16.800	80.459	15.511
BNI								
Business Energy Rebates	14.956	3.469	21.871	6.285	34.619	9.367	24.610	4.880
Custom Retrofit	32.930	3.764	28.941	3.490	26.470	2.689	26.988	1.599
Custom New Construction	-	-	4.644	0.525	7.477	2.122	6.656	2.517
Business Energy Solutions	48.968	9.413	30.152	5.244	12.649	2.759	13.175	2.570
BNI Subtotal	97.505	16.750	87.922	16.078	83.315	17.296	71.429	11.566
Portfolio Total	141.751	28.864	158.058	33.783	163.249	34.096	151.888	27.077

2.5 Portfolio Analysis

In addition to the performance of individual program components, it is worth taking a look at individual program components' contributions to the portfolio's overall savings over the years. Table 10 below shows the evaluated contribution of each DSM program component to total portfolio savings since 2011.

Table 10: Individual Program Components' Contributions to Total Portfolio Savings in %

DSM Program	Percentage of Portfolio Savings							
	2011		2012		2013		2014	
	Energy	Demand	Energy	Demand	Energy	Demand	Energy	Demand
Residential								
Appliance Retirement	5.1%	4.0%	3.8%	2.6%	2.5%	1.9%	2.6%	2.3%
Appliance Replacement	0.4%	0.2%	-	-	-	-	--	--
Instant Savings	9.7%	4.8%	6.9%	5.7%	16.2%	11.1%	6.2%	5.5%
Home Energy Assessment	3.4%	5.3%	4.6%	7.1%	1.6%	1.8%	3.8%	5.3%
Green Heat	1.1%	2.7%	1.0%	2.6%	0.9%	2.0%	1.0%	2.2%
Low Income Homeowner	5.4%	5.7%	1.4%	3.1%	1.0%	1.2%	1.5%	2.0%
New Home Construction	1.7%	3.0%	3.2%	4.4%	3.6%	4.5%	3.0%	4.3%
Residential Direct Install	3.4%	3.7%	23.8%	25.4%	22.8%	24.9%	16.2%	21.2%
Rental Properties and Condos Service	0.5%	0.4%	1.5%	1.6%	1.3%	1.1%	1.8%	2.3%
Solar	-	-	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%
LED Holiday Light Exchange	1.0%	12.5%	0.2%	2.3%	0.2%	1.9%	0.1%	1.5%
Home Energy Report	-	-	-	-	-	-	16.8%	10.7%
Residential Subtotal	31.2%	42.0%	45.0%	53.2%	49.0%	49.3%	53.0%	57.3%
BNI								
Business Energy Rebates	10.6%	12.0%	14.0%	18.9%	21.2%	27.5%	16.2%	18.0%
Custom Retrofit	23.2%	13.0%	18.6%	10.5%	16.2%	7.9%	17.8%	5.9%
Custom New Construction	-	-	3.0%	1.6%	4.6%	6.2%	4.4%	9.3%
Business Energy Solutions	34.5%	32.6%	19.4%	15.8%	7.7%	8.1%	8.7%	9.5%
BNI Subtotal	68.8%	58.0%	55.0%	46.8%	51.0%	50.7%	47.0%	42.7%

As highlighted in the table above, in 2014, the residential components accounted for 53 percent of ENSC's total DSM program component portfolio energy savings, while the BNI components accounted for the remaining 47 percent. As for the peak demand savings, the residential components contributed for 57 percent, while the BNI components contributed for the remaining 43 percent.

Residential Direct Install and Home Energy Report have generated the most energy savings for the residential sector, while Business Energy Rebates and Custom Retrofit have been the components achieving the biggest impact in terms of energy savings for the BNI sector.

2.6 Overall Performance

In 2014, ENSC's program component portfolio achieved a total of 151.888 GWh in net energy savings and 27.077 MW in net peak demand savings at the generator. In addition to the savings generated by ENSC's DSM programs, Codes and Standards was found to achieved net energy savings of 31.433 GWh and net peak demand savings of 5.164 MW at the generator. Overall, ENSC has reached its targets set for 2014. Although the majority of individual program components did not achieve their goals, the excellent results of Custom Incentives and Energy Savings Actions compensated those shortfalls.

The Evaluator has noticed the continuous efforts that ENSC has made since 2010 to educate customers about energy efficiency and to promote the products and measures eligible under its various program components. Some of those program components have been in place for a few years now and have definitely achieved a good momentum. These include Residential Direct Install, Instant Savings, Business Energy Rebates and Custom Retrofit, which have generated the most energy savings in their respective sectors. The increase in participants who found out about ENSC's program components via word of mouth is evidence showing how successful ENSC has been in creating a foothold and maintaining a persistent presence for its program components in the diverse market segments it has targeted.

In addition to these well-implemented program components, ENSC has developed new initiatives, such as Residential Financing and Home Energy Report, to further diversify its services and activities. While most of ENSC's programs provide financial and technical assistance to households and businesses looking to improve their energy efficiency, Home Energy Report dealt with a different challenge, namely to improve energy consumption behaviour. This component complemented ENSC's offerings and resulted in very large savings in 2014. Although Residential Financing and Home Energy Report were launched in 2013 and evaluated for the first time in 2014, the Evaluator has observed that participants and partners were generally satisfied with them. In fact, the vast majority of partners and participants interviewed through the 2014 evaluation expressed very high levels of satisfaction with their relationship with ENSC and how ENSC had been able to increase awareness and education about energy efficiency through its different program components.

The Evaluator has observed major improvements to the program portfolio since the last evaluation in 2013. The 2014 evaluation demonstrated that most of the process-related recommendations made for each program component in the last evaluations had been implemented. The Evaluator commends ENSC on its efforts in improving and optimizing its program components. By implementing changes specific to each program component, ENSC has succeeded in improving the overall portfolio performance. Among the improvements, the Evaluator noticed the efforts made in the area of tracking

systems, relationships with partners, product eligibility, as well as education and awareness. The recommendations concerning impact evaluation were partially implemented. Since last year, many new tools were developed to improve savings calculations, such as a list of assumptions for BER Instant Rebates lighting technologies and a calculation tool for Custom Retrofit motors and drives projects. Nevertheless, for a few programs, the savings calculation parameters were not updated accordingly with last year's evaluation recommendations.

3 OVERALL RECOMMENDATIONS

This section presents general recommendations for the program component portfolio. These recommendations are generally considered good practices and can be applied to most ENSC program components. They are specifically aimed at enhancing program documentation and data management.

3.1 Program Manual

A program manual that provides key information on program processes and tracking for internal use is an essential reference tool for all the program staff. In addition, a program manual is widely used by the Evaluator throughout the process and impact evaluation activities. The program manual is intended to capture information about the program, such as its characteristics, the parameters used to determine its objectives and the changes that have been made. ENSC's program manuals also include a number of documents in appendices, such as participant and partner process flow charts, and program forms.

The following table summarizes the Evaluator's recommendations on the program manuals.

Table 11: General Recommendations on ENSC Program Manuals

No.	Recommendations
OV-R1.	Consider the core budget allocation in the cost/subsidy ratio and cost-effectiveness tests. Every organization has a so-called core budget that supports its fundamental operations. This budget is to pay for office space, computers and office equipment, supporting staff salaries, training, traveling, and many other expenses that are not directly related to any given program. The core budget has to be allocated to the different programs based on a value analysis. Generally, the most complex programs receive a bigger share of the attribution. Usually, the allocation percentages are decided by consensuses reached among all the parties in the organization. Once the programs' shares are established, they can be added to each program's cost as indirect costs to obtain a total program cost. The performance indicator representing the incentive-to-total cost ratio cannot be calculated until the total program cost is established. If the cost is so much higher than the incentives as exceeding the threshold of 50%, the program should be flagged for close monitoring. A high incentive and a low cost are considered as a best practice. As currently shown in the program manual, the cost/subsidy ratio does not take into account the core budget allocation. The Evaluator recommends that the core budget allocation be added to the cost/subsidy ratio and considered in the cost-effectiveness tests since it reflects the true costs of a program.
OV-R2.	Document all pilot projects. Over the last few years, ENSC has launched a number of pilot projects as part of existing program components, such as the LED Blitz pilot in Business Energy Solutions and the pilot meant to encourage customers to wash their clothes in cold water as part of Residential Direct Install. To facilitate the Evaluator's work and make sure that the Evaluator has all the necessary information from the very beginning of the evaluation process, ENSC should document all the pilot projects in the program manual. The program manual should include a description of the pilot project, as well as its strategy and activities. In addition, ENSC should document the evaluation-related needs with respect to these new pilots in the evaluation plan.

3.2 Tracking System

Data-tracking and reporting is crucial for effective program management as well as for evaluation purposes. In 2010, ENSC implemented an online Demand-Side Management Data System (DSMDS) and has been working on its improvement since then. This centralized system is meant to allow all the projects of each program component to be tracked. In 2014, the DSMDS succeeded in automatically producing reporting sheets containing all the necessary information about the projects implemented for most program components. Indeed, Custom Retrofit and Green Heat are some of the components for which it was new for project management to rely only on using the DSMDS. Whenever custom tools were required to perform savings calculations, those tools (such as energy-modeling software or the Screening tool) were used and savings were then manually entered into the DSMDS; such was

the case for BER Mail-In, Custom Retrofit and Custom New Construction. However, all the project management information of those components is stored in the DSMDS. For some program components that rely on partners' data, such as BER Instant Rebates, Residential Direct Install and Instant Savings, ENSC does not plan on moving all their tracking systems to the DSMDS and will continue to track savings by aggregating retailers' or distributor's reports.

Again in 2014, the Evaluator noticed the improvements made to data tracking over last year. New data management tools have made the savings validation process easier. For instance, the master list of products available under BER Instant Rebate is now linked to the reporting sheet, which ensures that the same equation and values are used for all similar products. Additionally, the Custom Retrofit DMSDS-generated reports now include important elements, such as the diversity factor for each measure.

The Evaluator commends ENSC on its efforts in improving data-tracking and reporting, and emphasizes the importance of continuing working on this aspect. Each program component has its own specific challenges and opportunities for improving its tracking system. For instance, the individual component evaluation reports showed that Business Energy Solutions need to find a way to allow validation of the savings entered for each measure, while for Custom Retrofit, the focus should be placed on presenting the projects' total savings and milestones claims separately in the same report. Specific recommendations regarding the tracking system are provided in the individual program component's evaluation reports.

4 INDIVIDUAL PROGRAM COMPONENTS' PERFORMANCE

This section provides a summary of the key findings and recommendations for the program components, with the exception of those that only required validating their tracked savings. Please note that the numbering of the recommendations corresponds to the numbering presented in Appendix I of the individual reports.

4.1 Residential

4.1.1 Instant Savings

The 2014 evaluation of Instant Savings demonstrated that most of the recommendations made specifically for Instant Savings in the previous evaluations were implemented. The Evaluator commends ENSC on the efforts it made to improve and optimize Instant Savings. Among the improvements, the Evaluator noticed that efforts had been made to modify the range of appliances offered to cover the most energy-efficient models on the market, to better promote products other than CFLs and LEDs and to improve the accuracy of the wattage values for LED lamps entered in the tracking sheet. Furthermore, ENSC phased out CFLs from Instant Savings, with a final removal in July 2014. Given that the market was at an advanced stage of transformation with regards to CFLs, they were removed from the program to facilitate stronger market penetration for LED lamps.

The in-depth interviews showed that the DA was pleased with the program's success, program marketing, outreach activities and the relationship with ENSC staff. The DA was also satisfied that its relationship with the retailers had improved over time because everyone was getting increasingly familiar with the program management and delivery requirements. However, the DA mentioned that retailers showed varying levels of engagement and commitment towards promoting the program among customers; this remains one of the main barriers to the proper delivery of Instant Savings. According to the DA, weak engagement of the retailers often resulted in shortcomings in the installation of point-of-purchase (POP). During the in-store visits, the Evaluator did notice that POP displays were not properly installed in some of the stores.

The retailers interviewed gave the highest overall satisfaction ratings to their relationship with ENSC and the DA, as well as the program-related support and communication. Regarding communication and rebate-processing, some retailers did raise a few concerns about the wait time to have the list of eligible products approved and the wait time for receiving the reimbursement.

In terms of awareness and education, the partners believed that Instant Savings had been very successful in improving general awareness about energy efficiency and about ENSC in particular. Furthermore, the customer engagement events were quite successful in informing clients about eligible Instant Savings products. That said, the evaluation revealed issues with the in-store representatives having inadequate knowledge about other ENSC programs.

Table 12: Recommendations for Instant Savings

No.	Recommendations
Instant-R1.	Continue monitoring the retailers' commitment to meeting POP requirements. The DA mentioned that though its interactions with retailers improved over time, challenges remain in engaging some of the retailers. The DA pointed out that weak retailer engagement can often lead to issues with proper POP installation. When making in-store visits, the Evaluator did notice some shortcomings in the in-store signage installation, which could mislead both salespeople and customers about which products are discounted. The Evaluator recommends continuing to check on POP displays to ensure that retailers fully meet the POP requirements.
Instant-R2.	Improve training among in-store event representatives. The evaluation results indicate that there is room for improving in-store event representatives' knowledge and training. For instance, during the three customer engagement events visited by a mystery shopper in the fall campaign, no representative offered information about the other programs offered by ENSC. The DA reported receiving participant complaints about event representatives providing inaccurate information about other ENSC programs. Additionally, one nationwide retailer questioned the level of knowledge of an event representative in one of its stores. All this feedback highlights the need for ENSC and the DA to improve training among event representatives to strengthen the program's educational components. Customer engagement events in general have been successful and considered useful over the years by both the DA and the Evaluator; such training would further improve the positive impact of those events.
Instant-R3.	Better communicate with the retailers regarding the program processes and timeline. This year, some retailers expressed some dissatisfaction with the time waited to obtain a final list of approved product SKUs and receive their payments after submitting their sales data. However, ENSC claimed that it had sent the list of eligible product categories and rebates within the 90-day timeframe prior to campaign deadline (which is verbally agreed upon with the retailers). In fact, the retailers had to send the list of product SKUs to ENSC and the DA; failure to provide complete information could lead to delays in approving the final list. ENSC also claimed that the processing of the rebate payment had never taken more than 45 days, as required by the contract signed with the retailers. The Evaluator thinks that the reason why some retailers thought that ENSC failed to meet their expectations could have been due to a lack of clear and effective communication concerning timelines and the information required.
Instant-R4.	Continue to closely monitor the evolution of the market for lighting products. This year, the evaluated savings of LED lamps were significantly reduced in comparison with the tracked values, because the baseline wattage was lowered. Indeed, the Atlantic Survey showed that more than half of the LEDs purchased were used to replace CFLs. The Evaluator believes that ENSC should continue to use surveys and other tools to monitor the evolution of the market, as incandescent have already started being phased out as required by the federal regulation. ENSC should also expect unitary savings of lighting products to continue decreasing in the years to come.

No.	Recommendations
Instant-R5.	Analyze the Consortium for Energy Efficiency (CEE) Tier III appliances offered. In September of 2014, the CEE Tier III energy performance requirements for refrigerators increased significantly in order to align with the new American federal standards. As a result, the availability of Tier III qualified refrigerators is currently very limited, and ENSC has so far applied the previous Tier III specifications as an eligibility requirement for Instant Savings. In 2015, ENSC will have to determine a new eligibility criterion, because the list of the refrigerators complying with the old CEE standard will no longer be available. This new criterion must take into account the availability of eligible products in Nova Scotia, while ensuring that the promoted products can perform significantly better than the average products on the market. This recommendation also applies to clothes washers, for which the CEE Tier III was considered to be too close to the baseline (e.g., many distributors said in 2012 that they only sold Tier III models). Therefore, an energy consumption criterion was added in 2013 and should be reassessed periodically.
Instant-R6.	Ensure the model number field is completed and accurate for all the appliances. Since the unitary savings value is based on the most popular appliance models sold, it is necessary to have this field accurately completed for all those products.
Instant-R7.	Ensure retailers enter all requested info. Some of the independent retailers do not provide pricing, SKU numbers or technical information on the products. This information is valuable for some activities included in the impact evaluation, such as validating the technical specifications of the products sold.

4.1.2 Green Heat

The 2014 evaluation of Green Heat demonstrated that most of the recommendations made specifically for Green Heat in the last evaluations were implemented. The Evaluator commends ENSC on the efforts it made to improve and optimize Green Heat. Among the improvements, the Evaluator noticed efforts made to continue marketing and outreach activities, conduct calibrated simulations with real participants who installed wood or pellet stoves and review information provided to participants to determine potential improvements or clarifications. Furthermore, ENSC extended the deadline for participants to complete the installation of their equipment. In 2013, having the equipment installed before the deadline was identified by participants as the main challenge or barrier. The timeline for installing the new equipment was changed from four months to two months in 2013 to align with the financing deadline. To follow up on the Evaluator's recommendation, this deadline was extended to six months, and survey results showed positive feedback from participants with this extended deadline.

On-site visits conducted as part of the 2014 evaluation confirmed that the equipment for which a rebate was claimed through Green Heat was installed, and currently used as the primary heating source. These visits also allowed identifying the discrepancies between the information in the tracking system and that collected on site concerning the replaced heating system. Although the information provided by ENSC in the tracking report contains enough information to allow carrying out the

evaluation, it is recommended that further improvements be made to the accuracy of the data collected.

Survey results showed that participants' satisfaction with Green Heat was very high in 2014. Indeed, nearly all the respondents indicated that they were satisfied with Green Heat overall and its various aspects, such as the equipment installed, the initial confirmation of eligibility and the program application, forms and associated paperwork. Participants also expressed high levels of satisfaction with various factors related to ENSC.

Participation in Green Heat has had a slight decline since its beginning in 2011: a total of 235 participants participated in Green Heat in 2014, compared to 226 participants in 2013, 282 in 2012 and 296 in 2011. This decrease in Green Heat participation could be perhaps best explained by the decision made in 2012 for Green Heat to focus on heating systems that use fuel derived from renewable resources. Because of this decision, rebates for customers who wished to switch to natural gas were removed.

The evaluation revealed that Green Heat generated net energy savings of 1.472 GWh and peak demand savings of 0.594 MW at the generator in 2014, which is a decrease compared to previous years (1.524 GWh and 0.665 MW in 2013, 1.549 GWh and 0.857 in 2012, and 1.570 GWh and 0.785 MW in 2011). To calculate Green Heat's 2014 net savings, the Evaluator reviewed the gross savings used in the tracking sheet by comparing them with the same type of values found in a literature review. Moreover, the Evaluator took into consideration the free-ridership measured in the participant survey.

Table 13: Recommendations for Green Heat

No.	Recommendations
GH-R1.	Consider using an initial system efficiency other than 100 percent when the air source heat pump or the geothermal heat pump is used as the initial primary heating system. Some projects were found to have an existing ducted or ductless air source heat pump or a geothermal heat pump as the existing primary source of heat. Unitary savings are based on a switch from an electrical heating system with an assumed efficiency of 100 percent (like baseboard heaters). It is recommended that ENSC consider using lower unitary savings when the initial primary heating system is a heat pump, and remove the eligibility criterion that requires these participants to have a total electricity consumption greater than 21,000 kWh/year before the installation of the new system.

No.	Recommendations
GH-R2.	Improve the pre-screening process to ensure the use of exact information regarding the initial heating system type. For a significant number of on-site visits, the information collected about the primary heating system type was different than the information given in the tracking report. In one case, the visit showed that a geothermal system was initially used while the tracking report listed an electrical baseboard. In another case, an electrical furnace was listed as the primary heating system before the conversion while the visit showed that an air-source heat pump had actually been used. As these differences can have a significant impact on the eligibility and the energy savings, ENSC should take actions and measure to ensure the use of exact information regarding the primary heating system.
GH-R3.	The Evaluator recommends that ENSC use the updated tracked unitary savings value for central air source heat pumps. If air-to-water heat pumps account for a larger portion of Green Heat savings, ENSC should consider carrying out a calibrated model simulation of installed units or a metering study to measure and verify consumption and peak demand savings.
GH-R4.	The literature review did not show conclusive results regarding wood stoves and pellet stoves because no detailed metering studies on similar climates were identified. Additionally, since the tracked unitary savings values for these two types of equipment were updated in the 2013 evaluation using calibrated simulations, the Evaluator recommends that ENSC continue using the current tracked savings values.
GH-R5.	Similar to the results of the literature review for wood and pellet stoves, the Evaluator did not find any updated studies for wood and pellet furnaces/boilers. Since the current tracked unitary savings are based on simulations carried out by Dunskey Energy Consulting and Navigant Consulting, as well as a billing analysis conducted by Econoler in 2012, the Evaluator recommends keeping the current figures. Given the small number of projects installing these technologies through the program, it is hard to justify the need for conducting a metering study or a more thorough analysis.

4.1.3 Residential Direct Install

The 2014 evaluation of Residential Direct Install demonstrated that all of the recommendations made specifically for Residential Direct Install in the last complete evaluation were implemented. The Evaluator commends ENSC on its efforts in improving and optimizing Residential Direct Install. Among the improvements, the Evaluator noticed efforts made to fine-tune program marketing, keep informing participants about energy-efficient products, improve the tracking sheet and ensure the need for nightlights in participating households. Furthermore, CFL installations have transitioned to LED installations. Following the Evaluator's recommendation to follow the penetration of regular CFLs, ENSC has since monitored the market and taken actions to transition from CFLs to LEDs, except in specific situations where an LED product would not be suitable.

On-site visits conducted as part of the 2014 evaluation confirmed that the installation process was conducted in a professional and efficient manner. It was found, however, that the installation rates for many products (mainly faucet aerators, low-flow showerheads, pipe insulation and smart power

controllers) were much lower than in previous years. This was found to be due in part to higher product removal rates by the participants, but also to entry errors made by the DAs. The Evaluator recommended that this situation be investigated.

Survey results showed that word of mouth was, by far, the main source of awareness for Residential Direct Install in 2014. This result is very positive as word of mouth is a good indication of the satisfaction of participants. Participants were indeed very satisfied with Residential Direct Install overall and its various aspects, such as the time required to complete the work, the quality of the work performed, program communication and the energy conservation measures installed. The DAs also expressed positive feedback about Residential Direct Install. They believe Residential Direct Install provides sufficient opportunity to provide education on energy efficiency in general and to promote other ENSC programs. Both DAs also complimented ENSC staff for their timely response and communication. Even if they are responsible for the majority of the promotional efforts under Residential Direct Install, the DAs did provide recommendations to improve marketing, which, according to them, is the greatest impediment to program delivery.

The majority of participants recalled receiving information about energy-efficient products from the installer who came to their house. This information led to a change in behaviour for half of the participants, with the most common behavioural change being related to turning off the lights. Other behavioural changes include increased awareness of power usage and saving energy, turning off appliances and reducing water consumption.

A total of 13,945 participants participated in Residential Direct Install in 2014, compared to 23,587 participants for 2013 and 28,397 participants for 2012. Even though the number of participants per se has decreased in 2014, Residential Direct Install has reached its targets in terms of savings, and demand remains strong. Targets for Residential Direct Install were lowered in 2014, but the savings per home increased, especially after the introduction of LEDs in the standard package, and the addition of smart power controllers. These two changes to Residential Direct Install had a sizeable effect on the savings per home, meaning that DAs did not have to visit as many homes to reach the energy savings targets.

The evaluation revealed that Residential Direct Install generated net energy savings of 24.552 GWh, compared to 37.275 GWh in 2013 and 37.043 GWh in 2012, and peak demand savings of 5.721 MW at the generator in 2014, compared to 8.499 MW and 8.446 MW in 2012. To calculate the net savings of Residential Direct Install in 2014, Econoler reviewed the gross savings estimated by ENSC and conducted 50 on-site visits to calculate installation rates for each category of product installed. Econoler took into consideration the free-ridership and spillover levels associated with the non-low-income participants. These distortion effects were measured as part of the quarterly participant survey.

In addition to the regular Residential Direct Install savings, 438 participants took part in the CBSM Pilot, which encouraged them to use less warm water to do laundry. This pilot initiative generated 0.055 GWh in energy savings and 0.013 MW in peak demand savings at the generator.

Table 14: Recommendations for Residential Direct Install

No.	Recommendations
RDI-R1.	Provide participants with more streamlined and personalized information during the visit from the installer. The evaluation results indicated that a majority of participants recalled receiving information about energy-efficient products from the installer who came to their house, and that this information led to a change in behaviour for half of those participants. This result shows that the visit from the installer is a good time to educate participants about Residential Direct Install or other ENSC program components, but also to provide information that is more specific to their household. Because the majority of the promotional efforts rest on the DAs, but require ENSC's approval, the Evaluator recommends that ENSC work closely with the DAs to develop more streamlined and personalized promotional materials to further improve Residential Direct Install's educational outreach. More specifically, the DAs suggested grouping materials in one folder, similar to the Home Energy Assessment toolkit folder, and tailoring the information to the participant's individual needs.
RDI-R2.	Follow up with DAs to identify the cause of entry errors. In 2014, the installation rates observed by the Evaluator during the on-site visits were generally lower than those calculated in 2012. While a portion of this decrease was due to higher removal rates of products by the participants, it was found that a significant amount of missing products were due to potential entry errors by the DAs. It should be noted that ENSC's quality assurance program did not uncover the same discrepancies as those observed by the Evaluator. It is therefore recommended that ENSC investigate the source of those errors, as this had a sizable impact on the gross savings evaluated in 2014.
RDI-R3.	Under the logic model, the Evaluator recommended that activities meant to address each of the barriers in the program theory column be clearly identified.
RDI-R4.	Make sure that all the fields are systematically filled out. The Evaluator observed that some fields were left blank, namely the rate code and the secondary space heating source. For instance, the absence of a secondary source should be stated, thus indicating that the main heat source is used at 100 percent. All of the tracking system information can be helpful for the various tasks involved in the impact evaluation. Therefore, it is recommended to ensure that these fields are systematically filled out.
RDI-R5.	Set limitations for entries and develop a validation process. The Evaluator found that for some products, a mix of "0" and blank entries were used to indicate that no product had been installed. This is possibly due to the different data gathering process from one DA to another. Econoler recommends that ENSC standardize entries into the DSMDS, which should facilitate the identification of missing entries.

4.1.4 Home Energy Report

Launched in 2013, Home Energy Report is an innovative program intended to promote behavioural changes towards greater energy efficiency. Since its inception, a total of 93,119 participants have taken part in the paper-based component of Home Energy Report, and 10,662 participants in the web-based component. The 2014 evaluation revealed that three-quarters of the web-based participants recalled signing up for Home Energy Report, and that the majority of them were satisfied with the program and the report they received. The Evaluator did review a sample report and was satisfied with its overall quality and content.

The 2014 evaluation of Home Energy Report also demonstrated that the paper-based component seemed to be achieving the expected results in terms of changing participants' electricity consumption behaviour. The impact of the web-based component, however, has been more difficult to evaluate and the Evaluator has not been able to establish any significant level of savings associated with this component.

Participants in the web-based component of Home Energy Report generally provided low ratings when asked about the influence that Home Energy Report had on their adoption of energy-efficient behaviours, such as purchasing energy-efficient appliances, reducing their shower time, turning off their computers at night, hanging their laundry to dry, installing heat-shrink film and washing clothes in cold water. The majority of respondents mentioned that it would have been likely for them to adopt these energy-efficient behaviours without Home Energy Report. That said, when comparing their specific behaviours prior to and after their participation in Home Energy Report, it was found that there had been changes in their behaviours following their participation in Home Energy Report. For example, the average participant hung their laundry to dry more often, did more loads of laundry in cold water, turned off their computers at night more often and reduced their shower time.

The evaluation revealed that the Home Energy Report paper-based component generated net energy savings of 34.498 GWh and the web-based component generated net savings of 0.291 GWh; in total, Home Energy Report has generated 34.789 GWh in net savings since its inception in 2013. To calculate the net savings of Home Energy Report, the Econoler team first reviewed the methodology used by Opower for calculating the paper-based component savings. In addition, Econoler defined the unitary savings values for seven specific tips recommended to participants by the web-based component. The participant survey was used to estimate the number of participants who had implemented the identified tips and they were asked questions to determine the level of influence that Home Energy Report had on the participant's decision to implement the seven tips recommended. The energy savings achieved by these two components are considered net savings, since they have already included the program's influence on the participant's decision, by using a control group comparison for the paper-based component and a self-declared approach for the web-based component.

Table 15: Recommendations for Home Energy Report

No.	Recommendations
HER-R1.	Explain in greater detail the characteristics of Home Energy Report in the program documentation. Designed to influence and change participants' electricity use behaviour, Home Energy Report is different from other program components undertaken by ENSC. The specific and particular challenges and characteristics of this component should be clearly made known to program staff and the Evaluator. The program manual and the evaluation plan should be used to document and present all this information. Therefore, the Evaluator recommends that the program manual and the evaluation plan explain in greater detail the following elements of Home Energy Report: › The number of selected participants. The program manual explains how participating households were selected, but the number does not correspond to the number of those finally selected by Opower. › The process for selecting the tips recommended to participants. All the program documents available or developed when designing Home Energy Report. It is of crucial importance that Opower help develop a comprehensive evaluation plan by listing all the data available, including methodologies, databases, and any data-collection tools available or program documents so that the Evaluator knows how to evaluate the program and what other data to be collected.
HER-R2.	Review the raw and treated databases from Opower. Some confidentiality issues could not be solved within the evaluation timeframe and it was impossible for the Evaluator to review the raw data that Opower received and the treated data upon which it had applied the adjustments. For this evaluation, the Evaluator reviewed the adjustment methodology provided by Opower and considered the logic underlying this methodology to be sound. However, it is recommended that both databases be reviewed to validate whether the adjustments were applied as defined in the methodology. This review should be conducted in the next evaluation now that the confidentiality issues have been solved.
HER-R3.	Conduct a billing analysis to compare the pre-participation electricity consumption of the treatment and control groups. Socio-demographic data were analyzed and statistical tests were conducted to validate whether the control group selected was comparable to the treatment group (participants). An additional interesting test could be to analyze past electricity consumption from both groups. This analysis would help determine whether the savings observed through the billing analysis are attributable to Home Energy Report and not to any other trend that could be observed with the treatment group, but not with the control group. An analysis of the electricity consumption trend for a five-year period should be conducted as part of the next evaluation.
HER-R4.	The program manual mentions that Opower follows a set of criteria when creating both the treatment and the control groups. The Evaluator recommends that ENSC consider adding the age of the home to this set of criteria to indicate the particular building code according to which a house was built.

No.	Recommendations
HER-R5.	The latest version of the tip library has 92 pages. To allow for easier navigation throughout the tip library, the Evaluator suggests creating and placing an index at the beginning of the library to group similar tips under a number of more general topic areas, thereby making it easier for the reader to locate particular groups of tips in the library. For instance, several tips regarding heating, lighting, and hot water can be grouped under the topic area of “electricity end-use”. To better organize the tip library, another option is to divide the tips into two categories: behavioural change and resource acquisition.

4.1.5 Residential Financing

The 2014 evaluation of Residential Financing demonstrated that this pilot was designed in accordance with most of the process-related recommendations made by the Evaluator since the 2011 evaluation. Residential Financing has a program manual, an evaluation plan, a logic model, a process flow chart and a project workflow checklist. The Evaluator commends ENSC for developing Residential Financing using this standard practice, thus ensuring high-quality program design.

A total of 66 participants took part in Residential Financing in 2014—among them three participated through Solar, 21 through Home Energy Assessment and 42 through Green Heat. The in-depth interviews with participants showed that ENSC’s financing option was pivotal in helping participants complete upgrades in their homes. Most interviewed participants would have postponed their work if they had not been approved for ENSC financing, except for some necessary home improvements. The zero-percent interest rate was by far the most compelling motivator for participants to choose the ENSC financing over any other source of financing. All the interviewed participants expressed a strong preference for a zero-percent interest loan rate rather than a low-interest loan coupled with a rebate, except if both loan options offered the same overall cost or if monthly budgeting posed a problem.

The level of satisfaction with Residential Financing was very high among participants and the financing partner. The ease of making financing applications, the timeliness of loan approval and fund disbursements, the clarity of application forms and paperwork, the speed with which applications were processed, and the help provided by ENSC staff all received high satisfaction ratings from participants. The financing partner also expressed satisfaction with communications and their relationship with ENSC staff. The partner also believes that ENSC has thus far provided sufficient opportunities for it to offer input on its financing option.

Participants made recommendations to improve Residential Financing. Considering that all 10 interviewed participants learned about Residential Financing after they had decided to take part in their respective program, many of them recommended that ENSC provide information about the financing option when they apply to participate in eligible programs. Promoting Residential Financing at a larger scale among the general public was also suggested. Though they were mostly satisfied with communications, a few participants recommended that ENSC establish a formal communications timeline for the application review and loan disbursement process, with key milestones.

Table 16: Recommendations for Residential Financing

No.	Recommendations
Fin-R1.	Incorporate the financing option into existing program components instead of making it a distinct program component. Residential Financing is managed and evaluated as a distinct program. Because energy savings achieved by the projects completed with financial assistance from Residential Financing are accounted for under their respective program components, referring to it as a separate program can be misleading. The Evaluator recommends turning Residential Financing into an option available under Green Heat, Solar and Home Energy Assessment, rather than continuing to treat it as a program component.
Fin-R2.	Increase awareness of the financing option. All 10 participants interviewed during this evaluation first heard about Residential Financing from their contractor after they had decided to take part in Solar, Home Energy Assessment or Green Heat. Many participants indicated that prior knowledge of the financing option would have further helped them decide on the feasible scope of home improvements. Also considering that most of the participants would have postponed their work if they had not been approved for ENSC financing, ENSC should increase the promotion of the Residential Financing component to help participants better plan their home improvements. In addition, ENSC should use this opportunity to provide more information on the terms and conditions of the financing option, including that it is offered across suppliers and contractors.
Fin-R3.	Develop a formal communications timeline. The interviews with participants revealed a high level of satisfaction with communications given the frequency of contacts during the preapproval process and the quick preapproval. That said, nearly none of the participants interviewed had any communications with ENSC or the bank during the period from loan application preapproval until loan disbursement. To reassure participants and avoid confusion about the status of their participation process, participants recommended that ENSC give advance notice regarding the major communications scheduled. The Evaluator therefore recommends establishing henceforth a formal communications timeline for the application review and loan disbursement process, with clearly identified key milestones, as to provide the participant with a clear view of the communication process.
Fin-R4.	Monitor the loan disbursement process and the time required for payments to be received. Interviews conducted with participants revealed that in two cases, the loan disbursement was mistakenly allocated to a participant instead of a contractor, and that in one case, there was a delay in loan disbursement to the contractor. Even though these issues were properly solved by ENSC, the Evaluator still recommends collecting the feedback of contractors and participants on the loan disbursement process, and monitoring the time required for payments to be received. To avoid issues or dissatisfaction among contractors or participants, assessing these two elements should be part of future evaluations and closely monitored.
Fin-R5.	The Evaluator recommends that for internal control purposes, ENSC continue to collect information regarding the number of financing requests received per year, the number of accepted or rejected requests, the number of default payments, etc. to establish performance indicators.

No.	Recommendations
Fin-R6.	The lack of qualified participants because they have low creditworthiness ratings is one common barrier, which would be difficult to overcome. Even though ENSC is considering having participants obtain financing from local municipalities without having to go through credit checks and letting them repay their municipalities through property taxes, the Evaluator still recommends that this barrier be eliminated.

4.2 Profit Business, Non- and Institutional

4.2.1 Business Energy Rebates

The 2014 evaluation of Business Energy Rebates demonstrated that most of the recommendations pertaining to process issues made in the previous evaluations have been implemented. The Evaluator commends ENSC on its efforts in improving and optimizing Business Energy Rebates. Among the improvements, the Evaluator noticed the efforts made to improve the tracking system, analyze the product offerings to reduce duplicate rebates and implement some automated calculations of savings in the DSMDS. Furthermore, ENSC has deployed efforts to collaborate more closely with distributors by reducing the burden associated with product approval. In fact, ENSC is now a member of the Design Lights Consortium (DLC), which will allow distributors to refer to the DLC's product repertory, resulting in fewer product approval procedures. However, the impact evaluation has shown that few improvements have been made to the savings calculations since the past two evaluations conducted by the Econoler team. This is an aspect of the program which ENSC should focus on in the future.

Survey results showed that participants were very satisfied with their experience with Business Energy Rebates, including their interactions and communications with contractors, distributors and consultants, rebate or incentive amounts and the time required to receive the rebate or incentive. For the most part, participants found it easy to participate in Business Energy Rebates. That said, a smaller proportion of the participants found the Business Energy Rebates participation process easy to complete for reasons such as difficulty in obtaining the information that ENSC needed, insufficient amount of information regarding the process, time-consuming process, eligibility hard to ensure and communication issues. Participants also recommended that more information be provided about the program.

Similar to last year, distributors expressed dissatisfaction with the rebate tracking and reporting processes. While satisfaction with this aspect of Business Energy Rebates has slightly improved compared to last year, distributors were dissatisfied with the time required to record and report rebates, the financial responsibility resulting from rebate processing errors and the complexity related to applying rebates. This proved to be the main source of dissatisfaction with Business Energy Rebates among distributors, whose overall satisfaction with the program has decreased since last year.

To calculate the net savings of Business Energy Rebates in 2014, the Evaluator reviewed the gross savings estimated by ENSC based on 58 on-site visits and a literature review, and took into consideration the free-ridership level for each rebate approach. A free-ridership level of 25 percent was established through the quarterly participant surveys, resulting in an NTGR of 0.75 for the mail-in approach, with the exception of LED tubes with a promotional rebates, for which the NTGR was of 1.00. For the instant rebate approach, the Evaluator calculated the respective free-ridership levels of the three major product categories (i.e., T5 and T8 high bay fixtures, LED outdoor wallpacks and LED downlights) based on the distributor interviews, and applied a zero free-ridership level to other products. This resulted in an overall NTGR of 0.73 for energy savings of this component.

The evaluation revealed that overall Business Energy Rebates generated net energy savings of 24.610 GWh and peak demand savings of 4.880 MW at the generator in 2014, compared to 34.169 GWh and 9.367 MW respectively in 2013, and 21.858 GWh and 6.285 MW respectively in 2012¹. While these overall results represent a significant decrease in savings compared to last year, it should be noted that the BER Mail-In component results have much improved. However, BER Instant Rebates generated far less savings (13.537 GWh in 2014 vs. 37.557 GWh in 2013). This has largely been due to the fact that the 2013 sales of LED downlights were too high because of a special event in February which led to gross savings of more than 9 GWh being claimed by two distributors for this single product.

Table 17: Recommendations for Business Energy Rebates

No.	Recommendations
BER-R1.	Review information provided to participants about Business Energy Rebates to better assist them with the participation process. Survey results have shown that a smaller proportion of the participants found the Business Energy Rebates participation process easy to complete. Difficulties encountered by participants included difficulties in getting the information that ENSC required, insufficient information about the process, time-consuming process and communication issues. Participants also mentioned the need to provide more information about the program as the main recommendation to improve Business Energy Rebates. These results show a need for both enhanced and clearer information about the Business Energy Rebates participation process. Thus, the Evaluator recommends reviewing current Business Energy Rebates information to better assist participants.

¹ 2011 net energy savings include Business Energy Rebates (BER) and Smart Lighting Choices (SLC) results.

No.	Recommendations
BER-R2.	Continue with the efforts to simplify rebate tracking and reporting processes. In 2013, the Evaluator recommended that ENSC review the rebate tracking and reporting processes, with a particular focus on timeliness and structure. ENSC has made progress in this aspect of Business Energy Rebates, which distributors have noticed as shown by their higher level of satisfaction with this in 2014. That said, rebate tracking and reporting remains the main source of dissatisfaction with the program among distributors. Distributors raised several issues regarding rebate processing, tracking and reporting, including the time required to record and report rebates, and the financial responsibility resulting from rebate processing errors, which were often caused by the complexity associated with applying rebates. The Evaluator recommends continuing to make efforts to improve the rebate tracking and reporting processes to reduce the distributors' administrative burden, thereby increasing their satisfaction with Business Energy Rebates.
BER-R3.	Implement recommended changes to savings calculations in a timely manner. Once again this year, the Evaluator found that not many modifications to savings calculations recommended in last year's evaluation report were made. In fact, many recommendations on this matter made two years ago have not yet been implemented. This year, to avoid applying an adjustment ratio that would have been too big and would have caused an excessive margin of error, the Evaluator adjusted the tracked savings for peak demand and energy savings of air-source heat pumps to follow up on last year's recommendation. The Evaluator thinks that ENSC should have made such adjustments as part of its responsibilities.
BER-R4.	Collect additional information on the measures sold through BER Instant Rebate and continue improving the tracking system. BER Instant Rebate tracking report has seen some significant improvements since last year. Most notably, the Masterlist tab, which lists all the unitary savings equations and values for all the approved products, can now be easily linked to the Reporting tab by using the unique code assigned to each product. Since the equation used for each transaction can now be validated, the Evaluator recommends that ENSC use those tools to collect information that can improve the accuracy of the savings calculated. For instance, the type of each approved occupancy sensor can be identified in the Masterlist. Since all the products sold through BER Instant Rebates are lighting products, their unitary savings can be calculated with a limited number of variables (baseline and efficient wattage, and hours of operation). It is therefore also recommended to present each of these three variables in a separate column so that they can be easily validated and used to allow energy and demand savings to be automatically calculated.
BER-R5.	Be proactive in addressing issues related to contractors. In the 2013 evaluation of BER Mail-in, a quality issue with one contractor's work to install the electronically commutated motor (ECM) was identified. This issue caused a major reduction in the evaluated savings established for this measure category. Although ENSC took the time to contact the participants affected by this issue, it took no concrete measures to improve the quality of this contractor's installation work. As a result, similar problems occurred again with this contractor in 2014, and 22 projects had to be removed from the claimed savings.

No.	Recommendations
BER-R6.	Re-assess the product offerings to consider the baseline improvement observed in the market. In 2014, the free-ridership level increased to an average of 26 percent for Business Energy Rebates. This was a significant increase compared to the 17 percent value established in the 2013 evaluation. The Evaluator believes that this is an indicator that some rebated products might have become closer to the current practice of the market. For example, BER Instant Rebates distributors reported that the market was naturally moving towards T5 and T8 high bay fixtures and LED downlights; the free-ridership levels for those products were respectively at 46 percent and 35 percent. The lighting market is changing rapidly, because the prices of new technologies are dropping and new regulations have recently been enacted. The Evaluator is of the opinion that ENSC should re-assess its product offerings to ensure that it is promoting products of higher efficiency than those used in the current practice.
BER-R7.	Use a formula to calculate all the projects' total savings. It was found that in some cases, the total savings of a given project were entered manually rather than calculated by a formula that would have added up all of the measure's savings. This method led to a few errors in the tracked savings. It is recommended that a formula be systematically used to calculate every project's total savings.
BER-R8.	Provide complete project documentation in the DSMDs. While the documentation quality of some project categories has improved over the past few years, the Evaluator still found some projects, whose worksheets provided did not contain all the necessary information. This is especially true for ECMs and lighting projects. ENSC should continue to make efforts to ensure every project has complete documentation to facilitate the evaluation process.
BER-R9.	Stating baseline assumptions in the Equations tab. The Equation tab now indicates the baseline wattage for each product sub-category. However, it is often difficult for the Evaluator to understand how this value was defined; this might also pose a problem for ENSC, as assumptions are not documented for future revisions. Consequently, it is recommended that a new column be added to give more details about the baseline, including elements such as the technology used, number of lamps and ballast consumption, if applicable (e.g., 2x 32W T12 with magnetic ballast (20 W)).
BER-R10.	To better estimate the peak demand savings of heat pumps, the Evaluator conducted research into weather data of the province to determine the lowest temperature recorded from 5 p.m. to 7 p.m., and estimated the minimum temperature at -15°C. The coefficient of performance (COP) and capacity at -15°C was obtained from capacity tables for each heat pump model, and those values were applied to calculate the revised demand savings. This adjustment should be taken into account for tracked peak demand savings in the future.
BER-R11.	One project this year included one redundant motor, for which the variable speed drive (VSD) measure savings were reduced. To prevent this from occurring in the future, the Evaluator recommends adding a specific question about redundancy into the worksheet.

No.	Recommendations
BER-R12.	At the moment, ENSC does not collect the efficiency of the motor controlled; since this is a variable in the Massachusetts methodology, it will have to be added to the information required in the application package and worksheets.
BER-R13.	The Evaluator recommends that the savings for VSDs used for other applications than HVAC be calculated using the custom calculation tool developed by ENSC. The Evaluator also suggests that ENSC consider moving such projects to the Custom Retrofit component.
BER-R14.	For T8 lamps and CEE-listed ballasts, the baseline wattage was revised based on Canadian regulations and a literature review of the values used by other Canadian utilities. For other products, the Evaluator did not find much representative data: on one hand, the baseline values used by other Canadian utilities were either unavailable or seemed outdated; on the other hand, regulations for a variety of lighting products have changed in the past few years in the United States. Although some baselines presented in other jurisdictions' technical reference manuals are much more sophisticated than those currently used by ENSC, they are not applicable to the Nova Scotian market. Therefore, the Evaluator did not update the baseline wattage, but still made recommendations on improving energy savings equations and assumption documentation. Given the current situation, the Evaluator recommends investigating the current commercial lighting practice as part of the next program evaluation. Furthermore, the lighting products offered in Canada are likely to rapidly change in the next years, as the Canadian government is starting to implement Amendments 13 and 14 to the Energy Efficiency Regulations.
BER-R15.	The Evaluator recommends again this year adjusting the baseline values for both lamps and ballasts, in a manner consistent with other jurisdictions' baseline values. Also, a ballast factor of the new fixtures should be applied in the calculations
BER-R16.	The Evaluator recommends that for next year, the baseline for LED downlights be based on the results of on-site visits that will be conducted as part of the 2015 evaluation of the Business Energy Solution component.
BER-R17.	The currently used controlled wattage value of 150 W for occupancy sensors seems to be too low, when compared to values used in other jurisdictions. In fact, technical reference manuals of Illinois, Pennsylvania and Vermont cite values of 73 W to 587 W per occupancy sensor, depending on the type of sensor (e.g., wall mounted, remote or fixture). ENSC started collecting information about the sensor type in June 2014. It is recommended that the controlled wattage be adjusted in 2015, based on the type of sensor and the values from Vermont's TRM

4.2.2 Custom Retrofit

The 2014 evaluation of Custom Retrofit demonstrated that most of the recommendations made in previous evaluations have been implemented. The Evaluator commends ENSC on its efforts in improving and optimizing Custom Retrofit. Among the improvements, the Evaluator noticed the efforts made to improve the general project documentation. Moreover, the Evaluator noticed that one of the

2012 recommendations implemented by ENSC has resulted in major changes for Custom Retrofit, namely: simple lighting projects have been transferred to the prescriptive programs of ENSC. This change may explain the participation decline observed for Custom Retrofit in 2014. The evaluation nevertheless demonstrated that the 100 projects completed through Custom Retrofit in 2014 generated a good level of electrical savings.

To calculate the savings of Custom Retrofit in 2014, the Evaluator used an approach that involved conducting on-site visits of sample projects and an in-depth review of each sample project's technical documentation (e.g., feasibility study, metered data, energy billing, M&V reports, etc.). Then, the Evaluator calculated the gross energy and peak demand savings for all the sampled projects, based on the specific characteristics of each project type. The adjustment ratios that resulted from this calculation were used to estimate the overall gross savings. It was found this year that the adjustment ratios for energy savings were very close to unity, which indicates that ENSC's verification process was thoroughly and properly conducted. One element that explains why adjustments to peak demand savings were more significant is that the Evaluator changed some of the diversity factors estimated by ENSC.

Moreover, when calculating the net energy and peak demand savings achieved by Custom Retrofit in 2014, the Econoler team applied the free-ridership level measured using a telephone survey with participants, and the spillover level established through the on-site visits,. The free-ridership level was found to have increased slightly compared with last year (from 9% to 10%). No internal spillover was detected.

In 2014, Custom Retrofit generated net energy savings of 20.292 GWh and net peak demand savings of 1.599 MW at the generator. Additionally, EBC and EMIS respectively generated 1.690 GWh and 5.001 GWh, amounting to a total of 26.988 GWh energy savings when combined with Custom Retrofit's energy savings. No demand savings were claimed for those two components.

Like the last few years, a survey conducted with participants revealed that most of them were satisfied with Custom Retrofit overall. All participants surveyed mentioned that they would recommend Custom Retrofit to other businesses, and that they would participate in other ENSC programs, based on their experience with Custom Retrofit.

Table 18: Recommendations for Custom Retrofit

No.	Recommendations
Custom-R1.	Perform thorough M&V and document it in a complete report for every large project for which thorough M&V work is justified and required. The Evaluator has observed that ENSC is using M&V as a tool increasingly often each year for Custom Retrofit. For some simpler and smaller projects, performing some hours-of-operation data logging and spot measurement may be adequate to allow establishing savings with a fairly good level of accuracy and reliability. However, this year, the Evaluator encountered some very large projects with multiple energy efficiency measures, for which the M&V activities conducted were limited to a few spot measurements. The Evaluator considers that in order to justify incentives amounting to hundreds of thousands of dollars, a complete M&V report should be written to report on all the major elements defined in standard M&V protocols, such as the IPMVP. For smaller projects, a good practice would be to summarize the measurement methodology (what was measured and when) and the equations used to establish energy savings based on the raw data in a short form.
Custom-R2.	Improve the information presented in the DSMDS reports. The Evaluator found that most of the important information for evaluation purposes could be obtained from the DSMDS reports. Some elements could, however, be added to improve clarity and the ease of use. For instance, this report has not presented the line loss factor, the rate code, or the verified savings at the meter. The answers to the free-ridership screening have not been included either. Furthermore, it is only possible to obtain either the projects' total savings (over multiple years), or the claimed savings for the current year. To improve sample selection, it will be important to have both these values, because the adjustment ratios are calculated based on the project's total savings, but the average ratio for all the projects is weighted based on the contribution of each project to the current year's savings. Additionally, some projects were identified as claimed in 2014, while only an adjustment to M&V results was made this year. This resulted in some projects being incorrectly included in the 2013 sample. The Evaluator recommends adding a unique identification code name, or tag to indicate if the project is being claimed in the current year or represents ongoing M&V adjustments being made to a project from a previous year.
Custom-R3.	Improve the free-ridership pre-screening procedure. This year again, ENSC discussed the clients' payback period threshold and the importance of the incentive for each of the projects submitted through Custom Retrofit. This way, ENSC can avoid giving incentives to participants who would have implemented the project without it. In turn, the calculated free-ridership has been significantly reduced for all participants who underwent this pre-screening. The Evaluator found that in some cases this year, the answers were weak; for instance, one answer included in the annual survey sample read as "To reduce payback period". It is recommended that the pre-screening questions be standardized, in a way similar to that used for Business Energy Rebates, and that acceptable answers be better defined.

No.	Recommendations
Custom-R4.	Better define the expected scope of the EBC feasibility studies. Although the component's name refers to recommissioning, the studies conducted this year were more limited in scope than a full recommissioning process. The Evaluator understands that the reason for this was to focus on low-cost measures and facilitate a first contact with customers who might not be quite ready to participate in the Custom program. However, the Evaluator believes that the scale and scope of the measures to be considered in the study should be better defined. Some studies were limited to rescheduling ventilation to match occupancy schedules, while others considered the operation of the whole HVAC system and its control. A better definition of the expectations will help make sure that the customer gets the full benefits of the study.
Custom-R5.	Require EMIS service providers to track and present savings using the IPVMP. The IPVMP, a widely recognized M&V protocol, requires the service providers to develop a detailed M&V plan as part of their implementation plans. This action can help address most of the weaknesses identified in the projects reviewed: for instance, a representative baseline data collection period will be required, and all the adjustments will have to be thoroughly documented. In addition, ENSC should review the proposed M&V plans and verify the tracked savings claimed in the quarterly reporting periods, which will help ensure that all the relevant independent variables have been identified, that the baseline model is adequate, and that the routine and non-routine adjustments are being properly applied.
Custom-R6.	Plan on conducting a thorough impact evaluation of EMIS and EBC in 2015. This year, the impact evaluation of the EMIS and EBC was limited in scope, and no on-site visits were conducted. The Evaluator considers that this choice was appropriate, since only 9 projects in total were claimed for these two components. However, the amount of savings (6.696 GWh) they achieved at the generator was significant, with more than 5 GWh achieved by EMIS alone. The Evaluator did not make adjustments to the tracked savings, given the limited amount of information available this year, but it believes that a thorough review should be made next year.
Custom-R7.	The Evaluator also recommends continuing to monitor the types of projects submitted to Custom Retrofit in order to identify whether measures of the same type (becoming less customized) are frequently implemented through the program. If too many projects submitted to Custom Retrofit are similar, ENSC should consider transferring these measures into an existing program with a simpler approach or into a new program.
Custom-R8.	Require that contractors collect and document the main equipment specifications for all the major mechanical systems reviewed in the scoping studies: This information should be presented in the implementation report, and would help ENSC ensure that all major energy-saving opportunities related to capital projects were considered.
Custom-R9.	Supply service providers with a standardized summary document for them to report the actual measures implemented: This document will help ensure that savings and associated costs are indicated for each measure, along with a short description on the substantiation approach (schedule log, engineering calculation, etc.). Furthermore, the document will indicate the savings in kWh and dollars, therefore avoiding combining non-electrical and electrical savings into a single value.

4.2.3 Custom New Construction

Custom New Construction saw a total of 13 projects implemented in 2014, which represents a small decrease over the 15 projects implemented in 2013. However, the 2014 project count is higher than the number of projects carried out in 2012 (8) and 2011 (9), which indicates that Custom New Construction is maintaining its level of participation.

The 2014 evaluation of Custom New Construction demonstrated that the program component generated net energy savings of 6.656 GWh, and peak demand savings of 2.517 MW at the generator. In comparison, Custom New Construction had net energy savings of 7.477 GWh and peak demand savings of 2.122 MW in 2013, and respectively 4.644 GWh and 0.525 MW in 2012. The small drop in annual savings can be attributed to the small reduction in participants over 2013.

A total of nine site visits were carried out in 2014. The results of the site visits were used in combination with the project information provided by ENSC to validate and adjust the tracked savings. To calculate the savings of Custom New Construction in 2014, the Econoler team revised the gross energy and peak demand savings for all of the sampled projects in accordance with the specifics of each project. The team calculated adjustment factors to be applied to all 2014 Custom New Construction projects, resulting in adjusted gross energy and peak demand savings. Overall, Custom New Construction showed solid results that exceeded ENSC's annual target. The adjustments made to the 2014 sample were relatively small, which indicates that the majority of projects are being carried out as submitted.

Due to ENSC's new approach of defining a specific baseline for each participant, no free-ridership was applied as part of the 2014 evaluation. The net savings were therefore equivalent to the adjusted gross energy and peak demand savings.

Table 19: Recommendations for Custom New Construction

No.	Recommendations
NC-R1.	Gather more data to conduct a conclusive calibration billing analysis in 2015. Despite the fact that 23 projects were completed in 2012 and 2013, it was only possible to obtain sufficient energy billing data for seven projects to perform a calibration analysis in 2014. This calibration analysis proved to be inconclusive due to numerous factors. The Evaluator consequently suggests that this evaluation activity be continued in future evaluation. Other measures could be taken to ensure the quality of the result, such as requiring a final energy simulation submission (based on the as-built conditions), making enhanced building commissioning a mandatory element of Custom New Construction and/or including a full energy simulation review to ensure the accuracy of the model inputs.

No.	Recommendations
NC-R2.	Adopt the National Energy Code for Buildings (NECB) 2011 as a baseline for all new projects in 2015. The literature review conducted as part of 2013 evaluation revealed that more stringent baseline construction designs are currently being used in similar new construction programs in other Canadian jurisdictions. Moreover, the NECB is now enforced in large buildings as of January 2015 in Nova Scotia. Therefore, the Evaluator reiterates their 2013 recommendation of updating the baseline used for calculating savings. Noteworthy is that the eligibility criteria Custom New Construction should also be modified in accordance with this change to baseline construction design.
NC-R3.	Explain the diversity factor value used in peak demand savings calculations. In 2014, the report included the addition of a diversity factor for each measure. It is good practice that this factor be explicitly defined on an individual measure basis. To facilitate the task of validating this value for the Evaluator, it would be advisable to add a field where the calculation or assumptions are explained in a few words.
NC-R4.	Adding the Nova Scotia Power's rate code to the DSMDS report: While the Nova Scotia Power's rate code is entered into the DSMDS, it does not appear in the Evaluation Report. As the information contained in the project feasibility studies, M&V reports and other technical documents is always expressed in terms of energy and demand savings at the meter, the Evaluator needs to apply the correct line loss factor to the savings at the generator presented in the DSMDS report to compare the values. An easy access to Nova Scotia Power's rate in the DSMDS report would then be very helpful in establishing the corresponding line loss factor.
NC-R5.	To improve the accuracy of the energy simulations, the Evaluation makes the following recommendations: › A final energy simulation submission could be required and would be based on the as-built conditions. › Enhanced building commissioning could be a requirement of the New Construction initiative. › Projects from 2011 should be included in the calibration study as to increase the availability of energy consumption data. The impact evaluation could include a full energy simulation review to ensure the accuracy of the model inputs.

4.2.4 Business Energy Solutions

The 2014 evaluation of Business Energy Solutions demonstrated that the program component generated important electrical savings in 2014. Even though Business Energy Solutions did not reach its targets in 2014, an increase in savings associated with the Business Energy Solutions lighting and non-lighting measure categories was observed. Furthermore, savings associated with the implementation of LED lighting products have also increased, thus proving the efficiency of Business Energy Solutions in promoting the use of the technology.

The evaluation revealed that participants' overall satisfaction with Business Energy Solutions remains high (90%). The survey results however showed that the percentage of participants reporting a challenge or barrier to participation in 2014 increased to 23% of all the participants. Respondents who reported having experienced barriers cited problems with contractors, unavailability of measures and lack of financing.

The on-site visits performed as part of 2014 evaluation showed that work conducted by DAs is done according to ENSC's procedure. No lighting intensity measurement was performed during visits. DAs did mention, however, that such an analysis would be useful to identify overlit areas and to support participants in their decision to reduce the quantity of fixtures according to their lighting needs. Visited participants were also concerned about how to get replacement lamps. This information was not always given to participants and should be included in ENSC's procedures in the future.

For the year 2014, Business Energy Solutions totalled 761 participants. In addition, 51 participants implemented Rental Properties and Condos Service common space measures and 42 participants took part in the LED Blitz pilot, which makes for a total of 854 participants for the whole Business Energy Solutions component.

The impact evaluation revealed that, when all initiatives are considered together, Business Energy Solutions generated net energy savings of 13.175 GWh and peak demand savings of 2.570 MW at the generator in 2014. To calculate the net savings of Business Energy Solutions in 2014, the Econoler team reviewed the gross savings estimated by ENSC and included interactive effects for lighting and non-lighting measures. On-site visits were used to establish installation rates for the most installed products and to calculate diversity factors. The Econoler team also took into consideration the free-ridership and spillover calculated from participant annual and quarterly survey results.

Table 20: Recommendations for Business Energy Solutions

No.	Recommendations
BES-R1.	Make follow-up telephone calls to ensure participant satisfaction with the work done by the third-party contractor. Survey results showed that participants encountered issues with third-party contractors and the quality of their work. ENSC already requires that the DAs follow up with customers after installation to ensure their satisfaction. The Evaluator recommends that ENSC itself (instead of the DAs) make some follow-up phone calls with a certain portion of the participants so that ENSC is quickly made aware of any major issues related to DAs' work. Such phone calls by ENSC will help verify whether contractors have properly completed the work and met customer needs.

No.	Recommendations
BES-R2.	Include a light intensity analysis as part of the on-site energy assessment and provide participants with information on how to obtain replacement products. DA visits, performed during the initial on-site assessment and the installation process, showed that no lighting intensity analysis was performed. All DAs mentioned that such an analysis would be helpful to identify overlit areas. The Evaluator thus recommends that ENSC evaluate the possibility to include a lighting intensity analysis during the initial assessment. This analysis could include the use of a ballast discriminator. This could help identify potential reballast measures and support participants in their decision to reduce the quantity of fixtures according to their lighting needs. However, additional costs and contractual agreements between DAs and ENSC should be taken into account before adding such an analysis into the assessment. Visits also showed that participants had questions on how to obtain replacement lamps in lighting projects. As it would be beneficial to participant satisfaction, this information should be systematically given to customers during the installation process and should be part of ENSC's procedures.
BES-R3.	Eliminate adjustment of operating hours of proposed measures to take burnt out lights, safety considerations and delamping into account. For some projects, the operating hours of the proposed measures have been increased to take existing burnt out lights into account. The Evaluator recommends that no adjustment should be made because of burnt out lights as they are usually replaced even if no lighting retrofit or fixture replacement is done. A similar adjustment to the proposed operating hours have been made for customers who wanted lights to be on 24 hours a day, seven days a week, for safety considerations. Safety considerations are not related to the energy efficiency measures implemented. Safety would have been a concern even without the replacement of lighting systems. For this reason, the Evaluator recommends that no increase in operating hours should be considered in the savings calculations for safety considerations. Operating hours were also adjusted to take the partial delamping of existing measures into account. This reduction should be taken into account through the quantity of lighting systems.
BES-R4.	Add information about cooling systems and hot water heat pumps in the non-lighting measures tracking report. The Evaluator reiterates this recommendation for heat pumps, which was first mentioned in the 2013 evaluation report. It is recommended to add new fields to record information regarding the cooling capacity and Seasonal Energy Efficiency Ratio (SEER) of the existing cooling systems. This would enable more accurate savings calculations. The tracking report should also contain all hot water heat pump parameters required to perform energy savings calculations.
BES-R5.	Develop a process for validating savings calculations. As detailed in the Impact Evaluation section, the Evaluator reviewed the energy savings recorded in the tracking sheet and found small calculation errors. To ensure that the savings recorded in the tracking sheet correspond to those calculated using the parameters documented for each measure (quantity, unitary wattage value, hours of operation, etc.), ENSC should develop a validation process using a formula that can automatically calculate savings using the parameters entered in the tracking sheet. This will ensure the consistency of the energy savings recorded for each measure.

No.	Recommendations
BES-R6.	Use ballast efficacy factor when available to evaluate system wattage of fluorescent and LED linear tube lighting system. For measure categories involving linear fluorescent and linear LED tubes to replace T8, the Evaluator recommends using first and foremost the ballast efficacy factor to evaluate the lighting system wattage. This parameter represents the ratio of the ballast factor to the system input wattage. This represents the most accurate method to calculate the energy consumption of the system wattage. When the ballast efficacy factor is not available, the Evaluator recommends using system wattage data from the literature. Databases for different ballast and lamp combinations are widely available in the literature for conventional T8 fluorescent tubes. For LED tubes, such databases may not be available in the near future. For proposed measures related to LED tubes, the Evaluator recommends using the product of the ballast factor and lamp nominal wattage, unless the ballast efficacy factor values of the system wattage databases become available.
BES-R7.	Use proposed ratio value when the ballast factor is used as lighting system wattage to lamp nominal wattage ratio in savings calculations. In 2013, it was recommended to use a ratio of 0.85 instead of ratios ranging between 0.74 and 0.78 when the ballast factor is taken as the ratio of the lighting system wattage to lamps nominal wattage. This recommendation applies for LED linear tubes when the system wattage is taken as the product of the ballast factor and lamp nominal wattage. The Evaluator adjusted the savings calculations, as recommended in last year's evaluation.
BES-R8.	Plan on the complete and ultimate removal of CFLs and fluorescent T8 tubes from Business Energy Solutions. Business Energy Solutions results showed that savings associated with florescent T8 decreased by 53 percent in 2014. So, the Evaluator recommends that either (1) the use of fluorescent T8 be limited to applications with low operating hours next year; or (2) the fluorescent T8 be used for specific applications and that this technology be gradually yet completely phased out and removed in the near future. Similarly, the share of savings associated with CFLs decreased by 64 percent this year. A significant portion of this decrease was attributable to the removal of screw-in CFLs from the program. CFLs are now limited to hardwired lamps and special applications, for which the cost of LED technologies is still high. However, as the costs of LED products continue to drop, ENSC should plan on completely removing this technology from Business Energy Solutions in the near future as well.
BES-R9.	Remove the "BES Measure Occupancy Sensor Savings" field from the tracking report. Savings associated with occupancy sensors are now claimed through a reduction of operating hours. Moreover, some of the values presented in this field are not related to occupancy sensors.

4.2.5 Codes and Standards

Based on international experience and our own, evaluating the energy impact of regulations or policies is usually more difficult than calculating the impact of a DSM program, which has a list of participants and a range of products distributed. As for the evaluation of Codes and Standards, the main challenge resides in the necessity to understand the whole market of targeted products. This not only involves establishing the quantity of products sold in a specific market, but also making in-depth characterization of that market (e.g., quantity by size, type, efficiency level, etc.). Depending on the product, this information can be hard or even impossible to obtain in some cases.

Based on the outcomes of our activities, the Econoler team makes the following recommendation on how to ensure the success of future Codes and Standards impact evaluations:

Table 21: Recommendations for Codes and Standards

No.	Recommendations
CS-R1.	Focus the evaluation collection activity on industry associations to ensure that the most up-to-date market information is collected. Based on this year's experience and for future evaluations, the Evaluator recommends to keep the focus on working collaboratively with associations to collect up-to-date market data. The 2012 and 2013 evaluations have shown that it is extremely difficult to establish the total market size for some products by widely relying on the understanding of manufacturers and distributors in the market. By contrast, information obtained in 2014 from regulatory organizations and industry associations was useful to effectively assess the provincial market size by product category, even though costs were incurred to purchase the data. Going forward for the next impact evaluation, a more extensive secondary review of existing data may provide more accurate estimates for some of the codes and standards, especially where the analysis relied primarily on outdated studies as for the incandescent bulb products.

APPENDIX I BIBLIOGRAPHY

Programs	Bibliographic References
Appliance Retirement	Energy Star. <i>Room Air Conditioners Key Product Criteria</i> < https://www.energystar.gov/index.cfm?c=roomac.pr_crit_room_ac > (Last accessed January 29, 2014)
	NRCan's Office of Energy Efficiency. <i>Air Conditioning Your Home</i> , Available at: http://publications.gc.ca/collections/Collection/M91-23-7-2003E.pdf (Last accessed January 29, 2014)
	NREL. <i>The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 7: Refrigerator Recycling Evaluation Protocol</i> , Available at: < http://www1.eere.energy.gov/wip/pdfs/53827-7.pdf > (Last accessed January 29, 2014)
	Statistics Canada (CANSIM), <i>Households Having Air-conditioning</i> , Nova Scotia, 2009.
	The Cadmus Group, <i>Evaluation of the Ontario Power Authority's 2008 Every Kilowatt Counts Power Savings Event, Keep Cool Pilot and Rewards for Recycling Programs, Final Report, Prepared for the Ontario Power Authority</i> , July 9, 2009.
Instant Savings	ADS ASSOCIÉS, <i>Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale</i> , report presented to Hydro-Québec, 1992.
	Ad Hoc Recherche, <i>Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)</i> , p. 18, available at < http://www.regie-energie.qc.ca/audiences/Suivis/Suivi-R-3644-2007-ProcedurePGEE/HQD_RapportEvaluationPGEE_Electro_02fev2012.pdf >
	CEE Qualifying Residential Refrigerators, available at < http://library.cee1.org/content/qualifying-product-lists-residential-refrigerators >, November 15, 2013.
	Cited in Cadmus Group inc., <i>Home Energy Services Impact Evaluation, Part of the Massachusetts Residential Retrofit and Low Income Program Area Evaluation</i> , prepared for The Electric and Gas Program Administrators of Massachusetts, August 2012, available at < http://ma-eeac.org/wordpress/wp-content/uploads/Home-Energy-Services-Impact-Evaluation-Report_Part-of-the-Massachusetts-2011-Residential-Retrofit-and-Low-Income-Program-Area-Evaluation.pdf > (Last accessed October 16, 2014)
	Econoler, <i>Évaluation du programme thermostats électroniques – Volet nouvelle construction au marché résidentiel</i> , Final Report presented to Hydro-Québec, February 9, 2009.
	Econoler, <i>Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel</i> , presented to Hydro-Québec, Quebec, March 30, 2011.
	Efficiency Maine, <i>Residential Technical Reference Manual, version 2014.1</i> , July 1, 2013, p. 7
	Energy & Resource Solutions, <i>Savings Estimation Technical Reference Manual for the California Municipal Utilities Association</i> , May 5, 2014, 136 p.
	ENERGY STAR, <i>ENERGY STAR Qualified Lamps Product List</i> , Posted on January 30, 2013, < www.energystar.gov >.
	Massachusetts Electric and Gas Energy, <i>Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, 2013-2015 Program Years</i> , 2012, p. 39
	National Renewable Energy Laboratory. 4.1.2. <i>In-service Rates</i> . < http://ump.pnnl.gov/showthread.php/4839-4.12-In-Service-Rate >, (Last accessed on February 16, 2014).

Instant Savings (continued)	Natural Resources Canada, <i>Energy Consumption of Major Household Appliances Shipped in Canada, Summary Report, Trends for 1900-2007</i> , December 2009, p. 43.
	Natural Resources Canada, <i>Residential Sector Nova Scotia</i> Table 10: Water Heating Secondary Energy Use – shares (%) < http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=10&page=4&CFID=31970021&CFTOKEN=fed6e0b3f51f8fc8-C05E90B0-B973-A582-25DA340381F0B679 >, (Last accessed February 14, 2014)
	NMR Group inc. and DNV GL, <i>Northeast Residential Lighting Hours-of-Use Study</i> , May 5, 2014, 69 p.
	NREL, <i>Uniform Methods Protocol Chapter 6 : Residential Lighting Evaluation Protocol</i> , February 2014, p. 6-20, available at < http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf >
	NYSERDA, <i>Advanced Power Strip Research Report</i> , August 2011.
	Energy Center of Wisconsin, <i>Energy Savings Opportunities with Home Electronics and Other Plug-Load Devices: Results from a Minnesota Field Study</i> , 2010.
	Office of Energy Efficiency, <i>Search: Clothes Washers Energy Efficiency Ratings</i> , < http://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESWASHERS > (Last accessed January 27, 2015)
	Ontario Power Authority (OPA), <i>2011 Prescriptive Measures and Assumptions, Version 1</i> , March 2011.
	Ontario Power Authority (OPA), <i>2010 Prescriptive Measures and Assumptions</i> , January 1, 2010.
	Opinion Dynamics & The Cadmus Group, <i>CFL Hours of Use Study Summary of Approach and Results</i> , July 2012.
	Pennsylvania Public Utility Commission, <i>Technical Reference Manual</i> , State of Pennsylvania, June 2014.
	Research into action, <i>Final Report: 2012 Consumer Program Evaluation</i> , Report presented to OPA, October 11, 2013, 154 pages.
	RLW Analytics, <i>Validating the Impact of Programmable Thermostats</i> , prepared for GasNetworks, January 2007, page 2.
	State of Illinois, <i>Illinois Statewide Technical Reference Manual for Energy Efficiency</i> , version 3.0, February 24, 2014, 675 p.
Green Heat	ANSI/AHRI, <i>Standard 201/204 with Addenda 1 and 2 (formerly ARI Standard 210/240), Table 19 “Representative Cooling and Heating Load Hours for Each Generalized Climatic Region” (page 116)</i> , March 2012.
	Dunsky Energy Consulting, <i>Residential Fuel Substitution Pilot Program</i> , Submitted to Efficiency Nova Scotia Corporation, December 16, 2010.
	EnerGuide, Natural Resources Canada's Office of Energy Efficiency, <i>Heating and Cooling With a Heat Pump</i> , December 2004.
	Hydro-Québec, <i>Rapport d'évaluation : Programme : Géothermie – Marché résidentiel 2007 to 2009</i> , March 25, 2011.
	Natural Resources Canada, <i>Air-Source Heat Pumps</i> , available at < http://www.nrcan.gc.ca/energy/publications/efficiency/heating-heat-pump/6831 > (Last modified April 15, 2014).

Green Heat (Continued)	Navigant Consulting, 2011 to 2019 <i>Fuel Substitution Potential Analysis</i> , Submitted to Nova Scotia Power Inc., February 24, 2010.
	Ontario Power Authority (OPA), <i>2011 Quasi-Prescriptive Measures and Assumptions, Release Version 1</i> , December 2010, pages 221 to 224.
	Ontario Power Authority (OPA), <i>OPA Prescriptive Measures and Assumptions List</i> , January 2014.
	Pennsylvania Public Utility Commission (PUC), <i>Technical Reference Manual</i> , June 2014.
Low Income Homeowner	ENERGY STAR®, <i>Program Requirements for Dehumidifiers Eligibility Criteria V3.0, Partner Commitments</i> , July 2012, available at : http://www.energystar.gov/ia/partners/product_specs/program_reqs/Dehumidifiers_Program_Requirements.pdf , (Last accessed January 27, 2015).
New Home Construction	Housing, Buildings, Communities and Simulation (HBCS) group of CanmetENERGY, a division of NRCan. For additional information : http://198.103.48.154/eng/software_tools/hot2000.html , (Last accessed January 15, 2015).
	Nova Scotia, Building Code Legislation, <i>Nova Scotia Building Code Regulations – Users Version, 2014</i> , p88-89, available at http://novascotia.ca/lae/buildingcode/legislation.asp , (Last accessed January 15, 2015).
Residential Direct Install	Ad Hoc Recherche, <i>Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)</i> , p. 18, available at < http://www.regie-energie.qc.ca/audiences/Suivis/Suivi-R-3644-2007-ProcedurePGEE/HQD_RapportEvaluationPGEE_Electro_02fev2012.pdf >
	ADS ASSOCIÉS, <i>Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale</i> , report presented to Hydro-Québec, 1992.
	Aquacraft, Inc. Water Engineering and Management, <i>Residential Indoor Water Conservation Study</i> , July 2003.
	Canadian Building Energy End-Use Data & Analysis Centre, <i>Domestic Water Heating and Water Heater Energy Consumption in Canada</i> , April 2005, page 29.
	Embertec – Energy Efficiency Technologies, Solution Provider Presentation, <i>Maximum Savings – Zero Effort</i> .
	Econoler, <i>Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel</i> , report presented to Hydro-Québec, Quebec, March 30, 2011.
	Efficiency Maine, <i>Residential Technical Reference Manual, version 2014.1</i> , July 1, 2013, p. 7
	Energy & Resource Solutions, <i>Savings Estimation Technical Reference Manual for the California Municipal Utilities Association</i> , May 5, 2014, 136 p.
	Frost King Weatherization Products, <i>Water Heater Insulation Blanket</i> , http://www.frostking.com/water-heater-insulation-blanket/ (Last accessed January 4, 2014)
	Giant Inc., <i>Engineering Submittal Data Sheet 152ETE Models</i> , http://www.giantinc.com/tech-data/FT-152ETE-An.pdf (Last accessed November 22, 2014).
	Karebo Systems, <i>Audiovisual standby power controller: Energy savings field trial, South Africa - June-August 2012</i> , 6 March 2013.
	Massachusetts Electric and Gas Energy, <i>Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, 2013-2015 Program Years</i> , 2012, p. 39
	Mayer, P. W., W. B. Oreo et al., <i>Residential End Uses of Water</i> , published by the AWWA Research Foundation, 1999, p.99-102.
	Natural Resources Canada, <i>Energy Efficiency Ratings : Search – Clothes Washers</i> , < http://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESWASHERS > (Last accessed November 24, 2014)

Residential Direct Install (Continued)	NMR Group inc. and DNV GL, <i>Northeast Residential Lighting Hours-of-Use Study</i> , May 5, 2014, 69 p.
	Northeast Energy Efficiency Partnerships, <i>Mid-Atlantic Technical Reference Manual, Version 3.0</i> , March 2013, p. 135.
	NREL, <i>Uniform Methods Protocol Chapter 6 : Residential Lighting Evaluation Protocol</i> , February 2014, p. 6-20, available at < http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf >
	Ontario Power Authority, <i>2011 Prescriptive Measures and Assumptions, Release Version 1</i> , March 2011, 646 p., available at < http://www.powerauthority.on.ca/sites/default/files/2011PrescriptiveMeasuresAssumptionsListVersion1.pdf > (Last accessed November 24, 2014)
	Opinion Dynamics & The Cadmus Group, <i>CFL Hours of Use Study Summary of Approach and Results</i> , July 2012.
	Pennsylvania Public Utility Commission, <i>Technical Reference Manual</i> , State of Pennsylvania, June 2013, pages 45–48.
	State of Illinois, <i>Illinois Statewide Technical Reference Manual for Energy Efficiency, version 3.0</i> , February 24, 2014, 675 p.
	The Cadmus Group, Inc. <i>Focus on Energy Evaluated Deemed Savings Changes for the Public Service Commission of Wisconsin</i> , November 26, 2013, available at < https://focusonenergy.com/sites/default/files/FOC_XC_Deemed_WriteUp_12122013%20(2).pdf > (Last accessed September 24, 2014)
Rental Properties and Condos Service	ADS ASSOCIÉS, <i>Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale</i> , report presented to Hydro-Québec, 1992.
	Aquacraft, Inc. Water Engineering and Management, <i>Residential Indoor Water Conservation Study</i> , July 2003.
	Canadian Building Energy End-Use Data & Analysis Centre, <i>Domestic Water Heating and Water Heater Energy Consumption in Canada</i> , April 2005, page 29.
	Econoler, <i>Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel</i> , report presented to Hydro-Québec", Québec, March 30, 2011.
	Natural Resources Canada. <i>Water Heaters: Energy Consideration</i> , Office of Energy Efficiency. < http://oee.nrcan.gc.ca/equipment/heating/514#reducStanbdy > (Last accessed November 26, 2013).
	Pennsylvania Public Utility Commission, <i>Technical Reference Manual</i> , State of Pennsylvania, June 2013, page 45.
	Statistics Canada (CANSIM), <i>Households having air conditioning</i> , Nova Scotia, 2009.
LED Holiday Light Exchange	BC Hydro, <i>Make Your Holiday Season Bright and Energy Efficient!</i> , available at : < https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/Power_Smart_FACT_sheet_s/FACTS_Holiday_Lighting.pdf > (Last accessed January 14, 2015).
	California Municipal Utilities Association, <i>Energy Efficiency Technical Reference Manual and TRM205_LED-holiday-lights-spreadsheet</i> , available at < http://cmua.org/energy-efficiency-technical-reference-manual > (Last accessed January 14, 2015)
	Nova Scotia Power, Open access same time information system, <i>Hourly Total Net Nova Scotia Load</i> , available at < http://oasis.nspower.ca/en/home/oasis/monthly-reports/hourly-total-net-nova-scotia-load.aspx > (Last accessed January 14, 2015).
	Ontario Power Authority, <i>2010 Prescriptive Measures and Assumptions and 2014 Prescriptive Measures and Assumptions</i> , available at < http://www.powerauthority.on.ca/opa-conservation/conservation-information-hub/evaluation-measurement-verification/measures-assumptions-lists > (Last accessed January 14, 2015).
	Pacific Gas and Electric Company, <i>A Better Way to Light Up the Holidays</i> , available at < http://www.pge.com/myhome/saveenergymoney/savingstips/seasonaltips/winter/led/index.shtml >, (Last accessed January 14, 2015).

LED Holiday Light Exchange (Continued)	Pennsylvania Public Utility Commission, <i>Technical Reference Manual</i> , available at < http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/technical_reference_manual.aspx > (Last accessed January 14, 2015).
	Sampson Research, <i>Market & Impact Evaluation of BC Hydro's Seasonal LED Initiative - Executive Summary</i> , available at < www.bchydro.com/content/dam/hydro/medialib/internet/documents/info/pdf/rates_regulation_post_decision_filings_directive_66.pdf > (Last accessed January 14, 2015).
	The University of Maine, <i>LED Alternatives Offer Efficient Holiday Lighting</i> , available at < http://umaine.edu/ext-energy/blog/2010/11/29/led-alternatives-offer-efficient-holiday-lighting >, (Last accessed January 19, 2015).
	U.S. Department of Energy, LED Products, Energy Savers, available at < http://energy.gov/energysaver/articles/led-lighting > (Last accessed January 14, 2015).
Business Energy Rebates	ADS ASSOCIÉS, <i>Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – secteur commercial</i> , report presented to Hydro-Québec, 1992.
	AHRI. ANSI/AHRI Standard 210/240, <i>2008 Standard for Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment</i> .
	Erik Page and Associates, Inc., <i>A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings</i> , Energy Analysis Department, Lawrence Berkeley National Laboratory, September 2011.
	Natural Resources Canada, <i>Fluorescent Lamp Ballasts Energy Efficiency Regulations</i> , updated March 21, 2014, available at < http://www.nrcan.gc.ca/energy/regulations-codes-standards/products/6897 > (Last accessed January 21, 2015)
	Tecmarket Works, <i>New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs</i> , Prepared for New York Department of Public Service, October 2010.
	Nova Scotia Power, <i>Domestic Service Time-Of-Day Tariff</i> , available at: < http://www.nspower.ca/en/home/aboutnspi/ratesandregulations/electricityrates/domesticservicetimeofdaytariffoptional.aspx > (Last accessed January, 2015)
	Pennsylvania Public Utility Commission, <i>Technical Reference Manual</i> , State of Pennsylvania, June 2014.
	Efficiency Vermont, <i>Technical Reference User Manual (TRM) - Measure Savings Algorithms and Cost Assumptions</i> , August 9, 2013.
Business Energy Solutions	ADS ASSOCIÉS, <i>Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – secteur commercial</i> , report presented to Hydro-Québec, 1992.
	Air Conditioning, Heating, and Refrigeration Institute, <i>2008 Standard for Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump</i> , March 2012.
	Econoler, <i>Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel</i> , report presented to Hydro-Québec, Québec, March 30, 2011.
	Efficiency Vermont, <i>Technical Reference User Manual (TRM) – Measure Savings Algorithms and Cost Assumptions</i> , September 20, 2011.
	OSRAM, <i>SubstiTUBE IS LED T8</i> , available at: < https://assets.sylvania.com/assets/Documents/LED417.ac8824e1-3f0b-4310-9fc2-34d64766e5e8.pdf > (Last accessed November, 2014)
	Philips Lighting, <i>Philips InstantFit LED T8 Lamps</i> , available at < http://www.usa.lighting.philips.com/lightcommunity/trends/tled/assets/PLT-1309BN_LED_T8_InstantFit_bulletin_10.14_Web.pdf >, 2014. > (Last accessed November, 2014)
	US Department of Energy, <i>Chapter 3 – Market and Technology Assessment</i> , page 41, 2001.
	Veritec Consulting Inc., <i>City of Calgary Pre-Rinse Spray Valve Pilot Study: Final Report</i> , December 2005, Mississauga, Ontario.
	Veritec Consulting Inc., <i>Region of Waterloo Pre-Rinse Spray Valve Pilot Study: Final Report</i> , January 2005, Mississauga, Ontario.

APPENDIX II NTGR CALCULATIONS

This appendix presents some examples of how the Evaluator has made the calculations to establish the free-ridership, internal spillover and net-to-gross ratio values in the 2014 evaluation. To demonstrate how to apply the algorithm for calculating these values, this appendix looks at some examples from the Custom Retrofit and Residential Direct Install program components. The Evaluator has used a similar approach to assessing the free-ridership, internal spillover and net-to-gross ratio of other program components. More details can be found in the evaluation reports of the individual program components.

Custom Retrofit							
Free-ridership algorithm		Low free-ridership participant		High free-ridership participant		Average free-ridership participant	
Questions	Calculation Algorithm	Answer	Calculation Result	Answer	Calculation Result	Answer	Calculation Result
Has the participant be pre-screened for free-ridership prior to participation? (1=yes, 2=no)		1	-	1	-	1	-
FR2a. If your company had not participated in Custom, what is the likelihood that you would have implemented exactly the same energy efficiency measures that you implemented through the program? (Scale 0 to 10)	FR2a = Answer x 10%	0	0%	9	90%	10	100%
FR2b. If your company had not participated in Custom, what is the likelihood that you would have installed standard equipment instead of energy-efficient equipment? (Scale 0 to 10)	FR2b = (10 – Answer) x 10%	5	50%	5	50%	3	70%
PA1 Score	MEAN VALUE OF: (FR2a ; FR2b) IF PRE-SCREENING: 0%	-	0%	-	0%		0%
FR1. Before participating in Custom, did your company have plans to implement the specific energy efficiency measures that were implemented through the program?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%	2	0%	1	100%	2	0%
FR1a. I just want to make sure - Before you decided to participate in Custom, you had already made the decision to implement the energy efficiency measures you implemented through the program? [ASK IF FR1=2]	IF 1. Yes: FR1a = 100% IF 2. No OR 99 : FR1 = 0%	-	-	1	100%	-	-
FR3. If your company had not received the financial incentives and/or on-bill financing from ENSC, would you have paid and/or financed the full cost of the project you implemented? (Scale 0 to 10)	FR3 = Answer x 10%	3	30%	10	100%	0	0%
PA2 Score	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3 IF PRE-SCREENING: 0%	-	0%	-	0%	-	0%
FR4. Level of influence (Scale 0 to 10)	FR4_P = SUM(a; b; c; d; e; h)	-	36	-	15	-	38
	FR4_NP = SUM(f; g)		10	-	13	-	18
Factor a. The program financial incentives and/or on-bill financing		8	-	1	-	10	-
Factor b. The recommendations and technical assistance provided by the program when your company		9	-	0	-	10	-
Factor c. The technical assistance offered by the program during the project implementation and the Measurement & Verification process		6	-	0	-	10	-
Factor d. [ASK IF, IN DATABASE, SCOPING STUDY OR FEASIBILITY STUDY=YES] The funded Scoping Study and/or the Feasibility Study		0	-	0	-	0	-
Factor e. Your company or organization's corporate policy or guidelines regarding the purchase of equipment		6	-	6	-	8	-
Factor f. The standard practice in your industry		5	-	8	-	10	-
Factor g. The existing energy efficiency code		5	-	5	-	8	-
Factor h. Previous experience with the Custom Program or a similar program either from Efficiency Nova Scotia or Nova Scotia Power		7	-	8	-	0	-

Free-ridership algorithm		Low free-ridership participant		High free-ridership participant		Average free-ridership participant	
Questions	Calculation Algorithm	Answer	Calculation Result	Answer	Calculation Result	Answer	Calculation Result
PA3 Score	100% - [FR4_P/(FR4_P+FR4_NP)]	-	22%	-	46%		32%
FR2c. If your company had not participated in Custom, what is the likelihood that you would have implemented the energy efficiency measures but at a later date? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2dd Otherwise: PA4 = EMPTY	5	-	6	-	5	-
FR2dd. Approximately how many months later would you have implemented the measures? [ASK IF FR2C>5] 1. Less than 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later?	IF 1. : FR2dd = 100% IF 2. : FR2dd = 50% IF 3. : FR2dd = 25% IF 4. : FR2dd = 0% IF 5. : FR2dd = 0% IF 6. : FR2dd = 0% IF 7. : FR2dd = 0%	-		1	100%	-	
PA4 Score	FR2dd				100%		
Final Free-ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)		7%		37%		11%
Inconsistency Test #1 : Revised PA1 Score [ONLY USED IF NO PRE-SCREENING. IF PRE-SCREENING, THEN USE ORIGINAL PA1 VALUE]	IF ABS(FR2a – FR2b) ≥ 30%: PA1 = MIN OF (FR2a ; FR2b)		0%		0%		0%
Inconsistency Test #2 : Revised PA2 Score [ONLY USED IF NO PRE-SCREENING. IF PRE-SCREENING, THEN USE ORIGINAL PA2 VALUE]	IF FR3 ≥ 70% AND IF (FR2a OR FR2b < 70%: PA2 = EMPTY		0%		0%		0%
Revised Free-ridership	MEAN VALUE OF: (Revised PA1 ; Revised PA2 ; PA3 ; PA4)		7%		37%		11%

Overall free-ridership level (%) for the program component

$$FR_{total} = \frac{\sum_{i=1}^n (FR_i \times Gross\_Savings_i)}{\sum_{i=1}^n Gross\_Savings_i}$$

Where n represents the number of participants surveyed

FR_{total}= 10%

Spillover Algorithm

		Example participant (none with spillover this)	
Questions	Calculation Algorithm	Answer	Calculation Result
SO1. Since the time that you participated in Custom Retrofit, have you implemented one or more additional energy efficiency measures on your own?	IF 1. Yes: CONTINUE IF 2. No OR 99 : END	1	-
SO2. For the energy efficiency measures that you implemented on your own after participating in Custom Retrofit, did you receive or plan on requesting financing or rebates from other ENSC programs?	IF 2. No: CONTINUE IF 1. Yes OR 99 : END	2	
SO3. Which measures have you implemented on your own after participating in Custom Retrofit?	SO2 = SUM of kWh associated with each upgrade	Only non-electrical savings	0%
SO4. How influential was your experience with Custom Retrofit on your decision to implement the measures that you installed on your own after participating in the program? (Scale 0 to 10)	SO4 = Answer x 10%		0%
Spillover Savings	SO2 x SO4	-	0%

Overall spillover level (%) for the program component

$$SO_{total} = \frac{\sum_{i=1}^n SO\_Savings_i}{\sum_{i=1}^n Gross\_Savings_i}$$

Where n represents the number of participants surveyed

SO_{total}= 0%

NTGR calculation

$$NTGR = 1 - FR_{total} + SO_{total}$$

NTGR= 90%

Residential Direct Install		Low free-ridership participant		High free-ridership participant		Average free-ridership participant	
Free-ridership algorithm		Low free-ridership participant		High free-ridership participant		Average free-ridership participant	
Questions	Calculation Algorithm	Answer	Calculation Result	Answer	Calculation Result	Answer	Calculation Result
Measure 1		CFL		LED lamp		CFL	
FR2a. If you had not participated in RDI, what is the likelihood that you would have installed the same energy-efficient products that you installed through RDI? (Scale 0 to 10)	FR2a = Answer x 10%	0	0%	8	80%	8	80%
PA1 Score	FR2a	-	0%	-	80%	-	80%
FR1. Did you or anyone in your household have specific plans to purchase and install the energy-efficient products prior to talking with anyone about RDI?	IF 1. Yes: Use FR1a IF 2. No OR 98/99 : FR1 = 0%	98	0%	1	100%	1	100%
FR1a. I just want to make sure I understand - Before you decided to participate in RDI, you had already made the decision to purchase and install the energy-efficient products? [ASK IF FR1 =1]	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%	-	-	1	100%	1	100%
FR3. If ENSC had not installed energy-efficient products for free, would you have paid for the full cost of the products? (Scale 0 to 10)	FR3 = Answer x 10%	1	10%	7	70%	2	20%
PA2 Score	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3	-	5%	-	70%	-	20%
FR4. Level of influence (Scale 0 to 10) Factors a, b and c = Program factors	FR4_P = Max(a; b; c)	-	10	-	10	-	8
Factor a. The free installation of energy-efficient products offered by the program	-	10	-	10	-	8	-
Factor b. The information or advice provided by the program advisor during the installation	-	8	-	8	-	5	-
Factor c. Previous experience with a similar program either from Efficiency Nova Scotia or Nova Scotia Power	-	5	-	9	-	5	-
PA3 Score	(10 – FR4_P) x 10%	-	0%	-	0%	-	20%
FR2c. If you had not participated in the program, what is the likelihood that you would have installed the energy-efficient products but at a later date? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2d Otherwise: PA4 = EMPTY	10	-	8	-	8	-
FR2d. Approximately how many months later would you have implemented the measures? [ASK IF FR2C>5] 1. Less than 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later?	IF 1. : FR2dd = 100% IF 2. : FR2dd = 50% IF 3. : FR2dd = 25% IF 4. : FR2dd = 0% IF 5. : FR2dd = 0% IF 6. : FR2dd = 0% IF 7. : FR2dd = 0% IF 9. : FR2dd = 0%	4	0%	1	100%	3	25%
PA4 Score	FR2d	-	0%	-	100%	-	25%
Measure 1 Final Free-ridership	MEAN VALUE OF : (PA1 ; PA2 ; PA3 ; PA4)	-	1%	-	63%	-	36%
Inconsistency Test - Revised PA1 value	IF FR3 ≤ 70% AND IF FR2a > 70%: PA1 = EMPTY	-	0%	-	-	-	-
Measure 1 Revised Free-ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)	-	1%	-	57%	-	22%

Measure 2		Low-flow Showerhead		No Second Measure		Faucet Aerator	
FR2a. If you had not participated in RDI, what is the likelihood that you would have installed the same energy-efficient products that you installed through RDI? (Scale 0 to 10)	FR2a = Answer x 10%	0	0%	-	-	8	80%
PA1 Score	FR2a	-	0%	-	-	-	80%
FR1. Did you or anyone in your household have specific plans to purchase and install the energy-efficient products prior to talking with anyone about RDI?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%	2	0%	-	-	2	0%
FR1a. I just want to make sure I understand - Before you decided to participate in RDI, you had already made the decision to purchase and install	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%	-	-	-	-	-	-
FR3. If ENSC had not installed energy-efficient products for free, would you have paid for the full cost of the products? (Scale 0 to 10)	FR3 = Answer x 10%	1	10%	-	-	1	10%
PA2 Score	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3	-	5%	-	-	-	5%
FR4. Level of influence (Scale 0 to 10) Factors a, b and c = Program factors [DO NOT ASK TWICE, USE SAME ANSWERS FOR BOTH MEASURES]	FR4_P = Max(a; b; c)	-	10	-	-	-	8
Factor a. The free installation of energy-efficient products offered by the program		10	-	-	-	8	-
Factor b. The information or advice provided by the program advisor during the installation		8	-	-	-	5	-
Factor c. Previous experience with a similar program either from Efficiency Nova Scotia or Nova Scotia Power		5	-	-	-	5	-
PA3 Score	(10 – FR4_P) x 10%	-	0%	-	-	-	20%
FR2c. If you had not participated in the program, what is the likelihood that you would have installed the energy-efficient products but at a later date? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2d Otherwise: PA4 = EMPTY	0	-	-	-	8	-
FR2d. Approximately how many months later would you have implemented the measures? [ASK IF FR2C>5] 1. Less than 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later?	IF 1. : FR2dd = 100% IF 2. : FR2dd = 50% IF 3. : FR2dd = 25% IF 4. : FR2dd = 0% IF 5. : FR2dd = 0% IF 6. : FR2dd = 0% IF 7. : FR2dd = 0% IF 9. : FR2dd = 0%	-	-	-	-	6	0%
PA4 Score	FR2d	-	-	-	-	-	0%
Measure 2 Final Free-ridership	MEAN VALUE OF : (PA1 ; PA2 ; PA3 ; PA4)	-	2%	-	-	-	26%
Inconsistency Test - Revised PA1 value	IF FR3 ≤ 70% AND IF FR2a > 70%: PA1 = EMPTY	-	0%	-	-	-	-
Measure 2 Revised Free-ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)	-	2%	-	-	-	8%
Total Average Free-ridership	MEAN VALUE OF (FR_MEASURE1;FR_MEASURE2)	-	1%	-	57%	-	15%

Overall free-ridership level (%) for the program component

$$FR_{total} = \frac{\sum_{i=1}^n (FR_i \times Gross\_Savings_i)}{\sum_{i=1}^n Gross\_Savings_i}$$

Where n represents the number of participants surveyed

$$FR_{total} = 15\%$$

Spillover Algorithm

Spillover Algorithm		Example Participant	
		Answer	Calculation Result
SO1. Since the time that you participated in RDI, have you installed any additional energy-efficient products or retired any old appliances on your own?	IF 1. Yes: CONTINUE IF 2. No OR 99 : END	1	-
SO2. I just want to make sure I understand - After you participated in the RDI program, you installed additional energy-efficient products or retired old appliances on your own. Is that correct?	IF 1. Yes: CONTINUE IF 2. No OR 99 : END	1	-
SO3. Have you benefited from any other financing or rebates from any other Efficiency Nova Scotia programs for these additional energy-efficient products or retirement of appliances?	IF 2. No: CONTINUE IF 1. Yes OR 99 : END	2	-
SO4. Which additional energy-efficient products or retired old appliances have you installed on your own after participating in RDI?	SO4 = SUM (kWh associated with each upgrade)	Energy efficient refrigerator	171
SO5. How influential was your experience with RDI on your decision to install these additional energy-efficient products or retire these appliances on your own? (Scale 0 to 10)	SO5 = Answer x 10%	5	50%
Spillover Savings	SO4 x SO5	-	86

171 refrigerator calculated in Instant Savings

Overall spillover level (%) for the program component

$$SO_{total} = \frac{\sum_{i=1}^n SO\_Savings_i}{\sum_{i=1}^n Gross\_Savings_i}$$

Where n represents the number of participants surveyed

$$SO_{total} = 6\%$$

NTGR calculation

$$NTGR = 1 - FR_{total} + SO_{total}$$

$$NTGR = 91\%$$

*Note: For RDI, the NTGR is calculated only for non-low-income participants, and then a weighted average is calculated to take into account low-income participants, whose NTGR is estimated to be 1.



ECONOLER



APPLIANCE RETIREMENT

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

ARet	Appliance Retirement
CATI	Computer-assisted Telephone Interviewing
CRA	Corporate Research Associates
DA	Delivery Agent
EER	Energy Efficiency Ratio
ENSC	Efficiency Nova Scotia Corporation
NTGR	Net-to-Gross Ratio
UMP	Uniform Methods Project

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Induced consumption	Energy consumption of appliances that would have been unplugged and not replaced by the participants in the absence of the program.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.

Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Secondary market impacts	Energy consumption of appliances that would have been transferred to the secondary market in the absence of the program.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VII
1 PROGRAM DESCRIPTION.....	1
2 METHODOLOGY	2
2.1 Presentation of the Team.....	2
2.2 Methodology Description	2
3 VALIDATED SAVINGS	4
3.1 Refrigerators.....	4
3.1.1 Gross Unitary Savings	4
3.1.2 Distortion Effects.....	8
3.1.3 Net Unitary Savings	11
3.2 Freezers	13
3.2.1 Gross Unitary Savings	13
3.2.2 Distortion Effects.....	15
3.2.3 Net Unitary Savings	16
3.3 Room Air Conditioners	18
3.3.1 Gross Unitary Savings	18
3.3.2 Distortion Effects.....	19
3.3.3 Net Unitary Savings	20
3.4 Demand-to-Energy Ratio	22
3.5 Overall Gross Savings	22
3.6 Validated Savings for Appliance Replacement Pilot Projects.....	22
3.7 Internal Spillover	23
3.8 NTGR Calculation.....	24
3.9 Interactive Effects	25
3.10 Overall Net Savings.....	26
APPENDIX I PARTICIPANT SURVEY QUESTIONNAIRE.....	27
APPENDIX II PARTICIPANT SURVEY RESULTS.....	43
APPENDIX III ALGORITHM FOR FREE-RIDERSHIP CALCULATION	53
APPENDIX IV INTERNAL SPILLOVER METHODOLOGY	54

LIST OF TABLES

Table 1: Validated Gross and Net Savings at the Generator	viii
Table 2: Survey Sample Size and Margin of Error.....	3
Table 3: Average Metered Annual Consumption for Retired Refrigerators	5
Table 4: Assignment of Energy Consumption Level for Each Replacement Appliance Category	6
Table 5: Average Annual Energy Consumption per Replacement Refrigerator Category	6
Table 6: Average Annual Consumption for Refrigerator Replacement	7
Table 7: Calculation of Part-use Factors for Refrigerators.....	7
Table 8: Likely Use of Refrigerators and Corresponding Part-use Factors	8
Table 9: Final Energy Consumption Values for Refrigerators	8
Table 10: Scenarios for Discarding and Proportions of Refrigerators	9
Table 11: Proportions of Secondary Market Impacts for Refrigerators	9
Table 12: Proportions of Refrigerators for Induced Consumption	10
Table 13: Savings Value per Refrigerator Unit	12
Table 14: Average Metered Annual Consumption for Retired Freezers.....	13
Table 15: Average Annual Energy Consumption per Replacement Freezer Category	14
Table 16: Average Annual Consumption for Freezer Replacement	14
Table 17: Calculation of Part-Use Factors for Freezers.....	15
Table 18: Final Energy Consumption Values for Freezers	15
Table 19: Scenarios of Discarding and Proportions for Freezers.....	15
Table 20: Proportions of Secondary Market Impacts for Freezers.....	16
Table 21: Proportions of Induced Consumption for Freezers	16
Table 22: Savings per Freezer	17
Table 23: Scenarios of Discarding and Proportions for Room Air Conditioners	19
Table 24: Proportions of Secondary Market Impacts for Room Air Conditioners	20
Table 25: Proportions of Induced Consumption for Room Air Conditioners	20
Table 26: Savings per Room Air-conditioning Unit	21
Table 27: Validated Gross Energy and Peak Demand Savings.....	22
Table 28: Appliance Replacement Pilot Project Gross Savings.....	23
Table 29: Distortion Effects and Equivalent NTGR.....	25
Table 30: Validated Net Energy and Peak Demand Savings.....	26

LIST OF FIGURES

Figure 1: Logic Model of the UMP for Net Savings Calculation	4

EXECUTIVE SUMMARY

In 2014, the evaluation of Appliance Retirement (ARet) involved substantiating the tracked savings of Efficiency Nova Scotia Corporation (ENSC) with the parameters established in the 2013 evaluation, as well as the reassessment of specific key parameters. This report presents the validated gross and net savings for the year 2014.

Program Component Overview

ARet promotes the retirement of old household appliances, such as refrigerators, freezers and room air conditioners.

ARet encourages Nova Scotians to retire their old appliances by educating them on the cost of maintaining the appliance, while providing a cash incentive and offering a free pick-up service. The appliances retired through ARet are shipped to a local recycling depot, where over 95 percent of the constituent materials are recycled.

The following incentives are offered through ARet:

- › Refrigerators: \$30
- › Freezers: \$30
- › Air-conditioners: \$10

Key Findings

Econoler reviewed the content of the 2014 ARet tracking system. A total of 7,408 appliances were retired in 2014, including 4,745 refrigerators, 2,540 freezers and 123 air-conditioners.

As for the 2013 evaluation, the Evaluator applied the Uniform Methods Project (UMP) methodology to estimate the savings generated through ARet in 2014.

To calculate the consumption of retired appliances, the Evaluator used the results of the 2014 metering activity as well as the information obtained from the tracking sheet on the capacity of retired units. The consumption of retired appliances is equivalent to the gross savings and incorporates the part-use factor.

Four distortion effects were taken into consideration as part of this evaluation: free-ridership, secondary market impacts, induced consumption and internal spillover. Free-ridership, secondary market impacts and induced consumption were used to calculate the per-unit energy savings value, while spillover was rather evaluated on a global basis, as a percentage of ARet's total gross savings and was added to the program's global savings.

Because the UMP methodology was applied, no percentages of free-ridership, secondary market impacts and induced consumption were calculated. However, these effects plus spillover were transposed to an equivalent net-to-gross ratio (NTGR) of 0.60, 0.58 and 0.55 for refrigerators, freezers and air-conditioners respectively.

In 2014, ARet generated net energy savings of 3.841 GWh and peak demand savings of 0.611 MW, as shown in the table below.

Table 1: Validated Gross and Net Savings at the Generator

	Initial Gross Savings	Gross Savings with Interactive Effects	NTGR_{equiv}	Net Savings
Energy Savings	6.453 GWh	6.453 GWh	0.60	3.841 GWh
Peak Demand Savings	1.026 MW	1.026 MW	0.60	0.611 MW

Additionally, two appliance replacement pilot projects were conducted in institutional facilities. Savings for those projects were calculated separately from the rest of the ARet program. The results from the 2014 metering activity were adapted, based on the characteristics of the retired appliances, to estimate the energy consumption of those appliances. The energy consumption of replacement appliances was taken from their EnerGuide label. Both projects contributed to an additional 0.100 GWh and 0.016 MW in energy and peak demand savings to ARet, which bring ARet total savings to 3.941 GWh and 0.627 MW.

1 PROGRAM DESCRIPTION

Efficiency Nova Scotia Corporation (ENSC) promotes the retirement of household appliances, such as refrigerators, freezers and room air conditioners. Designed to sway Nova Scotians into retiring their old appliances, Appliance Retirement (ARet) educates them on the cost of maintaining old appliances, provides free pickup from their homes (not from the side of road) and provides a cash incentive.

In addition to removing old appliances from the premises, ARet also recycles these appliances by shipping them to a local recycling depot, where over 95 percent of the constituent materials are recycled. To have their appliances picked up, participants must register with an external call centre or register on the ENSC website. ARCA Canada is responsible for appliance transportation and recycling, while Answer 365 operates the call centre responsible for booking pickup appointments using a system called Enerpath.

Eligible appliances must be plugged in, in working order and older than 10 years. In addition, refrigerators need to be of standard size—between 10 and 25 cubic feet. To save on fuel and ensure that the trip is worthwhile for the pickup team, room air conditioners are only picked up together with the retirement of a refrigerator or freezer. To participate in ARet, customers must own the appliance they wish to retire.

The following rebates¹ are offered through ARet:

- › Refrigerators: \$30
- › Freezers: \$30
- › Air-conditioners: \$10

ARet aimed to achieve net electricity savings of 4.1 GWh and peak demand savings of 0.7 MW for 2014. Savings generated by ARet are reported under the Residential Efficient Product Rebates.

¹ Participants who registered before May 16, 2014 could choose between the cash rebate or Air Miles (100 Air Miles for refrigerators or freezers, and 25 Air Miles for air conditioners), whereas participants who registered after May 16, 2014 could no longer choose Air Miles and automatically received the cash rebate.

2 METHODOLOGY

This section presents the Econoler team involved in this evaluation and reports on the methodology used to evaluate ARet.

2.1 Presentation of the Team

To carry out the 2014 evaluation, Econoler worked together with Corporate Research Associates (CRA). Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all the deliverables.
- › CRA performed the telephone survey with participants.

2.2 Methodology Description

In 2014, a full-scale evaluation of ARet was not carried out. The evaluation of ARet involved substantiating ENSC's tracked savings with the parameters established in the 2013 evaluation, and re-evaluating the following specific key parameters:

- › annual energy consumption value of the retired appliances
- › free-ridership
- › secondary market impacts
- › induced consumption
- › spillover

Since 2013, the ARet evaluation complies with the general guidelines of the Uniform Methods Project (UMP).

Similar to the past evaluations, ENSC conducted a metering activity to measure the annual energy consumption of the retired refrigerators and freezers. The metering data were used to update the average energy consumption value of the retired refrigerators and freezers. For room air conditioners, the average energy consumption value established during the 2013 evaluation with the most recently published literature was used.

A survey with a total of 204 participants was also conducted by CRA staff. The interviews were conducted in September and October 2014 using a computer-assisted telephone interviewing (CATI) technology. The average length of the survey was 10 minutes.

The participant survey was meant to go over key parameters of the impact evaluation, such as distortion effects. The survey questionnaire also included questions regarding the satisfaction of participants with the program and ENSC.

The survey questionnaire and results are presented in Appendices I and II respectively. The table below shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 telephone surveys.

Table 2: Survey Sample Size and Margin of Error

	2012			2013			2014		
	Population	Sample Size (n)	Margin of Error at 90% Confidence Level	Population	Sample Size (n)	Margin of Error at 90% Confidence Level	Population	Sample Size (n)	Margin of Error at 90% Confidence Level
Refrigerators	4,788	80	+9.1%	4,593	92	+8.5%	4,399	93	+8.4%
Freezers	2,630	81	+9.1%	2,384	94	+8.3%	2,433	98	+8.1%
Air conditioners	121	40	+10.8%	101	15	+19.7%	89	13	+21.1%
Total²	7,008	201	+5.7%	6,654	201	+5.7%	6,463	204	+5.7%

The margin of error is used to determine the level of precision³ of the measurement, and its associated confidence level indicates the probability that a measure will fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or bias such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

² It should be noted that the categories of household appliances were not mutually exclusive. As a result, the total number of participants in the appliance groups did not equal the total number of participants (in terms of both population and sampling).

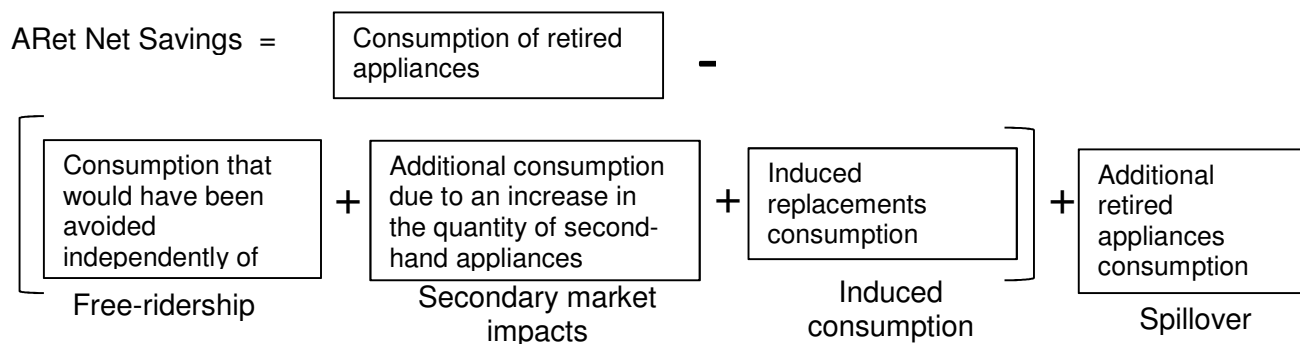
³ Precision refers to how close the measured values are to each other. It does not, however, take into consideration how close the measured value is to the true value, which refers to accuracy.

3 VALIDATED SAVINGS

This section presents the gross and net savings for ARet in 2014. To do so, the savings calculation methodology developed for the 2013 evaluation to comply with the general guidelines of the UMP for refrigerator recycling evaluation⁴ was used.

The logic model of the UMP method is summarized in the figure below.

Figure 1: Logic Model of the UMP for Net Savings Calculation



The consumption of retired appliances is equivalent to the gross savings and incorporates the part-use factor, while free-ridership, secondary market impacts and induced consumption are used to calculate the per-unit energy savings value. Spillover is not evaluated on a per unit basis and is added to the program's global savings for each appliance.

3.1 Refrigerators

This section presents the calculation for evaluating the unitary savings of the refrigerators retired in 2014.

3.1.1 Gross Unitary Savings

For all refrigerators retired in 2014, ENSC uses a gross unitary savings value of 932 kWh per year, which corresponds to the average energy consumption value of retired refrigerators established during the 2013 impact evaluation, using the same approach as in the current report.

The Econoler team revised the gross unitary savings value tracked by ENSC by updating the following key parameters based on the 2014 metering activity and participant survey results:

⁴ NREL, *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures. Chapter 7: Refrigerator Recycling Evaluation Protocol*, Prepared by the Camus Group, April 2013, available at: <http://www1.eere.energy.gov/wip/pdfs/53827-7.pdf> (Last accessed February 10, 2015)

- › average energy consumption of retired refrigerators based on the 2014 metering activity;
- › proportion of each type of replacement refrigerators used to calculate the average energy consumption of replacement refrigerators;
- › part-use factors.

Average Energy Consumption of Retired Refrigerators

The Evaluator revised the annual energy consumption value of the retired refrigerators using the data from the 2014 metering activity. Reliable data for a total of 68 refrigerators was used for this calculation.

In order to provide a more accurate estimate for the representative sample of the retired refrigerators, a number of factors were accounted for during the analysis. Different strata were segregated for the most common age categories. The average annual energy consumption per cubic foot was calculated for each age category in addition to the proportion that each age category represented in the 2014 tracking sheet. The details of the analysis are presented in the table below.

Table 3: Average Metered Annual Consumption for Retired Refrigerators

Refrigerator Age	Average Annual Consumption per Cubic Foot (based on metering data)	Proportion of Refrigerators in the 2014 Tracking Sheet
10 to 19 Years Old	41.2 kWh/cu. ft	58%
20 to 24 Years Old	49.1 kWh/cu. ft	22%
25 Years and Older	76.4 kWh/cu. ft	20%
Average Annual Consumption	50.0 kWh/cu. ft.	

The average consumption values for each age category were weighted against the proportion represented in the 2014 tracking sheet to establish an average consumption value of 50.0 kWh per cubic foot.

The average size of the retired refrigerators in 2014 is 16 cubic feet. This average is based on the weighted sizes documented in the 2014 tracking sheet. Therefore, the Econoler team calculated the average annual consumption as follows:

$$\text{Average Annual Consumption of Retired Refrigerators} = 50 \frac{\text{kWh}}{\text{cu. ft.}} \times 16 \text{ cu. ft.} = 800 \text{ kWh}$$

Based on the metering protocol of the New York Department of Public Service, an occupant adjustment factor of 1.12 was applied to the annual energy consumption value stated above. This occupant adjustment factor was used in the 2013 impact evaluation and allows to compensate for the difference between metering conditions and actual usage conditions in a residential setting with

respect to refrigerator door openings, since the energy consumption of an appliance increases with the number of door openings.

This results in an average annual consumption value of 896 kWh per year.

Average Energy Consumption of Replacement Refrigerators

The average annual energy consumption of replacement refrigerators is used to take into account the effects of the secondary market and induced consumption. To do so, refrigerators were divided into new and used categories, as well as high and standard efficiencies. Three different annual energy consumption levels were attributed to these categories, as shown in the table below. Based on the UMP methodology, it was assumed that the new high-efficiency refrigerators had a consumption level equivalent to that of refrigerators meeting the ENERGY STAR requirements, and that the new standard-efficiency refrigerators consumed about the same amount of energy as used high-efficiency refrigerators.

Table 4: Assignment of Energy Consumption Level for Each Replacement Appliance Category

Replacement Appliance Category	High Efficiency	Standard Efficiency
New	New - ENERGY STAR	New - Standard
Used	New - Standard	Used - Standard

The energy consumption established in the 2013 evaluation report for the new ENERGY STAR and New – Standard levels were applied for this year’s evaluation. They were obtained from a literature review and results from other programs. As for the Used – Standard level, as it was the case last year, the energy consumption of retired refrigerators aged between 10 and 19 years was used.

Table 5: Average Annual Energy Consumption per Replacement Refrigerator Category⁵

Replacement Appliance Category	High Efficiency	Standard Efficiency
New	408 kWh/year	587 kWh/year
Used	587 kWh/year	738 kWh/year

⁵ From the ARet 2013 DSM Evaluation Report.

The 2014 participant survey was used to establish which types of refrigerators were used to replace retired ones (new or used, high or standard efficiency). Answers from participants were used to establish the average annual energy consumption value of replacement refrigerators at 450 kWh per year, as shown in the following table.

Table 6: Average Annual Consumption for Refrigerator Replacement

Type of replacement	Annual Energy Consumption	Proportion
New High-efficiency Refrigerator	408 kWh/year	79%
Used High-efficiency Refrigerator	587 kWh/year	15%
New Standard-efficiency Refrigerator	587 kWh/year	3%
Used Standard-efficiency Refrigerator	738 kWh/year	9%
Average Annual Consumption	450 kWh/year	

Part-use Factors

Part-use factors serve to adjust the savings calculations to account for the fact that not all refrigerators are plugged in year-round. Secondary refrigerators or primary refrigerators that are in a secondary residence are likely to be unplugged for a portion of the year and, since they were eligible for the program, they were considered in the calculation of a global part-use factor.

The 2014 participant survey was used to estimate the amount of time during which participants had their refrigerators plugged in year round prior to retirement. To do so, the Evaluator used the number of months during which the refrigerator was in use in the past year, as per the participant's declaration, and established a ratio. The following table displays the results, divided into four levels of use.

Table 7: Calculation of Part-use Factors for Refrigerators

	Primary		Secondary		Overall	
Proportion	65%		35%		100%	
	Proportion	Part-Use Factor	Proportion	Part-Use Factor	Proportion	Part-Use Factor
Not in use	2%	0.00	6%	0.00	3%	-
Used part-time	7%	0.63	18%	0.36	11%	-
Used full-time	91%	1.00	76%	1.00	86%	-
Total	100%	0.95	100%	0.83	100%	0.91

Then, the possible use of unrecycled refrigerators was considered when establishing a weighted average of ARet's part-use factor.

Table 8: Likely Use of Refrigerators and Corresponding Part-use Factors

Use Prior to Recycling	Likely Use Independently of Recycling	Part-use Factor	Proportion
Primary	Kept (as primary unit)	0.95	2%
	Kept (as secondary unit)	0.83	20%
	Discarded	0.91	42%
Secondary	Kept	0.83	13%
	Discarded	0.91	23%
Overall		0.88	100%

This part-use factor of 0.88 is multiplied by the measured energy consumption value of refrigerators (896 kWh/year). The annual consumption value of retired refrigerators was thus established at 788 kWh. The same calculation was done for replacement refrigerators, for which the annual energy consumption level was established at 396 kWh.

Table 9: Final Energy Consumption Values for Refrigerators

	Measured Consumption (kWh/year)	Part-use Factor	Final Consumption (kWh/year)
Retired Refrigerator	896	0.88	788
Replacement Refrigerator	450	0.88	396

3.1.2 Distortion Effects

The three distortion effects considered to calculate the overall unitary savings for refrigerators are presented in the following section. It should be noted that internal spillover is calculated separately from the unitary savings of each appliance in ARet, and is presented in Section 3.6.

Free-ridership

Free-ridership for ARet corresponds to the energy consumption of the appliances that would have been disposed of in the absence of ARet. It does not include the consumption of appliances that would have been transferred to another owner, as assessed through the secondary market impacts. To determine this consumption level, the Evaluator surveyed participants on the actions they would have taken in the absence of ARet, such as selling it to a private party, giving it away to a charity organization or family member, or taking it to a landfill site or a recycling centre.

The following table presents the different discarding scenarios and the proportion of participants who would have disposed of their refrigerators without the program, and are therefore identified as cases of free-ridership. More details on the algorithm used to establish these scenarios are presented in Appendix III.

Table 10: Scenarios for Discarding and Proportions of Refrigerators

Would have kept unit	Proportion	Discard Scenario	Proportion	Total proportion
Yes	36%			36%
No	64%	Transferred	52%	33%
		Disposed	48%	31%

Secondary Market Impacts

In the case of participants who declared they would have transferred, i.e., sold or given away their appliances in the absence of ARet, the savings calculation takes into account the possible energy consumption of the appliances in the secondary market. There are two possible cases for this.

In the first case, would-be acquirers in the secondary market do not find alternate units. The appliance would be used as a secondary unit by someone who would normally not have sought another unit. This means that there would be one more appliance operating on the grid. For this case, no secondary market impact on energy consumption needs to be removed from the gross savings.

In the second case, would-be acquirers would have found another appliance if they had not gotten this second-hand appliance. Consequently, the total amount of appliances connected to the grid is not reduced by ARet. There are in fact two possibilities: (1) another similar used appliance would have been bought; or (2) a new standard efficiency appliance would have been bought because of the reduced quantity of appliances available on the secondary market.

The table below presents all possible scenarios for appliances that would have been sold or given away to the secondary market and their corresponding energy impacts. The proportions used for each of these scenarios are default values suggested by the UMP when no general population survey is conducted. These assumptions could be refined in future evaluations, based on further market research, but the cost of conducting such research should always be taken into account in the decision-making process.

Table 11: Proportions of Secondary Market Impacts for Refrigerators

Would-be Acquirer Finds an Alternate Unit	Proportion	Alternate Type	Proportion	Second Market Impact Value
Yes	50%	Old Unit	50%	Consumption of retired appliances
		New Unit	50%	Consumption of new standard-efficiency appliances
No	50%			Nil

Induced Consumption

Induced consumption is assessed so participants who would have unplugged their appliances without replacing it in the absence of the program can be taken into account. Induced consumption is deducted from the gross savings to subtract the consumption of new appliances that would not have been bought if the program had not existed. Since it is difficult to correctly assess this parameter with only one question, a second validation question was asked to ensure that the participants had really bought their replacement appliances because of the program, and not simply because they needed one.

An inconsistency test was also added, as suggested by the UMP, to eliminate answers from participants who had not understood the question properly. This was the case for participants who said that the replacement was prompted by the program, but also answered that they would have discarded the refrigerator without the program and that the refrigerator was their primary one. Answers from those participants have been removed as it would be highly unlikely for someone to live without a primary refrigerator.

Induced consumption is also used to consider the fact that people who would have kept their refrigerator without the program, and purchased a new one to use as a primary unit, might not keep two refrigerators—the old and the new models—running at the same time. In this case, induced consumption is equal to that of the new refrigerator. In the opposite case, for participants who were going to replace the refrigerator independently of the program (non-induced replacement) and who had not thought about retiring their refrigerator, there is no induced consumption because the avoided consumption is actually that of the retired refrigerator, as shown in the equation below.

$$Savings = Consum_{no\ program} - Consum_{program} = (Consum_{retired} + Consum_{new}) - Consum_{new}$$

Table 12: Proportions of Refrigerators for Induced Consumption

Replaced the Recycled Unit	Proportion	Program Induced Replacement	Proportion	Overall Proportion
Yes	83%	Yes	1%	1%
		No	99%	82%
No	17%			17%
			Total	100%

The one percent obtained for induced replacement is low, as expected. This represents a significant reduction compared to last year's result (12%), most likely due to the improvements made to the questionnaire by the Evaluator. One more validation question was indeed added to ensure that the cash incentive given to dispose of the refrigerator was the true reason for purchasing the replacement refrigerator.

3.1.3 Net Unitary Savings

The following table presents the unitary savings value calculated for the refrigerators retired through ARet. The first section of the table presents the unitary savings value after the portion attributable to free-ridership and secondary market impacts was deducted. The unitary savings are obtained by calculating a weighted average of each scenario. The second section corresponds to the induced consumption, which is then deducted from the unitary savings value. This results in an overall savings value of 445 kWh per unit retired.

Table 13: Savings Value per Refrigerator Unit

Free-ridership and Secondary Market Impacts											
Would have kept Unit	%	Discard Scenario	%	Would-be Acquirer Finds an Alternate Unit	%	Alternate type	%	Overall Proportion	Energy Consumption (kWh/year)		Savings
									Without Program	With Program	Net Reduction
Yes	36%							36%	788	0	788
No	64%	Transferred	52%	Yes	50%	Old Unit	50%	8.0%	788	788	0
						New Unit	50%	8.0%	788	396	392
				No	50%			17%	788	0	788
		Disposed	48%					31%	0	0	0
								100%	Weighted Average (kWh/unit)		449
Induced Consumption											
				Replaced Recycled Unit	%	Program Induced Replacement	%	Overall Proportion	Energy Consumption (kWh/year)		Induced Consum- ption kWh
									Without Program	With Program	
				Yes	83%	Yes	1%	1%	0	396	396
						No	99%	82%	396	396	0
				No	17%			17%	0	0	0
											100%
Overall Savings (kWh/unit)											445

3.2 Freezers

This section presents the calculation for evaluating the unitary savings of the freezers retired in 2014.

3.2.1 Gross Unitary Savings

For all freezers retired in 2014, ENSC uses a gross unitary savings value of 1,049 kWh per year, which corresponds to the average energy consumption value of retired freezers established during the 2013 impact evaluation.

The Econoler team revised the gross unitary savings value tracked by ENSC by updating the same key parameters as for refrigerators, also based on the 2014 metering activity and participant survey results.

Average Energy Consumption of Retired Freezers

The Evaluator revised the annual energy consumption value of the retired freezers using the data from the 2014 metering activity. Reliable data for a total of 61 freezers was used for this calculation.

As with refrigerators, different strata were segregated for the most common age categories, and the associated average annual energy consumption per cubic foot was calculated for each age category in addition to the proportion that each age category represented in the 2014 tracking sheet. The details of the analysis are presented in the table below.

Table 14: Average Metered Annual Consumption for Retired Freezers

Freezer Age	Average Annual Consumption per Cubic Foot (based on metering data)	Proportion of Freezers in the 2013 Tracking Sheet
10 to 19 Years Old	50.2 kWh/cu. ft	39%
20 to 29 Years Old	49.3 kWh/cu. ft	35%
30 Years and Older	67.6 kWh/cu. ft	26%
Average Annual Consumption	54.5 kWh/cu. ft	

The average consumption values for each age category were weighted against the proportion represented in the 2014 tracking sheet to establish an average consumption value of 54.5 kWh per cubic foot.

The average size of the retired freezers in 2014 is 15 cubic feet. This average is based on the weighted sizes documented in the 2014 tracking sheet. Therefore, the Econoler team calculated the average annual consumption as follows:

$$\text{Average Annual Consumption of Retired Refrigerators} = 54.5 \frac{\text{kWh}}{\text{cu. ft.}} \times 15 \text{ cu. ft.} = 818 \text{ kWh}$$

To account for the difference between metering conditions and on-site conditions in a residential setting (i.e., door openings), the same occupant adjustment factor of 1.12 as used for refrigerators was applied to the metered consumption of the retired freezers. This results in an average annual consumption of 916 kWh per year.

Average Energy Consumption of Replacement Freezers

Three energy consumption levels are also attributed to possible categories of freezer replacement, as demonstrated for refrigerators in Section 3.1.1.

The energy consumption established in the 2013 evaluation report for two of the three levels was used for this year's evaluation. They were obtained from a literature review and results from other programs.

To estimate the consumption of used standard-efficiency freezer, the same approach as for refrigerators is used; the metered energy consumption of the stratum with the most recent retired freezers (from 10 to 19 years old) is selected.

The results of these calculations are presented in the table below.

Table 15: Average Annual Energy Consumption per Replacement Freezer Category

Replacement Appliance Category	High Efficiency	Standard Efficiency
New	518 kWh/year	589 kWh/year
Used	589 kWh/year	843 kWh/year

Surveyed participants were asked which type of freezers had replaced their retired ones (new or used, high or standard-efficiency). Their answers were used to set the average annual energy consumption value of replacement refrigerators at 543 kWh, as shown in the following table.

Table 16: Average Annual Consumption for Freezer Replacement

Type of replacement	Annual Energy Consumption	Proportion
New High Efficiency Freezer	518 kWh/year	86%
Used High Efficiency Freezer	589 kWh/year	6%
New Standard Efficiency Freezer	589 kWh/year	2%
Used Standard Efficiency Freezer	843 kWh/year	6%
Average Annual Consumption	543 kWh/year	

Part-use Factors

All freezers are considered to be primary, meaning that none is less used than the others. Only one part-use factors value is therefore calculated for freezers, based on the results of the 2014 Annual Survey. To establish the value of the part-use factor for freezers used part-time, participants were asked how many months per year they had kept their freezers plugged in, and the results were used to obtain a weighted average.

Table 17: Calculation of Part-Use Factors for Freezers

Level of use	Proportion	Part-use factor
Not in use	8%	0.00
Used part-time	3%	0.36
Used full-time	89%	1.00
Total	100%	0.90

This part-use factor is multiplied by the measured energy consumption of retired freezers (916 kWh/year), and their annual consumption value was established at 824 kWh. The same calculation was done with replacement freezers, and the annual energy consumption value was established at 489 kWh.

Table 18: Final Energy Consumption Values for Freezers

	Measured Consumption (kWh/year)	Part-use Factor	Final Consumption (kWh/year)
Retired Freezer	916	0.90	824
Replacement Freezer	543	0.90	489

3.2.2 Distortion Effects

This following section presents the distortion effects taken into account to calculate unitary savings for freezers.

Free-ridership

The following table presents the different discarding scenarios and the proportion of participants who would have disposed of their freezers without the program, and who are therefore identified as cases of free-ridership.

Table 19: Scenarios of Discarding and Proportions for Freezers

Would have Kept Unit	Proportion	Discard Scenario	Proportion	Total proportion
Yes	40%			40%
No	60%	Transferred	44%	26%
		Disposed	56%	34%

Secondary Market Impacts

Secondary market impacts have been calculated in a similar fashion for freezers and refrigerators. The table below presents all possible scenarios for appliances that would have been transferred to the secondary market and their corresponding energy impacts.

Table 20: Proportions of Secondary Market Impacts for Freezers

Would-be Acquirer Finds an Alternate Unit	Proportion	Alternate type	Proportion	Second Market Impact Value
Yes	50%	Old Unit	50%	Consumption of retired appliance
		New Unit	50%	Consumption of new standard efficiency appliance
No	50%			Nil

The assumptions made for refrigerators were also made for the proportions presented in this table, as suggested by the UMP.

Induced Consumption

Induced consumption is also deducted to establish the unitary savings value for freezers. A proportion of three percent is established based on findings from the participant survey, as summarized in the following table.

Table 21: Proportions of Induced Consumption for Freezers

Replaced the Recycled Unit	Proportion	Program Induced Replacement	Proportion	Overall Proportion
Yes	58%	Yes	5%	3%
		No	95%	55%
No	42%			42%
			Total	100%

3.2.3 Net Unitary Savings

The following table presents the unitary savings value calculated for the freezers retired through ARet. The first section of the table presents the unitary savings value after the portion attributable to free-ridership and secondary market impacts was deducted. The unitary savings are obtained by calculating a weighted average of each scenario. The second section corresponds to induced consumption, which is then deducted from the unitary savings value. This results in an overall savings value of 443 kWh per unit retired.

Table 22: Savings per Freezer

Free-ridership and Secondary Market Impacts											
Would Have Kept Unit	%	Discard Scenario	%	Would-be Acquirer Finds an Alternate Unit	%	Alternate type	%	Overall Proportion	Energy Consumption (kWh/year)		Savings
									Without Program	With Program	Net Reduction
Yes	40%							40%	824	0	824
No	60%	Transferred	44%	Yes	50%	Old Unit	50%	7%	824	824	0
				New Unit	50%	7%	824	489	335		
		No	50%			13%	824	0	824		
		Disposed	56%			34%	0	0	0		
								100%	Weighted Average (kWh/unit)		458
Induced Consumption											
				Replaced Recycled Unit	%	Program Induced Replacement	%	Overall Proportion	Energy Consumption (kWh/year)		Induced Consum- ption kWh
									Without Program	With Program	
				Yes	58%	Yes	5%	3%	0	489	489
						No	95%	55%	489	489	0
				No	42%			42%	0	0	0
								100%	Weighted Average (kWh/unit)		15
Overall Savings (kWh/unit)											443

3.3 Room Air Conditioners

This section presents the methodology and calculation to evaluate the unitary savings of the room air conditioners retired in 2014.

3.3.1 Gross Unitary Savings

Based on the 2012 evaluation, ENSC uses a unitary savings value of 371 kWh per year for retired room air conditioners. This value was calculated using an energy efficiency ratio (EER) of 6.69, which was established from a very small metering sample (15), an annual usage of 310.6 hours and an assumed average capacity of 8,000 Btu/h. This information was provided by the evaluation of the OPA's 2008 Every Kilowatt Counts program⁶ and based on the data collected during on-site metering.

Average Consumption of Retired Room Air-conditioners

The Evaluator reviewed the estimated annual energy consumption and the unitary savings value for retired room air conditioners by performing a literature review. The annual usage of 310.6 hours remains unchanged, as most participants use air conditioners during the summer months, when required.

The capacity of retired units was collected this year by the delivery agent (DA), and the average value was set at 7,185 Btu/h, which is slightly smaller than the value used for tracked savings.

The ARet tracking sheet shows that 88 percent of the room air conditioners retired in 2013 are between 10 and 24 years old. Room air conditioners have been required to have an EER of at least eight starting from 1995⁷; it is therefore assumed that most units through ARet met this level of efficiency. This value is considered more appropriate than the previously used EER value of 6.69, which was based on a small sample of 15 room air-conditioning units recycled through an Ontarian program in 2008.

Using these parameters, the calculations resulted in an average annual consumption of 279 kWh for retired room air conditioners:

$$\text{Consumption of Retired AC Unit} = \frac{7,185 \text{ Btu/hr}}{8.0 \frac{\text{Btu}}{\text{W} \cdot \text{hr}} \times \frac{1,000 \text{ W}}{\text{kW}}} \times 310.6 \frac{\text{hr}}{\text{year}} = 279 \text{ kWh}$$

⁶ The Cadmus Group, *Evaluation of the Ontario Power Authority's 2008 Every Kilowatt Counts Power Savings Event, Keep Cool Pilot and Rewards for Recycling Programs, Final Report, Prepared for the Ontario Power Authority*, July 9, 2009.

⁷ NRCan's Office of Energy Efficiency. *Air Conditioning Your Home*, 2003, p. 15 available at <<http://publications.gc.ca/collections/Collection/M91-23-7-2003E.pdf>> (Last accessed February 10, 2015)

Average Energy Consumption of Replacement Room Air-conditioners

Because the sample of participants surveyed about the retirement of their room air conditioners was too small to draw conclusions on the type of equipment they purchased as a replacement, it is assumed that the replacement units meet the minimum level of energy efficiency to be qualified as ENERGY STAR, which is now at EER 11.2 for units with a capacity below 8,000 Btu/h⁸. This assumption is supported by the fact that the majority of participants who replaced their retired units declared that they bought a new high-efficiency model.

The same capacity and operation hours as those used for retired room air conditioners have been used, resulting in an annual energy consumption value of 199 kWh.

Part-use Factor

Since all room air conditioners are assumed to be used 310.6 hours per year during summer time, no part-use factor is applied to the annual energy consumption.

3.3.2 Distortion Effects

This following section presents the distortion effects taken into account to calculate unitary savings for air conditioners.

Free-ridership

The following table presents the different scenarios for discarding and the proportion of participants who would have disposed of their air conditioners without the program. These participants are identified as cases of free-ridership.

Table 23: Scenarios of Discarding and Proportions for Room Air Conditioners

Would Have Kept Unit	Proportion	Discard Scenario	Proportion	Total Proportion
Yes	42%			42%
No	58%	Transferred	29%	16%
		Disposed	71%	42%

⁸ Energy Star, *Room Air Conditioners Key Product Criteria*,
<https://www.energystar.gov/index.cfm?c=roomac.pr_crit_room_ac> (Last accessed January 29, 2014)

Secondary Market Impacts

Secondary market impacts for room air conditioners are calculated in a way similar to the calculations applied to refrigerators and freezers. The table below presents all the possible scenarios for room air conditioners that would have been transferred to the secondary market and their corresponding energy impacts.

Table 24: Proportions of Secondary Market Impacts for Room Air Conditioners

Would-be Acquirer Finds an Alternate Unit	Proportion	Alternate Type	Proportion	Secondary Market Impacts Value
Yes	50%	Old Unit	50%	Consumption of retired appliance
		New Unit	50%	Consumption of new standard efficiency appliance
No	50%			Nil

The same assumptions as for refrigerators and freezers are made for the proportions presented in this table.

Induced Consumption

Induced consumption is also deducted from the gross unitary savings value estimated for room air conditioners in 0 percent proportion of the participants, as summarized in the following table.

Table 25: Proportions of Induced Consumption for Room Air Conditioners

Replaced the Recycled Unit	Proportion	Program Induced Replacement	Proportion	Overall Proportion
Yes	38%	Yes	0%	0%
		No	100%	38%
No	62%			62%
			Total	100%

3.3.3 Net Unitary Savings

The following table presents the unitary savings value calculated for the room air conditioners retired through ARet. The first section of the table presents the unitary savings value after deducting free-ridership and secondary market impacts. The unitary savings are obtained by calculating a weighted average for each scenario. The second section corresponds to induced consumption, which is then deducted from the unitary savings. This results in an overall savings value of 143 kWh per unit retired.

Table 26: Savings per Room Air-conditioning Unit

Free-ridership and Secondary Market Impacts											
Would Have Kept Unit	%	Discard Scenario	%	Would-be Acquirer Finds an Alternate Unit	%	Alternate type	%	Overall Proportion	Energy Consumption (kWh/year)		Savings
									Without Program	With Program	Net Reduction
Yes	42%							42%	279	0	279
No	58%	Transferred	29%	Yes	50%	Old Unit	50%	4%	279	279	0
						New Unit	50%	4%	279	199	80
				No	50%			8%	279	0	279
		Disposed	71%					42%	0	0	0
								100%	Weighted average (kWh/unit)		143
Induced Consumption											
				Replaced Recycled Unit	%	Program Induced Replacement	%	Overall Proportion	Energy Consumption (kWh/year)		Induced Consum- ption kWh
									Without Program	With Program	
				Yes	38%	Yes	0%	0%	0	199	199
						No	100%	38%	199	199	0
				No	62%			62%	0	0	0
											100%
Overall Savings (kWh/unit)											143

3.4 Demand-to-Energy Ratio

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.159 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by ARet in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

3.5 Overall Gross Savings

Gross energy and peak demand savings resulting from the retirement of old appliances through ARet are presented in the table below, for all three types of appliances. Overall, total gross energy and peak demand savings amount to 7.201 GWh and 1.145 MW at the meter. At the generator, energy and peak demand savings are estimated at 7.921 GWh and 1.259 MW, using a line loss factor of 1.100. This value was provided by Nova Scotia Power for the residential sector, considering the fact that 99 percent of participants have a residential rate code.

Table 27: Validated Gross Energy and Peak Demand Savings

	Refrigerators	Freezers	Room Air Conditioners	Total
Energy Savings				
Number of Units Retired	4,745	2,540	123	7,408
Unitary Savings (kWh)	788	824	279	-
Total Gross Energy Savings – at meter (GWh)	3.739	2.093	0.034	5.866
Line Loss Factor	1.100	1.100	1.100	-
Total Gross Energy Savings –at generator (GWh)	4.113	2.302	0.038	6.453
Peak Demand Savings				
Energy-to-Demand Ratio	0.159	0.159	0.159	-
Total Gross Peak Demand Savings – at meter (MW)	0.595	0.333	0.005	0.933
Line Loss Factor	1.100	1.100	1.100	-
Total Gross Peak Demand Savings – at generator (MW)	0.654	0.366	0.006	1.026

3.6 Validated Savings for Appliance Replacement Pilot Projects

In 2014, ENSC conducted two pilot projects with large institutional facilities to replace their refrigerators, mini refrigerators and freezers with new, energy-efficient appliances. Unitary savings for those projects were calculated separately from the regular ARet values.

The results of the 2014 metering activity were adapted, based on the characteristics of the retired appliances, to estimate the energy consumption of those appliances. One exception was a few fairly new refrigerators, for which the energy consumption of new standard efficiency refrigerators—as defined in the 2013 ARet evaluation report—was used. For energy-efficient new replacement appliances, the EnerGuide energy consumption was used.

To obtain the savings at the generator, the line loss corresponding to the facilities where the projects were conducted was applied. The same energy-to-demand ratio as for ARet was assumed.

Table 28: Appliance Replacement Pilot Project Gross Savings

	Project 1			Project 2	Total
	Refrigerators	Mini Refrigerators	Freezers	Refrigerators	
Energy Savings					
Quantity Replaced	56	28	52	55	191
Average Old Energy Consumption	831	441	1,238	768	-
Average New Energy Consumption	383	277	460	340	-
Average Unitary Savings (kWh)	448	164	778	428	-
Total Gross Energy Savings – at Meter (GWh)	0.025	0.005	0.040	0.024	0.094
Line Loss Factor	1.064	1.064	1.064	1.064	-
Total Gross Energy Savings – at Generator (GWh)	0.027	0.005	0.043	0.025	0.100
Peak Demand Savings					
Demand-to-energy Ratio	0.159	0.159	0.159	0.159	-
Total Gross Peak Demand Savings – at Meter (MW)	0.004	0.001	0.006	0.004	0.015
Line Loss Factor	1.064	1.064	1.064	1.064	-
Total Gross Peak Demand Savings – at Generator (MW)	0.004	0.001	0.007	0.004	0.016

Both pilot projects resulted in total gross energy and peak demand savings of respectively 0.100 GWh and 0.016 MW. Because those were special projects that would not have taken place without ENSC's involvement, distortion effects were assumed to be nil, and the net savings are equal to the gross savings.

3.7 Internal Spillover

For ARet, internal spillover can occur when participants decide to retire or replace other appliances on their own following their previous participation in the program and due to its influence.

During the telephone survey, participants were asked if they had retired additional appliances following their previous participation in the program. A question was asked to see how they had disposed of the old appliances. When participants answered they had transferred the appliance (e.g., they sold it or gave it away for free), the savings associated with the additional retirement were equal to the weighted average of the transfer scenario savings. If participants answered they had discarded the appliance, the additional savings were equal to the unitary gross savings for the retired appliance.

Subsequently, another question was asked to check the influence of the program on the decision of participants to dispose of additional appliances without receiving a rebate. Depending on the level of influence obtained during the survey, a portion of the savings related to the additional retirements was attributed to the program.

The level of internal spillover was calculated for each participant according to the equation below. The energy savings (kWh) associated with the additional retirements were estimated using the adjusted unitary savings value reviewed in this evaluation for each type of appliances.

$$\% SO = \frac{kWh \text{ associated with the additional retirement} \times \text{attribution level}}{kWh \text{ associated with the appliances retired through the program}}$$

The methodology used to calculate the level of internal spillover is presented in Appendix IV.

Out of the 204 participants who were surveyed, 11 declared having retired one or many additional appliances following their previous participation in the program. These participants estimated that the program had had an average influence of 60 percent on their actions. The total savings resulting from these additional retirements multiplied by the attribution level amounted to 6,878 kWh. Divided by the energy savings generated by the participants who had answered the survey, it corresponded to an internal spillover level of 4 percent.

3.8 NTGR Calculation

This year, the net-to-gross ratio cannot be calculated as an addition of percentage for each distortion effect. To comply with the UMP calculation methodology, it is required to calculate the savings associated with each possible “with program” and “without program” scenario, and then calculate a weighted average to obtain the average net savings per unit. Consequently, savings deducted from the gross savings for each distortion effects depend not only on a percentage of affected participants, but also on the difference in savings associated with each scenario. Following this methodology, the net unitary savings were established in previous sections of the report.

To obtain an equivalent net-to-gross ratio (NTGR) that takes into account both the distortion effects applied at the unitary savings level, and the spillover, which is applied globally to the gross savings of the program, the following equation is used:

$$NTGR_{equiv} = \frac{Net \ Unitary \ Savings}{Gross \ Unitary \ Savings} + Spillover\%$$

The results of those calculations are detailed in the following table.

Table 29: Distortion Effects and Equivalent NTGR

Appliance	Number of Units	Gross Savings	Distortion Effects			Net Unitary Savings (kWh)	Internal Spillover	Equival. NTGR
		Consump. of Retired Appliances (kWh)	Free-Ridership (kWh)	Secondary Market Impact (kWh)	Induced Consump. (kWh)			
Refrigerators	4,745	788	244	95	4	445.0	4%	0.60
Freezers	2,540	824	280	85	15	444.0		0.58
ACs	123	279	117	19	0	143.0		0.55

3.9 Interactive Effects

Interactive effects occur in a conditioned space when an implemented energy efficiency measure has an impact on the energy consumption of other elements in the system, such as heating and cooling equipment. In the case of ARet, retirement of old appliances causes an increase in the heating load during winter, and a decrease in the cooling load during summer, since the compressor of the old appliance released significantly more waste heat than a newer, more efficient model. If an inefficient refrigerator is retired without replacement, these interactive effects will be greater.

The heating load period in Nova Scotia lasts about eight months, while the cooling load period is relatively short, lasting approximately two months. The interactive effects due to the retirement or replacement of an old appliance are therefore expected to be negative as an annual total, influencing the savings generated by such retirement or replacement in a downward trend. A number of additional factors can nonetheless affect the interactive effects of the program:

- › As part of this evaluation, the focus of ARet is on electricity savings. The information collected in the 2013 tracking sheet showed that only 30 percent of participating households use electricity as their primary heating source. Therefore, the negative interactive effects on the heating load only affect approximately one third of the participating households.
- › Additionally, in Nova Scotia, only 18 percent of households use air conditioning⁹—an even smaller proportion of households—where positive interactive effects occur during the cooling period. Moreover, this cooling period is much shorter than the heating season, lasting only two months.¹⁰

⁹ Statistics Canada (CANSIM), *Households Having Air-conditioning*, Nova Scotia, 2009.

¹⁰ RETScreen, Climatic Data for Halifax International Airport.

- › Several appliances retired through the program, such as refrigerators and freezers, are built-in or leaned against an exterior wall. Rather than contributing to the loads, this results in more heat loss through the envelope and reduces their interactive effects.

Considering all these factors, Econoler concludes that the interactive effects of the ARet program are insignificant, and so has set the interactive effects factor at zero percent.

3.10 Overall Net Savings

The net energy savings are estimated by multiplying the gross savings by the NTGR and the interactive effects, based on the equation below.

$$\text{Net Energy Savings} = \text{Gross Energy Savings} \times \text{NTGR}_{\text{equiv}} \times (1 - \text{Interactive Effects Factor})$$

Overall, total net energy and peak demand savings for ARet amount to 3.492 GWh and 0.555 MW at the meter, and to 3.841 GWh and 0.611 MW at the generator. When including the appliance replacement pilot projects, those totals increase to 3.585 GWh and 0.570 MW at the meter, and 3.941 GWh and 0.627 MW at the generator.

Table 30: Validated Net Energy and Peak Demand Savings

	Refrigerators	Freezers	Room AC Units	Appliance Replacement Pilot	Total
Energy Savings					
Total Gross Energy Savings – at meter (GWh)	3.739	2.093	0.034	0.094	5.960
NTGR	0.60	0.58	0.55	1.00	-
Interactive Effects Factor	0%	0%	0%	0%	-
Total Net Energy Savings – at meter (GWh)	2.261	1.211	0.019	0.094	3.585
Line Loss Factor	1.100	1.100	1.100	1.064	-
Total Net Energy Savings – at generator (GWh)	2.487	1.333	0.021	0.100	3.941
Peak Demand Savings					
Total Gross Peak Demand Savings – at meter (GWh)	0.595	0.333	0.005	0.015	0.948
NTGR	0.60	0.58	0.55	1.00	-
Interactive Effects Factor	0%	0%	0%	0%	-
Total Net Peak Demand Savings – at meter (GWh)	0.360	0.193	0.003	0.015	0.570
Line Loss Factor	1.100	1.100	1.100	1.064	-
Total Net Peak Demand Savings – at generator (GWh)	0.395	0.212	0.003	0.016	0.627

APPENDIX I PARTICIPANT SURVEY QUESTIONNAIRE

Could I speak with [INSERT NAME]?

1. Yes [GO TO INTRODUCTION]
2. No [SAY “Perhaps you can help me anyway.” GO TO INTRODUCTION]

Hello, my name is _____ from CRA (Corporate Research Associates), a Halifax-based survey research company. We are currently performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your household recently participated in Efficiency Nova Scotia Corporation’s Appliance Retirement Program. We would appreciate your collaboration in answering questions related to your participation in this program.

We are calling customers who used the program to remove and recycle refrigerators, freezers or room air conditioner units in 2014. Are you the person who was most involved and familiar with deciding to have your old refrigerator, freezer or air conditioner unit picked up and recycled through the program?

[IF NO, ASK TO SPEAK TO THE APPROPRIATE PERSON: “May I please speak to the person who knows the most about having the appliance picked up?”]

[IF APPROPRIATE PERSON] We are trying to get feedback from customers about the Appliance Retirement program to improve it. Your responses will be kept strictly confidential—that is, your name will not be associated with any of your responses. This survey will take about 15 minutes of your time. Is this a good time for you?

[IF REFUSED, ASK “Can we schedule a more convenient time for you to conduct this survey?”]

[SCHEDULED, IF NECESSARY, FOR: _____]

Verification and Recall (V Series)

V1. Our records indicate that your household participated in Efficiency Nova Scotia’s Appliance Retirement Program, which removed and recycled

[INSERT NUMBER FROM VARIABLE “RF” IN THE SAMPLE] refrigerator(s),

[INSERT NUMBER FROM VARIABLE “FZ” IN THE SAMPLE] stand-alone freezer(s), (and)

[INSERT NUMBER FROM VARIABLE “AC” IN THE SAMPLE] room air conditioner unit(s)

from your home in 2014. Is this correct?

1. Yes [GO TO APPLIANCE SECTION]
2. No, does not recall participating [PROBE: "Let me clarify. Someone would have come to your home and picked up your old appliance to recycle it. You would also have received IF BEFORE MAY 16TH IN SAMPLE: a \$30 rebate OR Air Miles reward miles. IF MAY 16TH OR AFTER: A \$30 Rebate. (IF PERSIST AS NO, THANK, TERMINATE AND RECORD)]
3. No, different quantities (GO TO V2)
4. (Don't know) [PROBE: "Let me clarify. Someone would have come to your home and picked up your old appliance. You would also have received IF BEFORE MAY 16TH IN SAMPLE: a \$30 rebate OR Air Miles reward miles. IF MAY 16TH OR AFTER: A \$30 Rebate IF PERSIST AS NO, THANK, TERMINATE AND RECORD.

V2. [ASK IF V1=3] Let me clarify, I am talking about the Efficiency Nova Scotia's Appliance Retirement Program, which removed and recycled refrigerators, freezers or room air conditioner units from your home, paid you IF BEFORE MAY 16TH IN SAMPLE: a \$30 rebate OR Air Miles reward miles. IF MAY 16TH OR AFTER: A \$30 Rebate This was not a program that gave any rebates for purchases of new or replacement refrigerators, freezers or air conditioner units.

Thinking only about any appliances that were picked up through the Appliance Retirement Program, which quantities are wrong? The [READ BELOW 1 = YES, 2 = NO, 98 = Don't Know]

- a. Number of refrigerators picked up
- b. Number of freezers picked up
- c. Number of air conditioner units picked up

- V3. [IF V2a. = YES] How many refrigerators were picked up through the Appliance Retirement Program? [Record number, 98=Don't Know, 99= Refused] _____
- V4. [IF V2b. = YES] How many stand-alone freezers were picked up through the Appliance Retirement Program? [Record number, 98=Don't Know, 99=Refused] _____
- V5. [IF V2c. = YES] How many air conditioner units were picked up through the Appliance Retirement Program? [Record number, 98=Don't Know, 99=Refused] _____

Appliance Section

[PROGRAMMER: EACH RESPONDENT WILL BE ASKED ABOUT ONE APPLIANCE. IF AIR CONDITIONER, ASK ABOUT AIR CONDITIONER ONLY AND NO OTHER APPLIANCE.].

APPLIANCE	QUOTA
Refrigerator (RF)	n=80
Freezer (FZ)	n=80
Air Conditioner (AC)	n=40 ¹¹
TOTAL	n=200

REFRIGERATORS (RF)/FREEZERS (FZ)/AIR CONDITIONERS (AC)

RF: [IF V1=1 and RF>0 OR IF V3>0 (had refrigerator removed), ASK FOR REFRIGERATORS, OTHERWISE ASK FOR FREEZERS]

FZ: [IF V1 = 1 and FZ > 0 OR IF V4>0 (had freezer removed), ASK FOR FREEZERS, OTHERWISE ASK FOR AC]

AC: [IF V1=1 and AC>0 OR IF V5>0 (had air conditioner unit removed) ASK FOR AIR CONDITIONERS, OTHERWISE SKIP TO REPLACEMENT SECTION]

[READ IF V1 = 1 and RF/FZ/AC = 1 OR IF V3/V4/V5=1], Now, I'd like you to think about the [refrigerator/stand-alone freezer/air conditioner unit] you had removed through the program.

[READ IF V1 = 1 and RF/FZ/AC > 1 OR IF V3/V4/V5>1] I know you had more than one [refrigerator/stand-alone freezer/air conditioner unit] removed through the program. For purposes of this survey, pick just one of the [refrigerator/stand-alone freezer/air conditioner unit] removed and keep only that one [refrigerator/stand-alone freezer/air conditioner unit] clearly in your mind as you answer the next few questions.

Part-use Section (U Series)

[ASK U1 FOR REFRIGERATORS ONLY]

U1. Was the refrigerator removed through the program the main one used in the home, a second refrigerator that was being used at least part of the time, or a refrigerator that was not being used at all?

¹¹ AC participants : 40 approximately as of September 3, 2014. We will try to get as many as we can for the survey.

IF CLARIFICATION NECESSARY: "A main or primary refrigerator would typically be located in the kitchen, plugged in or "on" all the time, and used for regular household purposes. A secondary or spare refrigerator is typically located somewhere other than in the kitchen and may be plugged in or "on" all or only part of the time." [NOTE: If respondent recently bought a new refrigerator and was just waiting for the previously used one to be picked up by the program, it should be classified as "Main/Primary"]

1. Used as Main/Primary
2. Used as a Spare/Secondary at date of pickup
3. Not being used
98. (Don't know) [PROBE: READ CLARIFICATION AND TRY TO CLASSIFY STATUS OF REFRIGERATOR]
99. (Refused)

[ASK QUESTIONS U2-U6 FOR ALL APPLIANCES]

U2. Approximately how old was the [refrigerator/stand-alone freezer/air conditioner unit] you had removed through the program? Was it [RECORD IN YEARS. ENTER "00" IF LESS THAN ONE YEAR OLD. USE "98" FOR DON'T KNOW. USE "99" FOR REFUSED.]

_____ (Record years)

U3. Which of the following describes the condition of the [refrigerator/stand-alone freezer/air conditioner unit] when you decided to have it picked up by the program? READ

1. It worked well and was in good physical condition
2. It worked okay, but had some problems [RF AND FZ ONLY: example: it would not defrost]
3. It did not work (example: turned on but did not cool)
98. (Don't know)
99. (Refused)

[FOR RF: POSE U4 IF U1=2 or 3, FOR FZ AND AC: POSE U4 TO ALL RESPONDENTS]

U4. In the year prior to getting rid of the [refrigerator/stand-alone freezer/air conditioner unit], how often did you have the [refrigerator/stand-alone freezer/air conditioner unit] plugged in? Was it [READ, CHECK ONLY ONE]:

1. Kept running all the time. [SKIP TO U6]
2. For special occasions only.

- 3. During certain months of the year only.
- 4. Never plugged in or running. [SKIP TO U6]
- 5. (DO NOT READ) Other (Please Specify): _____
- 98. (Don't know) [SKIP TO U6]
- 99. (Refused) [SKIP TO U6]

U5. During the last year, how many total months do you think the unit was plugged in and running?
[USE "98" FOR DON'T KNOW AND "99" FOR REFUSED.]

_____ [RECORD MONTHS; RANGE: 1-12; HALF A MONTH=0.5]

[ASK U6 FOR REFRIGERATORS ONLY]

U6. Where in the house was the [refrigerator] most recently located? [RANDOMIZE AND READ 1-4, THEN 96 – CHECK ONLY ONE]

- 1. Kitchen
- 2. Garage
- 3. Porch/patio
- 4. Basement
- 96. Other [SPECIFY _____]
- 98. (Don't know)
- 99. (Refused)

[ASK QUESTION U7 FOR AIR CONDITIONER UNITS ONLY]

[ASK IF U4 = 2]

U7. You told me that you used to turn on your air conditioner unit when it was necessary. On what basis did you decide to turn on your air conditioner unit? [DO NOT READ - ALLOW MULTIPLE BUT DO NOT ASK FOR]

- 1. (According to the temperature/When it was warm)
- 2. (When people are at home)
- 3. (During night time)
- 4. (On weekends)
- 96. (Other, specify _____)
- 98. (Don't know)
- 99. (Refused)

Replacement Section (RE Series)

RE1. Did you replace the [refrigerator/stand-alone freezer/air conditioner unit] that you turned in through Efficiency Nova Scotia's Appliance Retirement Program?

1. Yes
2. No [GO TO FREERIDERSHIP SECTION]
98. (Don't know) [GO TO FREERIDERSHIP SECTION]
99. (Refused) [GO TO FREERIDERSHIP SECTION]

RE2. Why did you decide to replace your [refrigerator/stand-alone freezer/air conditioner unit]? [RANDOMIZE, BUT ASK 97 LAST] ACCEPT ONE RESPONSE ONLY

1. Wanted an upgrade (example: more space, new features)
2. Old appliance was not working well
3. Was planning to give previous unit away
97. Other, specify : _____
98. (Don't know)
99. (Refused)

RE3. Was the replacement [refrigerator/stand-alone freezer/air conditioner unit] new or used when you started using it as the replacement [refrigerator/stand-alone freezer/air conditioner unit]?

1. New
2. Used
98. (Don't know) [SKIP TO RE6]
99. (Refused) [SKIP TO RE6]

RE4. Was the replacement [refrigerator/stand-alone freezer/air conditioner unit] an ENERGY STAR or high-efficiency model?

1. Yes
2. No [SKIP TO RE6]
98. (Don't know) [SKIP TO RE6]
99. (Refused) [SKIP TO RE6]

RE5. How influential was the program in your decision to replace your [refrigerator/stand-alone freezer/air conditioner unit] with an ENERGY STAR or high-efficiency model? Please use a scale of '0' to '10', where '0' is had no influence at all, and '10' is extremely influential.

1-10 scale

98. (Don't know)
99. (Refused)

RE6. If you had disposed of your old [refrigerator/stand-alone freezer/air conditioner unit] without receiving any rebate from ENSC, would you still have acquired a replacement [refrigerator/stand-alone freezer/air conditioner unit]?

1. Yes [SKIP TO FREERIDERSHIP SECTION]
2. No
98. (Don't know) [SKIP TO FREERIDERSHIP SECTION]
99. (Refused) [SKIP TO FREERIDERSHIP SECTION]

RE7. **[ASK IF NO IN RE6]** Let me make sure I understand correctly: are you saying that you chose to acquire a new [refrigerator/stand-alone freezer/air conditioner unit] because of the 30\$ rebate offered by ENSC through the Appliance Retirement Program?

1. Yes
2. No
98. (Don't know)
99. (Refused)

Free-Ridership Section (FR Series)

Please continue thinking about just that one [refrigerator/stand-alone freezer/air conditioner unit].

FR1. Had you already planned to dispose of the one [refrigerator/stand-alone freezer/air conditioner unit] before you heard about Efficiency Nova Scotia's Appliance Retirement Program? By dispose of, I mean getting the appliance out of your home by selling it, giving it away, having someone pick it up, or taking it to the dump or a recycling center yourself.

1. Yes
2. No [GO TO SPILLOVER SECTION]
98. (Don't know)
99. (Refused)

FR2a. Now suppose that the Efficiency Nova Scotia Appliance Retirement Program that you used to dispose of this [refrigerator/stand-alone freezer/air conditioner unit] had not been available. Would you have disposed of your [refrigerator/stand-alone freezer/air conditioner unit] even if the program had not been available?

1. Yes
2. No
98. (Don't know)
99. (Refused)

FR2b. **[ASK IF YES IN FR2a]** Let me make sure I understand: If the Appliance Retirement Program was not available, you would have disposed of your [refrigerator/stand-alone freezer/air conditioner unit] anyway. Is that correct?

1. Yes, I would have disposed of it in the absence of the program
2. No, I would have kept it in the absence of the program
98. (Don't know)
99. (Refused)

FR3. **[ASK U6 FOR REFRIGERATORS ONLY]**

[ASK ONLY IF FR2a=2 OR IF FR2b=2] If you had kept the [refrigerator], would you have kept it in the same location you mentioned earlier? That is would it have been located in: [READ IN ANSWER FROM U6]?

1. Yes
2. No
98. (Don't know)
99. (Refused)

FR4. **[ASK ONLY IF FR2b=1]** How would you have disposed of the [refrigerator/stand-alone freezer/air conditioner unit] if the program had not been available?

(READ LIST IN RANDOM ORDER)

1. Sold it to a private party [example: friend, family member, craigslist].
2. Sold it to a used appliance dealer.
3. Given it away for free [example: friend, family, neighbor].
4. Given it away to charity organization
5. Left it on the curb with a free sign
6. Have it removed by the dealer supplying your new or replacement appliance. [DISPLAY ONLY IF RE1= 1]
7. Taken it to a dump or recycling center yourself (or with a friend or family member).
8. Hire someone to take the unit to a dump or recycling center
9. Have it picked up by local waste management company
96. (Other, specify :_____)
98. (Don't know)
99. (Refused)

[Programmer: If FR4 = 2 and AGE (U2) > 15 or FR4 = 4 or FR4 = 7, then read follow up question FR5 along with the corresponding.]

[Read only if FR4 = 2 and AGE (U2) > 15]

Used appliance dealers typically only buy units that are less than 15 years old and are in very good condition.

[Read only if FR4 = 4]

Market research suggests many local charities (e.g. Salvation Army) do not accept large appliances.

[Read only if FR4 = 7 – DO NOT READ FOR AIR CONDITIONER UNITS]

Appliances are heavy and often require a truck, trailer, or large vehicle to relocate.

FR5. **[ASK ONLY IF FR4= 2 or 4 or 7, OTHERWISE SKIP TO FR6]** Given this information, would you have [READ IN ANSWER FROM FR4], or would you have done something else?

1. Same thing as FR4 [SKIP TO FR7]
2. Something else
98. Don't know [SKIP TO FR7]
99. Refused [SKIP TO FR7]

FR6. How else would you have disposed of it? [Allow only one answer] (READ LIST IN RANDOM ORDER)

1. Sold it to a private party [example: friend, family member, craigslist]
2. Sold it to a used appliance dealer
3. Given it away for free [example: friend, family, neighbor]
4. Given it away to charity organization
5. Left it on the curb with a free sign
6. Have it removed by the dealer supplying your new or replacement appliance [DISPLAY ONLY IF RE1= 1]
7. Take it to a dump or recycling center yourself (or with a friend or family member)
8. Hiring someone to take the unit to a dump or recycling center.
9. Have it picked up by local waste management company
10. Kept it
96. (Other, specify : _____)
98. (Don't know)
99. (Refused)

FR7. What is the main reason you chose the Efficiency Nova Scotia program to dispose of your appliance? [DO NOT READ. RECORD ONLY ONE RESPONSE]

1. Energy conservation
2. Free pick-up service
3. Savings on electric bill
4. To ensure it was recycled
5. Incentive
96. Other, specify : _____)
98. (Don't know)
99. (Refused)

FR8. Would you have disposed of your [refrigerator/stand-alone freezer/air conditioner unit] through the program if the amount of the rebate had been less?

1. Yes
2. No [SKIP TO REMAINING APPLIANCES SECTION]
3. Maybe
98. (Don't know)
99. (Refused)

FR9. Would you have disposed of your [refrigerator/stand-alone freezer/air conditioner unit] through the program with no rebate check or Air Miles incentive at all?

1. Yes
2. No
98. (Don't know)
99. (Refused)

Spillover Section (SO Series)

SO1. Since participating in Efficiency Nova Scotia's Appliance Retirement Program, have you disposed of other appliances WITHOUT RECEIVING A REBATE?

1. Yes
2. No [SKIP TO PROGRAM PARTICIPATION SECTION]
98. (Don't know) [SKIP TO PROGRAM PARTICIPATION SECTION]
99. (Refused) [SKIP TO PROGRAM PARTICIPATION SECTION]

[GO TO PROGRAM PARTICIPATION SECTION IF SO1=2 OR 98 OR 99]

SO2. What other appliance(s) have you disposed of WITHOUT RECEIVING A REBATE since participating in Efficiency Nova Scotia's Appliance Retirement Program? [READ IN ORDER – CODE ONE ONLY PER STATEMENT]

- a. Other refrigerator
- b. Other stand-alone freezer
- c. Other air conditioner unit
- 1. (Yes)
- 2. (No)
- 98. (Don't know)
- 99. (Refused)

[GO TO PROGRAM PARTICIPATION SECTION IF 2 OR 98 OR 99]

[ASK SO3 FOR EACH OF SO2a-c]

SO3. How did you dispose of [this] [INSERT RESPONSE FROM SO2] appliance(s)? Did you... [READ, CHECK ALL THAT APPLY AND CODE SEPARATELY FOR EACH TYPE OF APPLIANCES AS IN SO2]

- 1. Sell it/ them
- 2. Give it/them away for free
- 3. Take it/them to a recycling center or hired someone to take it/them for recycling
- 4. Take it/them to a garbage dump or put out as trash
- 5. Hire hauler to take it/them away
- 6. Have a retail store come and pick it/them up
- 96. Or did you do something else? [SPECIFY]_____
- 98. (Don't know)
- 99. (Refused)

SO4. How influential was your experience with the Appliance Retirement Program on your decision to dispose of [this/these] additional appliance(s) WITHOUT RECEIVING A REBATE? Please give your answer on a scale of 0 to 10, where 0 indicates that the program "had no influence at all on your decision to dispose of this or these additional appliance(s)" and 10 indicates that the program was "extremely influential to your decision to dispose of [this/these] additional appliance(s)." [RECORD RESPONSE 0-10, 98 = Don't know, 99 = REFUSED] [DO NOT ACCEPT A RANGE]

Program Awareness and Satisfaction (CS Series)

CS1. How did you first learn about this program? [DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]

1. Media advertising
2. Contacted directly by Efficiency Nova Scotia
3. Through a third party contractor or service provider
4. Efficiency Nova Scotia website
5. Facebook or other social media
6. Word of mouth
97. (Other [SPECIFY _____])
98. (Don't know)
99. (Refused)

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the Appliance Retirement Program? [DO NOT READ RESPONSES – CODE ONE ONLY]

1. Yes
2. No
98. (Don't know)
99. (Refused)

IF YES IN CS2, CONTINUE. OTHERWISE, SKIP TO S10

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where "1" is not at all satisfied and "10" is completely satisfied, how satisfied were you with [READ AND ROTATE. CODE ONE RESPONSE FOR EACH STATEMENT]

- b. The responsiveness of employees to your requests and enquiries in a timely manner
- e. The length of time prior to your appointment to pick up your appliance
- g. The value of the program relative to the time and cost involved

___ Response ___ 98 Don't Know ___ 99 Refused

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

___ Response ___ 98 Don't Know ___ 99 Refused

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? [DO NOT READ RESPONSES – CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO S10.

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? [CODE ONE ONLY]

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's... [READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]

- a. Service attitude
- b. Knowledge of programs available
- c. Ability to provide advice
- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before the appliance was removed from your home? [RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
97. (Not eligible to any other programs)
98. (Don't know)

IM4. [ASK IF 'PROBABLY NOT' OR 'DEFINITELY NOT' IN CS27] Why would you not recommend the programs offered by Efficiency Nova Scotia to others? RECORD VERBATIM

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
98. (Don't know)
99. (Refused)

Demographics (D Series)

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

D1. What type of residence do you live in? [READ RESPONSES 1-7, then 96; SELECT ONE RESPONSE]

1. Detached single-family home
2. Semi-detached house
3. Mobile home or house trailer
4. Townhouse or duplex which share adjacent walls
5. Row house (Single story apartment building)
6. Apartment building that has fewer than five stories
7. Apartment building that has five or more stories
96. Or something else [SPECIFY: _____]
98. (Don't know)
99. (Refused)

- D2. How many bedrooms are in your home? [88=DK; Enter zero for a studio apartment with no bedrooms]
- D3. Do you own or rent this home?
1. Own/buying
 2. Rent/lease
 3. Other (Describe) _____
- D4. Do you pay the electric bills for your home?
1. Yes
 2. No
 98. (Don't Know)
 99. (Refused)
- D6. Including yourself, how many people live in this residence on a full-time basis?
- Number of people: _____[NOTE: DON'T ALLOW ZERO FOR A RESPONSE]
- D7. In what age category do you fall? Are you... [READ LIST; SELECT ONE RESPONSE]
1. 18 to 24
 2. 25 to 34
 3. 35 to 44
 4. 45 to 54
 5. 55 to 64
 6. 65 or over
 99. (Refused)
- D8. What is the highest level of education you have completed? [DO NOT READ]
1. (Less than high school graduation certificate)
 2. (High school graduation certificate and/or some post secondary)
 3. (Trades certificate or diploma)
 4. (College certificate or diploma)
 5. (University certificate or diploma)
 98. (Don't know)
 99. (Refused)
- D9. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category. [READ LIST; SELECT ONE RESPONSE]
1. Less than \$15,000
 2. \$15,000 - \$24,999

- 3. \$25,000 - \$34,999
- 4. \$35,000 - \$49,999
- 5. \$50,000 - \$69,999
- 6. \$70,000 - \$79,999
- 8. \$80,000 or more
- 98. (Don't know)
- 99. (Refused)

D10. [DO NOT READ] Gender

- 1. Male
- 2. Female

END.

Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

APPENDIX II

PARTICIPANT SURVEY RESULTS

The participants survey results are presented in the following tables.

CS1. How did you first learn about this program?

Sources of Awareness*	2012**	2013	2014
<i>Sample Size</i>	<i>57</i>	<i>201</i>	<i>204</i>
Media advertising	47%	32%	37%
Word of mouth	33%	43%	27%
Contacted directly by ENSC	2%	4%	10%
ENSC website	5%	3%	7%
Through the mail/Received pamphlet/flyer in the mail	5%	3%	6%
Through a third-party contractor/service provider	4%	2%	3%
Internet/website	4%	1%	3%
Retail store/Store where I bought new appliance	7%	3%	2%
Facebook or other social media	5%	3%	2%
Insert with power bill	-	1%	2%
Previous experience with the program	-	1%	-
Through Halifax Regional Municipality	-	1%	-
Through Nova Scotia Power	4%	-	-
Others	-	1%	3%
Don't know/Can't recall	4%	5%	6%
* Multiple responses			
**Source: 2012 C-Sat Residential Study			

U1. Was the refrigerator removed through the program the main one used in the home, a second refrigerator that was being used at least part of the time, or a refrigerator that was not being used at all?

Use of Retired Refrigerators	2012	2013	2014
<i>Sample Size*</i>	<i>80</i>	<i>92</i>	<i>93</i>
Used as primary/main	53%	66%	65%
Used as secondary/spare	48%	34%	31%
Not being used	-	-	4%
*Base: Respondents who retired a refrigerator			

U2. Which of the following describes the condition of the [refrigerator/stand-alone freezer/air conditioner unit] when you decided to have it picked up by the program?

Appliance Was Working	2013*			2014		
	Refrigerators (%)	Freezers (%)	Air-conditioners (#)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)
Sample Size	92	94	15	93	98	13
Worked well and in good physical condition	47%	77%	7	49%	72%	6
Worked okay but had some problems	48%	22%	6	48%	26%	7
It did not work	4%	1%	1	1%	1%	-
Don't know	1%	-	1	1%	1%	-

*Tracking data for 2012 not shown because of scale change in 2013.

U3. In the year prior to getting rid of the [refrigerator/stand-alone freezer/air conditioner unit], how often did you have the [refrigerator/stand-alone freezer/air conditioner unit] plugged in?

Time Plugged In*	2013***			2014		
	Refrigerators (%)	Freezers (%)	Air-conditioners (#)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)
Sample Size**	30	92	15	33	98	13
Kept running all the time	67%	93%	-	76%	89%	-
During certain months of the year	20%	2%	11	15%	2%	9
For special occasions only	10%	1%	1	3%	1%	1
Never plugged in or running	3%	3%	3	6%	7%	3
Others	-	-	-	-	1%	-

*Base: Respondents who turned in a secondary refrigerator, a freezer or an air-conditioner to the program
 **Don't know/'Refused' removed from calculations
 ***Tracking data for 2012 not shown because of scale change in 2013

RE1. Did you replace the [refrigerator/stand-alone freezer/air conditioner unit] that you turned in through Efficiency Nova Scotia's Appliance Retirement Program?

Replacement	2012			2013			2014		
	Refrigerators (%)	Freezers (%)	Air-conditioners (%)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)
Sample Size	80	81	40	92	94	15	93	98	13
Yes	75%	68%	38%	80%	71%	7	83%	57%	5
No	25%	32%	63%	20%	28%	8	17%	42%	8
Don't know	-	-	-	-	1%	-	-	1%	-

RE2. Why did you decide to replace your [refrigerator/stand-alone freezer/air conditioner unit]?

Reason for Replacing Appliance	2013*			2014		
	Refrigerators (%)	Freezers (%)	Air-conditioners (#)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)
Sample Size	74	67	7	77	56	5
Wanted an upgrade (more space, new features)	41%	58%	4	43%	48%	3
Old appliance was not working well	46%	24%	2	39%	29%	2
Wanted an energy-efficient appliance/ Wanted to save on energy bill	12%	7%	-	10%	11%	-
Was planning to give previous unit away	-	1%	-	-	-	-
Wanted smaller freezer	n/a	9%	-	-	7%	-
Others	1%	-	1	8%	5%	-
*New question in 2013						

RE3. Was the replacement [refrigerator/stand-alone freezer/air conditioner unit] new or used when you started using it as the replacement [refrigerator/stand-alone freezer/air conditioner unit]?

Replacement*	2012			2013			2014		
	Refrigerators (%)	Freezers (%)	Air-conditioners (#)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)
Sample Size**	60	54	15	74	67	7	77	56	5
New	77%	89%	14	73%	88%	5	77%	82%	5
Used	23%	11%	1	27%	12%	2	23%	18%	-
*Base: Respondents who replaced appliances retired through ARet									
***Don't know/'Refused' removed from calculations									

RE4. Was the replacement [refrigerator/stand-alone freezer/air conditioner unit] an ENERGY STAR or high-efficiency model?

The Replacement Appliance Was an ENERGY STAR® or High-Efficiency Model	2013*			2014		
	Refrigerators (%)	Freezers (%)	Air-conditioners (#)	Refrigerators (%)	Freezers (%)	Air-conditioners (#)
Sample Size	74	67	7	77	56	5
Yes	84%	87%	4	83%	80%	3
No	8%	4%	-	5%	7%	-
Don't know	8%	9%	3	12%	13%	2
*New question in 2013						

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the Appliance Retirement Program?

Contact with ENSC Staff	2012*	2013	2014
Sample Size	57	201	204
Yes	58%	61%	77%
No	39%	33%	21%
Don't know	4%	6%	2%
*Source : 2012 C-Sat Residential Study			

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where "1" is not at all satisfied and "10" is completely satisfied, how satisfied were you with...

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

Satisfaction with ENSC	2012***		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Mean (1=Not at all satisfied, 10=Completely satisfied)						
ENSC's overall performance in working with you	33	8.9	123	9.6	157	9.5
Responsiveness of employees to requests and enquiries in a timely manner	33	9.3	122	9.4	157	9.5
Value of the program relative to the time and cost involved	31	8.7	122	9.4	151	9.3
Length of time prior to your appointment to pick up your appliance	33	9.1	122	8.9	156	8.9
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of 'Refused' and 'Don't know' ***Source: 2012 C-Sat Residential Study						

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

Contact with ENSC Contact Centre Representatives	2012*	2013	2014
Sample Size	33	123	157
Yes	100%	81%	88%
No	-	8%	6%
Don't know	-	11%	6%
*Source : 2012 C-Sat Residential Study			

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's?

Satisfaction with Overall Performance*	2012****		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied***
Ability to provide advice	31	97%	94	100%	132	100%
Service attitude	33	97%	100	99%	137	100%
Overall level of service provided	33	100%	99	99%	138	100%
Knowledge of programs available	28	100%	95	99%	132	98%
*Base: Number of respondents who contacted ENSC contact centre representatives ** Percentage very satisfied/satisfied. 'Don't know'/'Refused' removed from calculations *** Percentage completely/mostly satisfied. 'Don't know'/'Refused' removed from calculations ****Source: 2012 C-Sat Residential Study						

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before the appliance was removed from your home?

Time Between Contact and Removal of Appliance	2014*
Sample Size	204
1-6 days	14%
7-9 days	14%
10-19 days	25%
20-29 days	8%
30 days or more	21%
Don't know	18%
Mean	18.7 Days
*Mean excludes responses of 'Refused' and 'Don't know'	

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others?

Would Recommend ARet to Others	2012***	2013	2014
<i>Sample Size*</i>	57	201**	202**
Definitely	89%	91%	89%
Probably	11%	9%	10%
Probably not	-	1%	-
Definitely not	-	-	-
Don't know/'Refused' have been removed from calculation **Does not equal 100% due to rounding *Source: 2012 C-Sat Residential Study			

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs?

Would Participate in Other ENSC Programs	2012**	2013	2014
<i>Sample Size*</i>	55	197	200
Definitely	80%	76%	72%
Probably	16%	23%	27%
Probably not	4%	1%	2%
Definitely not	-	-	-
**Don't know/'Refused' have been removed from calculation **Source: 2012 C-Sat Residential Study			

D1. What type of residence do you live in?

Type of home	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
Single-family detached house	87%	85%	87%
Mobile home or house trailer	2%	2%	4%
Apartment building that has fewer than 5 stories	3%	2%	2%
Single-family attached house (townhouse, row house, or duplex)	3%	3%	1%
Semi-detached house	2%	3%	1%
Apartment building that has 5 or more stories	-	1%	-
Others	1%	-	2%
Don't know/Refused	-	-	-

D2. How many bedrooms are in your home?

Number of Bedrooms	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
1	2%	2%	2%
2	13%	11%	14%
3	53%	53%	54%
4 or more	29%	32%	27%
Don't know/Refused	2%	1%	1%

D3. Do you own or rent this home?

Home Ownership	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
Own/Buying	91%	92%	95%
Rent/lease	7%	5%	3%
Others	1%	2%	1%
Don't know/Refused	-	-	-

D4. Do you pay the electric bills for your home?

You Pay Electricity Bills	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
Yes	94%	96%	96%
No	5%	2%	3%
Don't know/Refused	-	2%	-

D6. Including yourself, how many people live in this residence on a full-time basis?

Household Size	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
1	15%	16%	22%
2	50%	47%	50%
3	12%	15%	16%
4	16%	16%	8%
5	5%	4%	3%
6 or more	-	1%	2%
Don't know/Refused	-	1%	-

D7. In what age category do you fall? Are you...

Age of Respondent	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
18 to 24	1%	1%	-
25 to 34	6%	7%	4%
35 to 44	8%	8%	11%
45 to 54	24%	23%	15%
55 to 64	29%	29%	26%
65 or over	30%	30%	42%
Don't know/Refused	-	2%	1%

D8. What is the highest level of education you have completed?

Level of Education	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
Less than high school graduate certificate	10%	11%	14%
High school graduate certificate and/or some post-secondary education	27%	31%	27%
Trade certificate/diploma	5%	5%	5%
College certificate/diploma	16%	18%	20%
University certificate/diploma	40%	30%	33%
Don't know/Refused	2%	4%	1%

D9. Which of the following income categories best describes your total annual household income before taxes in 2013?

Household Income	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
\$14,999 or less	2%	3%	3%
\$15,000 to \$24,999	7%	9%	15%
\$25,000 to \$34,999	15%	12%	8%
\$35,000 to \$49,999	13%	10%	13%
\$50,000 to \$69,999	12%	11%	10%
\$70,000 to \$79,999	4%	8%	4%
\$80,000 or more	24%	19%	21%
Don't know/Refused	21%	27%	26%

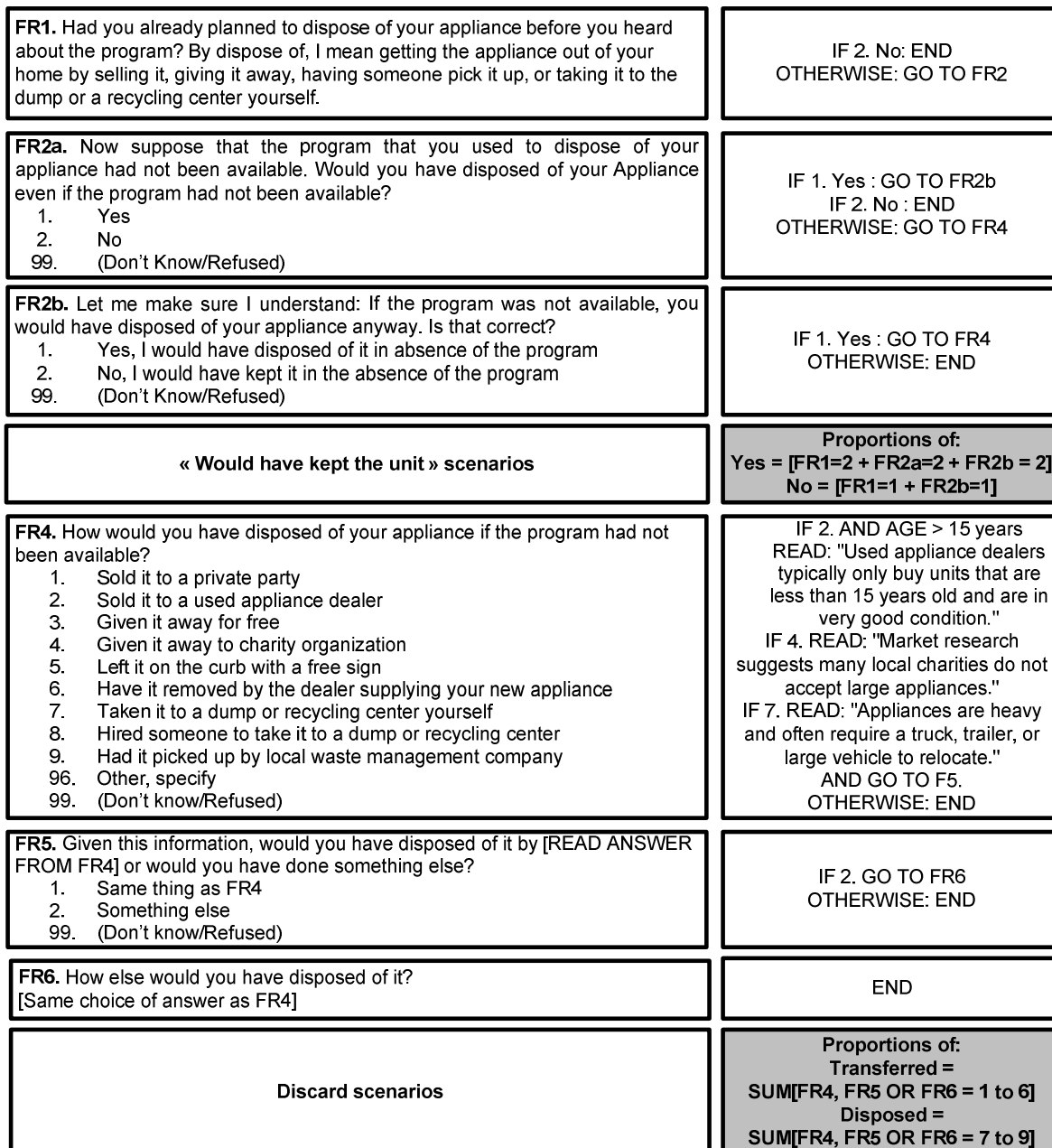
D10. Gender

Gender	2012	2013	2014
<i>Sample Size</i>	<i>201</i>	<i>201</i>	<i>204</i>
Female	54%	62%	60%
Male	46%	38%	40%

APPENDIX III

ALGORITHM FOR FREE-RIDERSHIP CALCULATION

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.



APPENDIX IV INTERNAL SPILLOVER METHODOLOGY

Internal spillover was measured using a participant survey. For ARet, internal spillover can occur when participants decide to retire or replace other appliances on their own following their previous participation in the program and due to its influence.

During the telephone survey, participants were asked if they had retired additional appliances following their previous participation in the program. A question was used to verify the eligibility of the additional retirements by asking how they disposed of the old appliances.

Subsequently, another question was asked to verify the influence of the program on participants' decisions to dispose of additional appliances without receiving a rebate. Depending on the level of influence obtained during the survey, a portion of the savings related to the additional retirements was attributed to the program.

The energy savings (kWh) associated with the additional retirements were estimated using the adjusted unitary savings value reviewed in this evaluation for each type of appliance.

The figure below illustrates the methodology used to calculate the internal spillover level.

INTRO. SO Section asked to all participants

SO1. Since participating in ARet, have you disposed of other appliances without receiving a rebate?

IF 1. Yes: CONTINUE
IF 2. No OR 99 : END

SO2. What other appliance(s) have you disposed of without receiving a rebate since participating in ARet?

SO2 = SUM (kWh associated with each eligible appliance retired)

FOR EACH APPLIANCE IN SO2:

SO3. How did you dispose of this appliance? Did you...

1. Sell it
2. Give it away for free
3. Take it to a recycling center or hire someone to do so
4. Take it to a dump or put out as trash
5. Hire a hauler to take it away
6. Have a retail store come and pick it up
96. Other, specify
99. (Don't know/Refused)

FOR EACH APPLIANCE IN SO2:

IF SO3 = 1 OR 2:
Savings associated with transfer scenario)

OTHERWISE: Gross unitary savings of each type of appliance

Revised SO2 = SUM of savings for SO2

Additional Retirement Savings:

Revised SO2

SO4. How influential was your experience with ARet on your decision to dispose of this/these additional appliance(s) without receiving a rebate? (Scale 0 to 10)

SO4 = Answer x 10%

Attribution Level:

SO4

Spillover Savings:

Revised SO2 x SO4

Final Spillover Level = $\frac{\text{SUM of (Revised SO2 x SO4) for All Respondents}}{\text{SUM of Program Savings for All Respondents}}$



ECONOLER



INSTANT SAVINGS

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

CEE	Consortium for Energy Efficiency
CFL	Compact Fluorescent Lamp
CRA	Corporate Research Associates
DA	Delivery Agent
DSM	Demand-side Management
DSMDS	Demand-side Management Data System
ENSC	Efficiency Nova Scotia Corporation
LED	Light Emitting Diode
MEF	Modified Energy Factor
NRCan	Natural Resources Canada
NTGR	Net-to-Gross Ratio
OPA	Ontario Power Authority
PM	Program Manager
POP	Point-of-Purchase
SKU	Stock-keeping Unit
TRM	Technical Reference Manual
UMP	Uniform Methods Project

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Market effects	The impact of the program on the market (such as increased product availability, practices, and prices) that extends beyond changing the program participants' behaviour. This includes spillover among non-participants.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.

Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VIII
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	3
2.1 Presentation of the Team	3
2.2 Evaluation Activities	3
2.2.1 Interview with Program Manager	4
2.2.2 Interview with Delivery Agent.....	4
2.2.3 Interviews with Retailers	4
2.2.4 In-store Visits	4
2.2.5 Survey	4
2.2.6 Unitary Savings Review.....	5
3 PROCESS EVALUATION.....	6
3.1 Follow-up on 2012 and 2013 Evaluation Report Recommendations	6
3.2 Program Documentation and Design.....	9
3.3 Tracking System	10
3.4 In-store Visits	11
3.4.1 Spring Campaign	11
3.4.2 Fall Campaign	12
3.4.3 In-store Visits Summary.....	14
4 MARKET EVALUATION	15
4.1 Partner Perspectives	15
4.1.1 Interview with Delivery Agent.....	15
4.1.2 Interviews with Retailers	16
4.2 Participant Perspectives	19
4.2.1 Instant Savings Awareness	20
4.2.2 Purchases.....	22
4.2.3 Influence	23
4.2.4 Other Discounted Products.....	23
5 IMPACT EVALUATION.....	24
5.1 Gross Savings	24
5.1.1 Compact Fluorescent Lamps (CFLs).....	24
5.1.2 LED Lamps	26
5.1.3 LED Recessed Downlight Fixtures	31
5.1.4 Dimmer Switches.....	32

5.1.5	Indoor Motion Sensors.....	33
5.1.6	Indoor Motion Sensor with Dimmer Switches.....	33
5.1.7	Outdoor Motion Sensors.....	34
5.1.8	Power Bars with Integrated Timer	35
5.1.9	Load Sensing Power Bars (Smart Strips).....	35
5.1.10	Heavy Duty Outdoor Timers	36
5.1.11	Programmable Thermostats	37
5.1.12	Clotheslines and Outdoor Drying Racks.....	39
5.1.13	CEE Tier III Refrigerators	40
5.1.14	CEE Tier III Clothes Washers.....	41
5.1.15	Demand-to-Energy Ratio.....	44
5.1.16	Revised Gross Savings	45
5.2	Interactive Effects	46
5.3	Net-to-gross Ratio.....	48
5.3.1	Free-ridership	48
5.3.2	Spillover	49
5.3.3	NTGR Calculation.....	49
5.4	Net Savings.....	50
CONCLUSION		53
APPENDIX I 2014 RECOMMENDATIONS		55
APPENDIX II INTERVIEW GUIDE WITH DELIVERY AGENT.....		57
APPENDIX III INTERVIEW GUIDE WITH RETAILER PARTNERS		61
APPENDIX IV IN-STORE VISIT PROTOCOL.....		69
APPENDIX V PARTICIPANT INTERCEPT SURVEY QUESTIONNAIRE		86
APPENDIX VI PARTICIPANT SURVEY RESULTS.....		107
APPENDIX VII ALGORITHM FOR FREE-RIDERSHIP CALCULATION.....		118
APPENDIX VIII INTERNAL SPILLOVER METHODOLOGY		119

LIST OF TABLES

Table 1: Distortion Effects and Net-to-Gross Ratio	X
Table 2: Comparison of Tracked and Evaluated Savings at the Generator	X
Table 3: List of Discounts per Product	1
Table 4: Survey Sample Size and Margin of Error	5
Table 5: Implementation Status of Recommendations in the 2012 and 2013 Executive Summaries	6
Table 6: Sources of Awareness	20
Table 7: Discount Awareness	21
Table 8: ENSC Awareness	21
Table 9: Type of Lamp Purchased	22
Table 10: CFLs/LED Lamps Currently Installed	22
Table 11: Importance of Discount in Influencing Installation	23
Table 12: Other Discounted Products Awareness	23
Table 13: Residential Lighting Metering Studies	28
Table 14: ENSC's Unitary Savings Calculations for Dimmer Switches	32
Table 15: Tracked Unitary Savings Value for Indoor Motion Sensors	33
Table 16: Revised Unitary Savings for Dimmer Switches with Motion Sensors	34
Table 17: Revised Unitary Savings for Outdoor Motion Sensors	34
Table 18: Unitary Savings Calculations for Power Bars with Integrated Timer	35
Table 19: Calculation Assumptions for Load Sensing Power Bars	36
Table 20: Tracked Unitary Savings Estimation Based on Results from Hydro-Québec's Evaluation of Electronic Thermostat Savings	37
Table 21: Measuring Studies on Programmable Thermostats Energy Savings	38
Table 22: Revised Unitary Savings Value for CEE Tier III Refrigerators	41
Table 23: Energy Consumption Breakdown for Standard and Efficient Clothes Washers	42
Table 24: Water-heating Sources for Clothes Washers	43
Table 25: Electricity Consumption for Standard Clothes Washers	43
Table 26: Electricity Consumption by Efficient Clothes Washers	43
Table 27: Evaluation Results – Gross Energy and Peak Demand Savings by Product – Lighting Products	45
Table 28: Evaluation Results – Gross Energy and Peak Demand Savings by Product – Other Products	46
Table 29: Interactive Effects Calculations for Lighting Products	47
Table 30: Interactive Effects Factor for CFLs, LED Lamps and LED Recessed Downlights	47
Table 31: Net-to-Gross Ratios	49
Table 32: Evaluation Results – Net Energy and Peak Demand Savings by Product – Lighting Products	50
Table 33: Evaluation Results – Net Energy and Peak Demand Savings by Product – Other Products	51
Table 34: Comparison of Tracked and Evaluated Savings at the Generator	52

LIST OF FIGURES

Figure 1: Methodological Model	3

EXECUTIVE SUMMARY

This report presents the results of the 2014 process, market and impact evaluation of Instant Savings, which is a component of the Residential Efficient Product Rebates program. The 2014 evaluation was based on in-depth interviews with the Program Manager (PM), the delivery agent (DA) and 14 retailers (also known as partners), 20 in-store visits, an in-store intercept survey of 294 participants who purchased compact fluorescent lamp (CFL) and light-emitting diode (LED) lamps, and a unitary savings review.

Program Component Overview

In 2014, Instant Savings worked in collaboration with nine major retail chains and 34 independent retailers across Nova Scotia to offer customers in-store discounts on different energy-efficient products. Discounts on eligible products were offered through two campaigns that took place in the spring (from April 1 through May 15, 2014) and the fall (from, October 1 through November 16, 2014). Discounts on Consortium for Energy Efficiency (CEE) Tier III refrigerators and CEE Tier III clothes washers were offered over a longer period in 2014, from January 15 through December 31.

Discounts were offered on the following types of products:

- › ENERGY STAR® regular and specialty CFLs (spring campaign only)
- › ENERGY STAR® LED lamps and recessed downlight fixtures
- › Hardwired dimmer switches
- › Indoor and outdoor motion sensors
- › Power bars with integrated timers
- › Load-sensing power bars (smart strips)
- › Heavy-duty outdoor timers
- › Programmable thermostats for electric baseboard heaters
- › Outdoor clothesline kits and outdoor clothes dryers (spring campaign only)
- › CEE Tier III refrigerators
- › CEE Tier III clothes washers with an energy consumption of 130 kWh or less

In 2014, Instant Savings was advertised through in-store promotions, store flyers, radio remotes, television and newspaper advertising, the Efficiency Nova Scotia Corporation (ENSC) website and other online platforms, social media, associated training and customer engagement in-store events. The purpose of these events was to provide information about Instant Savings and its products, as well as about other ENSC programs and services.

Instant Savings aimed to achieve net electricity savings of 13.4 GWh and peak demand savings of 2.1 MW for 2014.

Key Findings

In 2014, Instant Savings generated 9.360 GWh in net electricity savings at the generator in comparison with 26.524 GWh in 2013 and 10.767 GWh in 2012. It also generated peak demand savings of 1.479 MW at the generator in 2014. The main findings are presented in the following sub-sections.

Partner Satisfaction and Barriers

The DA was asked to share its feedback about Instant Savings and ENSC in 2014. For the most part, the DA was pleased with the program's success, program marketing, outreach activities and the relationship with ENSC staff. The DA was also satisfied that its relationship with the retailers improved over time, citing increased familiarity with the program's management and delivery requirements. However, the DA mentioned that retailers had varying levels of engagement and commitment towards promoting the program among customers and this remains one of the main barriers to the delivery of Instant Savings. During the in-store visits, the Evaluator did notice a lack of proper installation of the point-of-purchase (POP) displays in some stores.

The retailers interviewed gave the highest overall satisfaction ratings to their relationship with ENSC and the DA, as well as the support and communication. However, regarding communication, some retailers considered the delay for approving the list of eligible products to be too long, even though ENSC has confirmed that all lists were approved within the deadlines defined by the contractual agreement. Some retailers also mentioned dissatisfaction concerning rebate-processing, tracking and reporting, and more specifically concerning the delay in the reimbursement.

Awareness and Education

Similar to previous years, ENSC sources were the most common way for participants to find out about Instant Savings. These sources included media advertising in general, ENSC representatives during an in-store event, the ENSC website and in-store promotions (stickers, shelf signs or posters), which the vast majority of participants recalled seeing in the stores. Word of mouth was also an important source of awareness.

In terms of education, the DA believed that Instant Savings was very successful in improving general awareness about energy efficiency and about ENSC in particular. Furthermore, the customer engagement events were quite successful in informing clients about eligible Instant Savings products. During both campaigns, representatives were able to provide information on Instant Savings, but the spring representatives did a better job in informing the mystery shopper about other ENSC programs.

Energy Savings

The impact evaluation was conducted on the basis of the data and information gained from three main activities: a review of the unitary savings used to estimate gross savings; the CFL and LED lamp-buyer intercept survey; and the retailer interviews. To calculate the gross and net savings, the Econoler team took into consideration the interactive effects for lighting products, as well as free-

ridership and spillover for the two best-selling products (regular CFLs and LED lamps). The table below shows the net-to-gross ratio (NTGR) calculated by taking into account the free-ridership and spillover levels established in this evaluation. A NTGR of 1 was used for all other products, since the population of buyers of these products was too small to reach a sufficient number of participants through an intercept survey.

Table 1: Distortion Effects and Net-to-Gross Ratio

Product Category	Free-ridership	Spillover	NTGR
Regular CFLs	54%	28%	0.74
LED Lamps	0%	20%	1.20
All Other Products	-	-	1.00

The evaluation has revealed that Instant Savings generated net energy savings of 9.360 GWh and peak demand savings of 1.479 MW at the generator in 2014. These results include the savings from the products sold over the two campaign periods.

Table 2: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR*	Net Savings
Energy Savings					
Tracked Savings from ENSC	16.879 GWh	15.921 GWh	13.916 GWh	1.08	15.026 GWh
Evaluation Results	10.754 GWh	10.754 GWh	9.478 GWh	0.99	9.360 GWh
Peak Demand Savings					
Tracked Savings from ENSC	2.414 MW	2.277 MW	1.99 MW	1.08	2.149 MW
Evaluation Results	1.699 MW	1.699 MW	1.497 MW	0.99	1.479 MW
*NTGR was different for each category of product. The NTGRs presented in this table correspond to the rounded averages obtained by dividing the net savings by the installed gross savings (with interactive effects).					

Many elements can explain why the evaluated savings, both gross and net, have been lower than the corresponding tracked values. First of all, the baseline wattage for LED lamps, the best-selling product, was adjusted to take into account the percentage of participants who bought LED lamps to replace CFLs and LED lamps, rather than incandescent lamps. This adjustment reduced the unitary savings of LED lamps by 57 percent, and therefore had a significant impact on the evaluated gross savings. Nevertheless, this new approach using an adjusted baseline to take into account the types of lamps being replaced with LED lamps resulted in a nil level of free-ridership for LED lamps, as recommended by the Uniform Methods Project (UMP). Some other products also saw their unitary savings decrease (e.g., heavy-duty timers and clothes washers) based on new calculations that more accurately represent the baseline available on the market and/or the use made of those products.

Additionally, the NTGR calculated this year for regular CFLs was lower than the value established in the 2013 evaluation due to an increase in the free-ridership level.

This has resulted in evaluated net energy savings being 38 percent lower than the corresponding tracked value, while the evaluated net peak demand savings were 31 percent lower than the tracked value. The variation between the evaluated peak demand savings value and the tracked value was smaller, because the demand-to-energy ratio used for peak demand savings calculation increased from 0.143 in 2013 to 0.158 in 2014.

RECOMMENDATIONS

Overall, the Econoler team is of the opinion that though Instant Savings contributed to the market transformation in Nova Scotia, its net impact decreased significantly this year. In addition to the general recommendations presented for all ENSC program components in the overall 2014 evaluation report executive summary of the demand-side management (DSM) programs, the team makes specific recommendations in this report aimed at optimizing Instant Savings. What follows is a summary of the most important recommendations:

2014 Instant-R1. Continue monitoring the retailers' commitment to meeting POP requirements.

The DA mentioned that though its interactions with retailers improved over time, challenges remain in engaging some of the retailers. The DA pointed out that weak retailer engagement can often lead to issues with proper POP installation. When making in-store visits, the Evaluator did notice some shortcomings in the in-store signage installation, which could mislead both salespeople and customers about which products are discounted. The Evaluator recommends continuing to check on POP displays to ensure that retailers fully meet the POP requirements.

2014 Instant-R2. Improve training among in-store event representatives. The evaluation results indicate that there is room for improving in-store event representatives' knowledge and training. For instance, during the three customer engagement events visited by a mystery shopper in the fall campaign, no representative offered information about the other programs offered by ENSC. The DA reported receiving participant complaints about event representatives providing inaccurate information about other ENSC programs. Additionally, one nationwide retailer questioned the level of knowledge of an event representative in one of its stores. All this feedback highlights the need for ENSC and the DA to improve training among event representatives to strengthen the program's educational components. Customer engagement events in general have been successful and considered useful over the years by both the DA and the Evaluator; such training would further improve the positive impact of those events.

- 2014 Instant-R3. Better communicate with the retailers regarding the program processes and timeline.** This year, some retailers expressed some dissatisfaction with the time waited to obtain a final list of approved product SKUs and receive their payments after submitting their sales data. However, ENSC claimed that it had sent the list of eligible product categories and rebates within the 90-day timeframe prior to campaign deadline (which is verbally agreed upon with the retailers). In fact, the retailers had to send the list of product SKUs to ENSC and the DA; failure to provide complete information could lead to delays in approving the final list. ENSC also claimed that the processing of the rebate payment had never taken more than 45 days, as required by the contract signed with the retailers. The Evaluator thinks that the reason why some retailers thought that ENSC failed to meet their expectations could have been due to a lack of clear and effective communication concerning timelines and the information required.
- 2014 Instant-R4. Continue to closely monitor the evolution of the market for lighting products.** This year, the evaluated savings of LED lamps were significantly reduced in comparison with the tracked values, because the baseline wattage was lowered. Indeed, the Atlantic Survey showed that more than half of the LEDs purchased were used to replace CFLs. The Evaluator believes that ENSC should continue to use surveys and other tools to monitor the evolution of the market, as incandescent have already started being phased out as required by the federal regulation. ENSC should also expect unitary savings of lighting products to continue decreasing in the years to come.
- 2014 Instant-R5. Analyze the CEE Tier III appliances offered.** In September of 2014, the CEE Tier III energy performance requirements for refrigerators increased significantly in order to align with the new American federal standards. As a result, the availability of Tier III qualified refrigerators is currently very limited, and ENSC has so far applied the previous Tier III specifications as an eligibility requirement for Instant Savings. In 2015, ENSC will have to determine a new eligibility criterion, because the list of the refrigerators complying with the old CEE standard will no longer be available. This new criterion must take into account the availability of eligible products in Nova Scotia, while ensuring that the promoted products can perform significantly better than the average products on the market. This recommendation also applies to clothes washers, for which the CEE Tier III was considered to be too close to the baseline (e.g., many distributors said in 2012 that they only sold Tier III models). Therefore, an energy consumption criterion was added in 2013 and should be reassessed periodically.

1 PROGRAM DESCRIPTION

Efficiency Nova Scotia Corporation's (ENSC) Instant Savings offers customers instant cash discounts at participating retailers across Nova Scotia when they purchase eligible energy-efficient products. Instant Savings is carried out together with a delivery agent (DA), the Summerhill Group, nine major retail chains and 34 independent retailers.

In 2014, discounts on eligible products were offered during two campaigns that took place in the spring and the fall. The campaigns ran from April 1 to May 15, 2014, and from October 1 to November 16, 2014. Discounts on Consortium for Energy Efficiency (CEE) Tier III refrigerators and CEE Tier III clothes washers were offered over a longer period in 2014, from January 15 through December 31. Discounts on regular and specialty compact fluorescent lamps (CFLs), as well as on outdoor clothesline kits and outdoor racks were offered only during the spring campaign. CFLs were removed from Instant Savings after the spring campaign for several reasons: their high penetration on the market, the federal standard phasing out incandescent light bulbs and the Evaluator's recommendation to have them removed; whereas outdoor clothesline kits and racks were removed from the fall campaign for a matter of season.

Instant Savings features the following efficient products, each with a distinct discount. ENSC conducted an optimal price study between the spring and fall campaigns, which explains why discount amounts in the spring and the fall vary for some products.

Table 3: List of Discounts per Product

\$3 on ENERGY STAR® Regular CFLs (multipacks of two or more) – spring only	\$5 on Power Bars with Integrated Timers
\$3 on ENERGY STAR® Specialty CFLs (single or double packs) – spring only	\$10 (spring) / \$15 (fall) on Load Sensing Power Bars (Smart Strips)
\$5 on ENERGY STAR® Specialty CFLs (multipacks of three or more) – spring only	\$10 on Heavy Duty Outdoor Timers (plug-in)
Up to \$8 on ENERGY STAR® LED Lamps	\$10-\$30 (spring) / \$15-\$45 (fall) on Programmable Thermostats for Electric Baseboard Heaters (single pack/multipacks of three or more)
Up to \$10 (spring) / Up to \$15 (fall) on ENERGY STAR® LED Recessed Downlight Fixtures	\$5 on Outdoor Clothesline Kits and Outdoor Drying Racks – spring only
\$3 (spring) / \$5 (fall) on Dimmer Switches (hard-wired)	\$100 on Select CEE TIER III Refrigerators
\$3-4 on Indoor and Outdoor Motion Sensors (hard-wired)	\$75 on Select CEE TIER III Clothes Washers (energy consumption of 130 kWh or less)

In 2014, Instant Savings was advertised through in-store promotions, store flyers, radio remotes, television and newspaper advertising, the ENSC website and other online platforms, social media, associate training and customer engagement events. An Instant Savings App for iPad was also

developed for use by the representatives during the customer engagement events. The purpose of these events, which were held in participating retail stores during the campaign periods, was to provide information about Instant Savings and to cross-promote other ENSC programs and services. With the aim of making customers more aware of the non-lighting products available under Instant Savings, the customer engagement events held in 2014 were also used to further promote products other than CFLs and LED lamps, such as dimmer switches and power bars.

In 2012, ENSC conducted a LED research study to understand the barriers and perceptions associated with LED lamps and their use by Nova Scotians. The study revealed that Nova Scotians are indeed less receptive to purchasing LED lamps than CFLs, with prices being the main barrier. This represents a major opportunity for Instant Savings, as it offers significant discounts on LED lamps and LED recessed downlights.

Instant Savings aimed to achieve net electricity savings of 13.4 GWh and peak demand savings of 2.1 MW for 2014. Savings generated by Instant Savings are reported under the Residential Efficient Product Rebates.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and details on the activities carried out for the Instant Savings evaluation.

2.1 Presentation of the Team

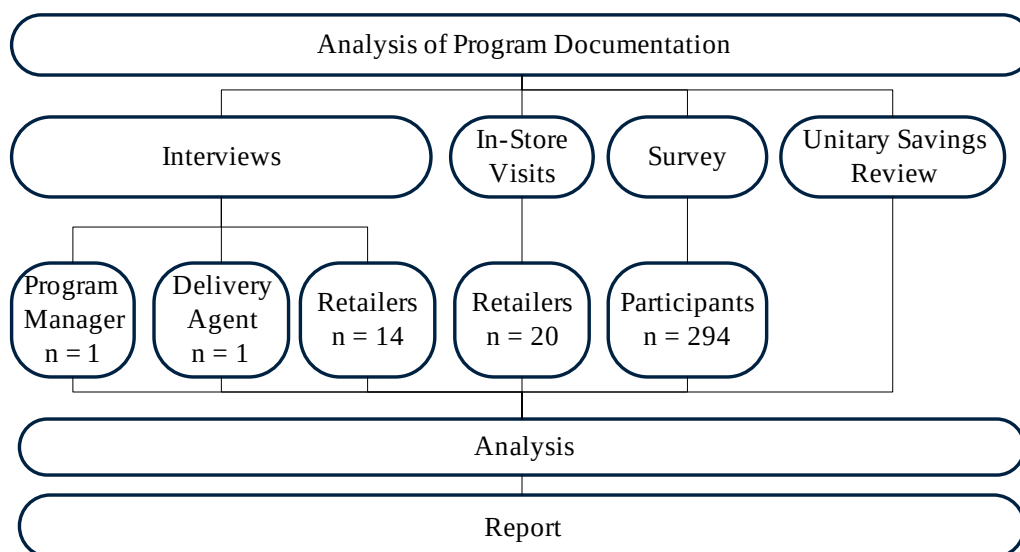
To carry out the 2014 evaluation, Econoler worked with two partner entities: Corporate Research Associates (CRA) and Equilibrium Engineering. Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all deliverables.
- › CRA conducted interviews with the DA and retailers, as well as an intercept survey with participants. CRA also analyzed and reported on data collected from these activities.
- › Equilibrium Engineering reviewed the tracking sheet and assisted Econoler with certain parts of the impact evaluation.

2.2 Evaluation Activities

Figure 1 illustrates the research strategy and data collection activities involved in the 2014 evaluation.

Figure 1: Methodological Model



Each step of this methodological model is further detailed in the following sub-sections.

2.2.1 Interview with Program Manager

The Econoler team conducted one interview with the Program Manager (PM) in September 2014. This interview was intended, among other things, to follow-up on the 2012 and 2013 evaluation recommendations, as well as to understand the main changes that occurred in the 2014 program delivery. Based on the information obtained in this interview, a list of questions and topics to include in the data collection tools was drawn up.

2.2.2 Interview with Delivery Agent

In October 2014, one interview was conducted with the DA in order to understand their involvement in the program, their participation process, as well as their perception of and satisfaction with the program.

The guide used for the interview with the DA is presented in Appendix II for reference.

2.2.3 Interviews with Retailers

In the fall of 2014, CRA conducted a total of 14 in-depth interviews with retailers (also known as “partners”). These interviews focused on two specific products: ENERGY STAR® CFLs and ENERGY STAR® LED lamps. Spillover (through market effects) was measured for both products using in-depth interviews. The aim of the interviews was also to understand the process the retailers underwent as part of their participation, determine their perceptions and gauge their level of satisfaction with Instant Savings.

The guide used for the interviews with the retailers is presented in Appendix III for reference.

2.2.4 In-store Visits

In the spring (April) and fall (October) of 2014, a total of 20 visits and observations were conducted by Econoler in various stores to gather qualitative information to describe the in-store client experience. Nine major chain retailers were visited.

The following elements were assessed in these in-store visits and observations:

- › Efficiency of instant rebates awarded at the counter
- › Product promotional displays
- › Employees’ knowledge of the products and program

A copy of the in-store visit protocol is included in Appendix IV.

2.2.5 Survey

An intercept survey with a total of 294 participants who purchased qualifying CFLs or LED lamps during the spring and fall campaign was conducted by CRA staff in Halifax. The spring survey focused

on CFLs and LED lamps, whereas the fall survey focused only on LED lamps since CFLs were no longer discounted. The interviews were conducted in-store in April, May, October and November at five of the participating retail banners. The average survey length was five minutes.

The participant survey was meant to generate feedback on the following aspects of Instant Savings:

- › CFL and LED lamp purchases
- › Free-ridership
- › Program awareness
- › Discount awareness
- › Products rebated

The questionnaire and complete survey results are presented in Appendices V and VI respectively. The table below shows the sample sizes and the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 intercept surveys.

Table 4: Survey Sample Size and Margin of Error

Survey	<i>Sample Size (n)</i>	Margin of Error at 90% Confidence Interval
2014 Participants	294	±4.8%
2013 Participants	241	±5.3%
2012 Participants	164	±6.5%

The margin of error is used to determine the level of precision¹ of the measurement, and its associated confidence level indicates the probability for a measure to fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling error into account; they do not reflect non-sampling error or bias such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

2.2.6 Unitary Savings Review

To review the unitary savings values used in the tracking sheet, the Econoler team validated the parameters currently used in the tracked savings calculations by conducting a literature review of technical reference manuals and public evaluation reports of similar jurisdictions and choosing the most recent and accurate data sources. When no reliable or representative source could be found in the literature, engineering calculations were made to estimate savings.

¹ Precision refers to how close the measured values are to each other. However, it does not take into consideration how close the measured value is to the true value, which refers to accuracy.

3 PROCESS EVALUATION

This section presents the findings of the 2014 Instant Savings process evaluation, which has been carried out on the basis of the information gathered from the Instant Savings documentation and tracking system, as well as an interview with the PM and in-store visits.

3.1 Follow-up on 2012 and 2013 Evaluation Report Recommendations

This section reports on the progress made in acting on the recommendations made by the Evaluator in the 2012 and 2013 evaluation reports. The Evaluator follows up on recommendations from both 2012 and 2013 because only a partial process evaluation was conducted in 2013, which did not include a review of the implementation status of the 2012 recommendations.

To monitor the progress in implementing the recommendations, the PM has been using a monitoring tool, namely a table that documents all the recommendations made and the corresponding implementation status. This tool is an excellent initiative which serves to enhance the program memory principle.

The Evaluator analyzed the content of the file to determine whether ENSC followed up on the recommendations. Table 5 gives a brief summary of the implementation status of each recommendation presented in the executive summary section of the 2012 and 2013 evaluation reports.

**Table 5: Implementation Status of Recommendations in the 2012 and 2013
Executive Summaries**

Recommendation	Status
2012 Recommendations	
2012 Instant-R1. Document the AIR MILES® approach	No longer applicable
2012 Instant-R2. Generate greater involvement from the retailers	Implemented
2012 Instant-R3. Focus on LED products going forward with the program	Implemented
2012 Instant-R4. Modify the offer of appliances under the program to consider the most energy-efficient appliances available on the market	Implemented
2012 Instant-R5. Improve the content of the tracking sheet	Implemented
2013 Recommendations	
2013 Instant-R1. Increase promotion of products other than CFLs and LED lamps	Implemented
2013 Instant-R2. Move forward with the transition from CFLs to LED lamps in 2014	Implemented
2013 Instant-R3. Review wattage entries in the tracking sheet for LED lamps and LED recessed lamps	Partially Implemented
2013 Instant-R4. Continue conducting general population surveys to assess key parameters used for the gross savings calculation of CFLs and LED lamps	Implemented
2013 Instant-R5. Consider adjusting the hours of operation used in the unitary savings calculations for lighting products in the upcoming years	Implemented

The sections below detail the actions that were taken by ENSC following these recommendations.

2012 Executive Summary Recommendations

The Evaluator noticed that four of the five recommendations were implemented by ENSC and allowed for overall program improvement. The only recommendation that was not implemented is the one requesting ENSC to document the AIR MILES approach (2012 Instant-R1). Prior to the spring campaign of 2013, AIR MILES incentives were removed from Instant Savings due to budget constraints and low savings generated through that approach in 2012.

The implementation of the other recommendations has resulted in a number of changes in Instant Savings. Among these, it is worth mentioning that during the 2012 evaluation, the Evaluator recommended centering the Instant Savings lighting offer around LED products over the years to come. Given the relatively high free-ridership level measured for regular CFLs, the Evaluator also suggested planning the removal of regular CFLs from the list of eligible products for 2014 (2012 Instant-R3). Following this recommendation, ENSC phased out CFLs from Instant Savings, with a final removal in July 2014. The market being in an advanced state of transformation with regards to CFLs, they were removed from the program to facilitate stronger market penetration for LED lamps.

Retailers interviewed during the 2012 evaluation pointed out that not many models of CEE Tier III refrigerators existed on the market, which constitutes a very specific class of high-end products. Moreover, many CEE Tier III refrigerators are larger in size. The Evaluator recommended adding to Instant Savings smaller models of CEE Tier II refrigerators with low annual energy consumptions to increase sales of this product and avoid promoting the purchase of larger refrigerators when it is not necessary (2012 Instant-R4). As for clothes washers, many of the retailers interviewed mentioned carrying only CEE Tier III washers in their stores. Therefore, the program did not have a great impact on their sales since the rebate became an extra instead of being the main incentive for customers to buy. The Evaluator thus recommended discounting a selection of energy-efficient clothes washers limited to the highest energy-efficient models (2012 Instant-R4). Following this recommendation, ENSC added Tier II refrigerators to the list of eligible products for 2013. Very few were however sold that year, and ENSC decided it was not required to continue offering a discount on them in 2014. As for clothes washers, ENSC modified its eligibility criteria to only discount Tier III clothes washers with an energy consumption of 130 kWh or less.

2013 Executive Summary Recommendations

Four of the five recommendations were implemented by ENSC. Acting on these recommendations, ENSC increased promotion of products other than CFLs and LED lamps, and continued conducting general population surveys to assess key parameters used for the gross savings calculation of CFLs and LED lamps.

Findings from the 2013 intercept survey indicated that under half of participants were aware of other products discounted through Instant Savings, besides the CFLs or LED lamps they had purchased. Yet, only a minority of those participants indicated having purchased or having the intention of purchasing those other products. The Evaluator recommended doing further promotion of products other than CFLs and LED lamps to increase the sales of those other products during the discount periods (2013 Instant-R1). To act on this recommendation, ENSC first carried out an optimal price point study to determine the price customers are willing to pay for those other energy-efficient products. In addition to in-store events held in 2014 that were used to highlight those products, a new POP system was also developed to direct customers towards other sections of the store that promoted and sold other eligible products. ENSC has also implemented a number of initiatives for 2014, such as the launch of the Instant Savings application, which shows customers the savings they can achieve through the use of eligible energy-efficient products.

Key parameters such as light bulb replacement and indoor/outdoor installation ratios have been evaluated since 2013 through the Atlantic Quarterly survey conducted by ENSC. This approach, using a general population phone survey, has proved more effective than the intercept survey to estimate such parameters. Therefore, the Evaluator recommended that ENSC continue undertaking this kind of general population surveys to assess the key parameters used in the gross savings calculation for lighting products. ENSC has followed this recommendation and conducted two general population surveys in 2014 to obtain this essential information, one in early 2014 and one in the fall.

The Evaluator has seen significant improvement in accuracy of the wattage values entered for LED lamps (2013 Instant-R3). In the sample used to establish the unitary savings for this year's products, the wattage was entered correctly for 9 out of 10 lamp models. However, there were still problems with the wattage values entered for LED recessed lamps, with values entered found to be inaccurate for 7 out of the 10 lamp models sampled by the Evaluator. It should be noted though that three of these inaccurate wattages were actually entered correctly into the DSMDS (as 9.5 watts), but appeared without their decimal digit (just 9 watts) in the report used for evaluation purposes. This was due to a technical weakness of the DSMDS report-generating function, which automatically removes decimal digits in this field.

Another recommendation that had not been implemented by ENSC has been addressed as part of this evaluation and can now be considered implemented. Due to the evolving market environment and in order to achieve greater precision, the Evaluator recommended that ENSC consider adjusting the hours of operation for their savings calculations. While a metering study in Nova Scotia was

mentioned as the most accurate way of estimating the hours of operation, the Evaluator suggested, as a more affordable option, using the U.S. Department of Energy's Uniform Methods Project (UMP) principles and potentially adjusting the number of sockets per household (2013 Instant-R5). Following this recommendation, ENSC decided that no metering would be performed in 2015 due to budget constraints. Therefore, the second option, the literature review, was instead conducted by the Evaluator as part of the 2014 evaluation. As a matter of fact, the Evaluator found, in 2014, a new residential lighting measuring study that took into account the difference in hours of operation between the efficient lamp and the standard lamp. This study was conducted in a geographically similar location (the northeastern United States) on a large sample of households; it is thus considered adequate to estimate savings for ENSC's programs.

3.2 Program Documentation and Design

As part of the evaluation, the Evaluator analyzed the program documentation and worked together with the PM to improve and revise the content of the program manual, the evaluation plan and the logic model, where applicable. More specifically, this revision work helped define relevant goals and barriers for Instant Savings that can be easily assessed.

In addition to this revision work, the Evaluator noted that the following change should be documented in the Revision section of the program manual:

- › ENSC added Tier II refrigerators to the list of eligible products in 2013, but decided it was not required to keep offering a discount on them in 2014 due to low sales.

The Evaluator also noted one element that was missing from the evaluation plan. Instant Savings was designed in such a way that participants are not identified. This leaves the Evaluator with a series of unknown variables, such as whether the product was actually installed, whether the purchased CFLs or LED lamps replaced the same type of lamp or a less efficient lamp, the number of hours the product is being used in a day, etc. To overcome these unknown variables, the Evaluator must rely on surveys and secondary research. This specific challenge of not knowing who the participants are should be mentioned in the next version of the evaluation plan.

As previously mentioned, to make it easier for consumers to participate, information about participants' identification is not collected under Instant Savings, given that most discounted products are small items that can be purchased in many retail stores across the province. Information about participants could still be collected for large appliances, such as clothes washers and refrigerators. ENSC should pursue its efforts with appliance retailers to obtain participant identification for program evaluation purposes. Another option to collect participant information would be to provide participants with an invitation to register online for a survey on the ENSC website when they purchase eligible products in-store.

3.3 Tracking System

For 2014, the tracking information for Instant Savings is presented in the form of an Excel spreadsheet, which is subsequently uploaded into the demand-side management data system (DSMDS). Each participating retailer collects the information on the individual products sold, such as the measure code, SKU, retail and promotional pricing, rebates, and the product specific information. This information is then compiled into a single sheet by Summerhill and then submitted to ENSC. As in 2013, the tracking sheet is formatted to be very clear and concise.

The tracking sheet contains detailed data on the number of units per package, the number of packages sold, and the associated unitary savings value. This allows ENSC to easily calculate the gross energy savings. Another field contains the specific store identifier (i.e., the individual store where the products were sold)—this is particularly important for the national retailers who have multiple locations, especially when error occurs and the store manager needs to be contacted. There are approximately 20 percent of the records in which the store identifier is not provided, which is an improvement of 9 percent points since 2013. The Evaluator commends ENSC on its continued efforts to improve this percentage every year, and reiterates that this information is helpful in planning data collection activities, such as intercept surveys.

The retailers also provide product-specific wattages. This information is available in the tracking sheet for more than 99 percent of all CFLs and 99 percent of all LED lamps and recessed downlights sold. The Evaluator verified the entered wattage of the 10 most popular LED lamps to ensure that it was consistent with the product specifications, and it turned out to be the case for nine products. For one product, one of the two retailers had entered a value of 11 W instead of 10.5 W, which had an effect on 3,236 lamps. In another case, the retailer presented the sale for three similar (but not identical) LED lamps under a single transaction. The lamps had a wattage that varied between 4.9 W and 5 W, which is not a significant difference. This is nonetheless a bad practice that reduces the accuracy of savings claimed under Instant Savings. The same kind of verification done on recessed LED lamps showed that only 3 out of 10 products had consistently correct wattage values entered. Notwithstanding those small errors, the Evaluator recognizes that the accuracy of wattages entered into the tracking system has greatly improved since last year. The verification of LED product wattages was one of the 2013 recommendations after the Evaluator had found a significant proportion of errors in the wattage information entered in the tracking sheet. The Evaluator therefore commends ENSC on this improvement and encourages them to pursue this verification.

The tracking sheet also provides information on the retail pricing and promotional pricing with the discount offered. Rebates applied by retailers are consistent with the prescriptive amounts identified in the 2014 Instant Savings Program Manual. Although the rebate amount is recorded for each of the 14,156 records, the retail and promotional pricing information is absent for approximately 13 percent of all cases. Another issue encountered by the Evaluator was that model numbers were missing for a non-negligible proportion of appliances. If these model numbers were found in the SKU or Product Technical Info fields, the Evaluator made the necessary modifications. Even after such remedial

actions, the model number was still missing for 4 percent of all the refrigerators and clothes washers entries (corresponding to 12% of the appliances sold). This field is crucial to determining the unitary savings of each appliance, since the Evaluator bases its calculations on the specifications of a sample of the most popular models found in the tracking sheet.

To estimate the gross energy and peak demand savings generated, ENSC uses specific unitary savings values for each product type. The unitary savings values are listed in a separate table. The tracking sheet automatically calculates the gross savings based upon the unitary savings value and the quantity of units sold.

The Evaluator considers the 2014 Instant Savings tracking sheet concise and straightforward. However, there are two improvement recommendations to make:

- › **Ensure the model number field is completed and accurate for all the appliances.** Since the unitary savings value is based on the most popular appliance models sold, it is necessary to have this field accurately completed for all those products.
- › **Ensure retailers enter all requested info.** Some of the independent retailers do not provide pricing, SKU numbers or technical information on the products. This information is valuable for some activities included in the impact evaluation, such as validating the technical specifications of the products sold.

3.4 In-store Visits

In the spring and fall 2014, a total of 20 visits and observations were conducted in various stores to gather qualitative information that would describe the in-store client experience. Nine major chain retailers were visited. The following sections describe the mystery shopper's key findings as a result of the in-store visits.

3.4.1 Spring Campaign

Effectiveness of Instant Discounts Awarded at the Cash

Most retailers automatically awarded the discount at the cash register when a qualifying product was purchased. In four out of nine² visits, however, the mystery shopper had to ask the cashier if a discount was applied because it was unclear. In two cases, it was because the discount awarded did not appear on the receipt. In another case, the mystery shopper was unaware that they needed a coupon to receive the discount. In the last case, the mystery shopper realized that the total price paid did not include the discount and then asked the cashier to confirm that there was indeed a discount on the product.

² Ten visits were conducted, but no product was bought at Sears.

Product Promotional Displays

The majority of the stores visited used the point-of-purchase (POP) displays provided by ENSC and displayed them in each section where eligible products were found. Most of the proposed promotional tools were used in the stores visited and included mainly stickers, as well as some bin violators, shelf talkers, posters and hang tabs.

Despite a good POP display for most of the eligible products, the mystery shopper noted that the clotheslines were more difficult to identify than other products. They were either placed too high or too low on the shelf, and POP for this product was less visible. In two cases, the mystery shopper needed help from the salesperson to find qualifying clotheslines. It should however be noted that product placement is not something over which ENSC has control.

The mystery shopper observed that one retailer used mostly in-house POP displays and promotion methods, which were really effective. In this particular case, eligible products were arranged on a table and also presented in a flyer, which were both located at the store entrance, which left no ambiguity for the customer. This goes to show that even though this retailer chose not to use ENSC's POP, they still found a way to promote Instant Savings effectively.

Out of the 10 stores that were visited, two had an in-store event at the time the mystery shopper conducted their visit. Overall, the in-store events were very successful—the two representatives knew the products and applicable discounts well. Both gave information on the other programs offered by ENSC. The information booths were well located in high-traffic areas.

Employees' Knowledge of the Products and Program

Overall, the salespeople were aware of the Instant Savings campaign, though they were not always aware of the terms and conditions of the program, such as the end date of the campaign. Salespeople were usually aware of the discount amounts applied to the offered products. That being said, the mystery shopper noticed that salespeople were less aware of the discount amounts when the POP displays were not properly in place and that discounts were not clearly associated to products. This suggests that salespeople may rely on POP displays to inform customers of eligible discounts, which stresses the importance to have the POP installed correctly throughout the entire campaign.

The salespeople's knowledge of the characteristics associated with energy-efficient products was mixed. Few of them knew the difference between energy-efficient and non-energy-efficient products.

3.4.2 Fall Campaign

Effectiveness of the Instant Discounts Awarded at the Cash

All retailers automatically awarded the discount at the cash register when a qualifying product was purchased. In one case, however, the mystery shopper expected to receive a \$5 discount, but instead received a \$3 discount at the cash, which was the right amount. The POP displays were therefore

misleading for this product. Moreover, it should be noted that the discount always appeared on the receipt, except on one occasion.

Product Promotional Displays

For the fall campaign, the mystery shopper noticed that a slightly wider array of POP tools was used by retailers. The most common POP tools were bin violators, vertical and horizontal hang tabs, tent cards, shelf talkers, posters and aisle interrupters.

In general, the stores visited used the POP displays provided by ENSC more evenly across all sections of the store. More specifically, the mystery shopper found that most of the POP displays were no longer concentrated in the lighting section of the store, as it was the case in previous visits. The other store sections were better highlighted by the POP than in previous visits. The Evaluator understands that this may be partly due to the fact that there are now fewer lighting products discounted under Instant Savings following the removal of CFLs, but also acknowledges the efforts made to promote products other than light bulbs, as recommended in the 2013 evaluation report. Indeed, the mystery shopper observed that some stores used POP displays to direct customers towards products other than lighting. For instance, three retailers used posters at the entrance of their store to promote these other products. One retailer also put up signs to advertise the sections of the stores where other eligible products could be found. However, the mystery shopper also noticed a lack of rigour in installing POP displays. For instance, some POP displays showed the wrong rebate amount for some lamps. In another case, the mystery shower noticed that a powerbar was identified as rebated even though it was not a smart powerbar.

Among the 10 stores visited in the fall, three had an in-store event at the time of the visit. Overall, the in-store events were quite successful. Representatives were indeed able to inform clients adequately about available products and applicable discounts. In one case, however, the mystery shopper was not told by the representative that a coupon was required to receive the discount at the cash register. Also, none of the representatives met during the fall campaign mentioned other ENSC programs, which had been the case during the spring campaign visits. No questions were asked either about whether the mystery shopper was a tenant or homeowner, as was the case during spring visits.

Employees' Knowledge of the Products and Program

Overall, the salespeople were aware of Instant Savings, but some of them did not know the campaign end date. That being said, every salesperson met knew that discounts were applied to various products as well as the discount amounts. Some of them were also able to redirect the mystery shopper to other eligible products.

3.4.3 In-store Visits Summary

In summary, the mystery shopper observed an improvement in the awarding of rebates at the cash between the spring and fall campaigns. Not only was there less confusion, but there were also fewer problems with processing rebates at the cash in the fall.

Special care was given to using a wider variety of POP displays and to better promoting products other than lighting products by installing posters or signs in key places of the store. POP displays were more uniform between all sections. On the downside, the mystery shopper believes more attention should be given to the installation of POP displays as they can be misleading to both customers and salespeople if not installed properly.

The events were clearly visible during both campaigns as the booths were placed in high-traffic areas. The representatives all had the necessary POP displays to inform clients about the campaign, but the spring representatives seemed better prepared to answer customers' questions than those in the fall. During both campaigns, representatives were able to provide information on Instant Savings, but the spring representatives were better at informing the mystery shopper on other ENSC programs.

4 MARKET EVALUATION

This section presents the findings of the 2014 Instant Savings market evaluation through the partner and participant perspectives.

4.1 Partner Perspectives

One interview with the DA and 14 interviews with retailers were conducted as part of the 2014 evaluation. The following sub-sections present the findings of an analysis of the feedback collected from these interviews.

4.1.1 Interview with Delivery Agent

The DA described its involvement in Instant Savings as complex, given its participation in multiple aspects of program delivery, including communication with all the retail partners, assigning and supervising the field staff, and developing the program design and strategy. It was determined that only minor changes were required in the way the DA worked to deal with ongoing program modifications this year.

Three barriers to the effective delivery of Instant Savings were identified. Specifically, retailer participation was identified as the primary barrier, with retailers having varying levels of engagement and commitment towards promoting the program among customers. The DA mentioned that some retailers required them to pay more attention to ensure they met POP requirements. Even though this is a service offered by the DA, it gave an indication of the retailer's engagement towards the program. Further, it was mentioned that some retailers had difficulty setting up rebate-processing at the point of sale, which led to lost savings opportunities for customers. Finally, the lack of adequate stock of rebated products was considered an issue. The retailers mentioned that the reason for this was the time they waited to receive the final list of rebated products. Although ENSC provided such list before the prescribed delay, some retailers still considered the wait time too long.

That said, opinions about Instant Savings were highly positive, particularly in terms of program marketing, outreach activities, and the relationship with ENSC staff and retailers. For the most part, the DA was pleased with the program's success, particularly in terms of meeting objectives, having a high level of awareness, and having achieved good market penetration. Overall, very few recommendations were made on program improvement, with the exception of further enhancing relationships and communication with nationwide retailers. It was also suggested to continue leveraging social media as the primary marketing and outreach tool, as well as brainstorming new and creative ideas to improve on the in-store customer engagement events.

The DA described the relationship with ENSC as collaborative and seamless. Interactions with retailers were also valued by the DA, who believed that those relationships had improved over time as everyone was getting increasingly familiar with program management and delivery requirements.

Further, it was mentioned that the strong and continuous efforts made by the DA's program implementation team has contributed to the development of strong relationships with retailers. The DA also believed that ENSC had offered sufficient opportunities to provide input about Instant Savings.

The DA believed that Instant Savings was very successful in improving general awareness about energy efficiency in general, and about ENSC in particular. The DA's in-store event representatives held 8,711 awareness conversations to date this year and 12,410 in-depth conversations with customers. It was recommended to continue building on the in-depth program training with in-store event representatives to strengthen the program's educational components.

The DA received feedback this year from in-store event representatives regarding the Instant Savings App. The App was considered an effective tool for engaging customers, with the summary page's savings calculation viewed as the most helpful function. It was however mentioned that some customers were intimidated by technology and thus preferred to engage in discussions with representatives.

The DA received three complaints from participants thus far in 2014. These participants believed in-store event representatives were providing inaccurate information about other ENSC programs. Complaints were first received by ENSC's Energy Solutions Advisors and then relayed to the DA, who addressed the complaints as high priority issues. If a complaint was related to a representative, the DA's program coordinator promptly addressed the issue with the representative. If the complaint was campaign-related (such as a rebate-processing issue, for example), the DA's program manager followed up on it with the retailer's head office representatives. Where possible, each complaint was addressed with the reporting participant on the same day it was received, or shortly after. To ensure that issues were solved to participants' satisfaction, the timeline and milestones for addressing complaints were formally tracked.

4.1.2 Interviews with Retailers

As part of the Instant Savings evaluation, eight interviews were conducted with nationwide retailers and six interviews were conducted with independent retailers. It should be noted that the nationwide retailers interviewed sold the majority of the rebated products sold under Instant Savings, whereas the independent retailers sold only appliances. Overall satisfaction with Instant Savings was moderately high, with opinions of independent retailers regarding various aspects of the program being generally better than those of nationwide retailers, with a few exceptions.

Regardless of the types of retailers, support and communication received the highest level of satisfaction rating, primarily because the program staff was deemed responsive, accessible, courteous, and helpful in providing information requested in a timely manner. Program materials were promptly mailed to retailers and independent retailers were pleased with the frequency at which program staff made in-store visits. Just a few concerns were raised with program communication. Specifically, one nationwide retailer questioned the level of knowledge of a DA representative that attended an in-store event. One independent retailer was displeased that the list of rebated appliances

was not updated in a timely fashion to align with manufacturers' released new models. Further, despite being highly satisfied with Instant Savings' support and communication, one retailer reported not being properly informed when it were assigned a new DA representative.

Opinions were also generally favourable regarding the marketing and advertising of Instant Savings, although many nationwide retailers did not comment on this aspect, because they were not familiar with initiatives being conducted in Nova Scotia. Point-of-sale advertising was well-liked and deemed adequate by many retailers. That being said, one nationwide retailer expressed concern with the time it took for the DA to approve their advertising. Independent retailers, for their part, mostly believed that advertising and promotions were adequate, although minimal, given the limited number of appliances rebated by Instant Savings. A few independent retailers believed that they were responsible for advertising the discounts if they wanted to do so.

The discount processing, tracking and reporting generally drew positive feedback from both types of retailers, despite some notable issues. The payment schedule was identified as a source of frustration. A few retailers noted a delay in the reimbursement being paid to them, and they suggested that retailers be advised in advance of the schedule for the anticipated payment. This issue was considered particularly serious by retailers that had a larger sales volume of discounted products. The payment delay was a greater concern during the fall campaign, which was close to retailers' fiscal year-end. Just over half of the retailers reported receiving the discount following the receipt of final sales data more than 60 days after its submission, while nearly all the others reported being paid within 45 days after the report was mailed out. While ENSC is confident that all payment demands were treated within the set deadline of 45 days, there was still some dissatisfaction with this aspect among the retailers.

Mixed opinions were offered regarding the preparation process of the campaign. Specifically, while independent retailers were largely pleased with the limited efforts required in terms of preparing for a campaign, nationwide retailers were generally more critical. One of the most common sources of frustration mentioned was the lack of a list of approved products with an early enough notice to enable retailers to plan their purchases and advertising accordingly. It should be noted that this year again, the list of rebated product categories, along with the energy performance required (e.g., being ENERGY STAR certified) and the rebate per unit, was sent within a 90-day timeframe before the start of each campaign. A few retailers seemed to think this was not sufficient, though for the most part, a period ranging from 60 to 90 days was deemed adequate. Some other retailers complained about receiving the final list of approved product SKUs at short notice. One retailer reported having received this list of products only days before the beginning of the campaign. It should be noted that this list has to be sent by each retailer after receiving the eligible product category list. In many cases, ENSC found that some information was missing, which forced it to wait some more before being able to approve the list.. That being said, a few retailers stressed the difficulty in providing advance notice about rebated products when technology changes so rapidly. One nationwide retailer suggested that the product approval process be streamlined to reduce the administrative burden it causes.

Another issue mentioned by a few retailers entails the rebated products being identified by SKU codes on program documentation, which makes it at times confusing for retailers to clearly identify the approved products under Instant Savings. It was recommended to use UPC codes in its place for greater clarity.

Opinions regarding the discount amounts also drew more favourable feedback from independent retailers than from nationwide retailers. This was probably due to the perception that although the percentage of discount applied to appliances might be similar to that applied to lamps, the dollar value of the appliance discount was bigger, thus appearing more substantial. Many of the nationwide retailers believed that the rebate was too low to effectively motivate consumers to completely retrofit their homes once for all rather than buying a few lamps at a time. Independent retailers mentioned that for washers, the rebated products included only higher-end models targeting a limited segment of the population. It was suggested to increase the rebate on those models or expand the range of rebated products to appeal to a broader socio-economic segment of the population. It should however be noted that the additional energy performance criterion, which restricts the eligible models, was introduced in 2013, following a recommendation made by the retailers. Indeed, in 2012, the retailers mentioned that they only almost exclusively sold Tier III clothes washers, resulting in the rebate having little impact on the customer's decision. Notwithstanding this, some retailers still believed the reduced number of rebated appliances limited the program's impact on sales of energy-efficient appliances.

Retailers were highly satisfied with their relationship with the DA, particularly with respect to the staff's professionalism, being provided with satisfactory responses to questions and required program information, although not always in a timely manner. Further, retailers were pleased with all the other aspects of their relationship with the DA. Generally, causes for concern were rare occurrences, with most having been solved to retailers' satisfaction. For the most part, the DA responded to requests and inquiries within one or two days.

Retailers still believed that Instant Savings had a limited impact on their staff's knowledge of CFL and LED technology. That said, regarding LED technology, Instant Savings spurred customers' interest in the technology, who then sought expert advice at stores to guide their purchase choices. As such, store staff was required to be knowledgeable about this technology to be able to correctly respond to customers' questions.

Instant Savings was considered to have influenced the quantity of products carried during campaign periods more than the variety of products offered in stores. In fact, for nationwide retailers, their customers' product selection decisions were driven by market conditions, while independent retailers' indicated choosing products that aligned with their customers' socio-economic profile rather than based on the availability of rebates.

4.2 Participant Perspectives

A participant intercept survey was conducted as part of the Instant Savings evaluation. In addition to the questions designed for impact evaluation purposes, survey participants were asked questions related to CFL and LED lamp purchases, program and discount awareness, and discounted products. The following sections present the survey results.

4.2.1 Instant Savings Awareness

As part of the intercept survey conducted in participating retail stores, consumers who purchased discounted products during the Instant Savings markdown periods in the spring and fall 2014 were interviewed. These discounted products specifically included ENERGY STAR® CFLs and LED lamps.

First, participants were asked if they had heard of Instant Savings before. Eight in 10 participants had heard of Instant Savings (78%) when answering the survey, which is consistent with the 2013 results.

While participants learned about Instant Savings in a number of ways, ENSC sources were the most common, which was the case in previous years as well. Specifically, eight in 10 participants heard about Instant Savings through ENSC advertising, such as in-store promotions, media advertising in general, or from an ENSC representative during an in-store event or on the ENSC website, as shown in the table below. Word of mouth is also a source of awareness, with two in 10 respondents hearing about Instant Savings this way.

Participants were specifically asked if they recalled seeing stickers, shelf signs or posters in the stores. This turned out to be an effective communication method, as the vast majority (93%) of participants recalled seeing these promotional materials.

Table 6: Sources of Awareness

Sources of Awareness*	2012			2013			2014		
	Overall	CFL Purchasers	LED Lamp Purchasers	Overall	CFL Purchasers	LED Lamp Purchasers	Overall	CFL Purchasers	LED Lamp Purchasers
<i>Sample Size**</i>	91	51	35	199	36	159	231	32	203
Total Advertising	79%	78%	83%	81%	72%	84%	78%	75%	79%
In-store promotions	37%	33%	43%	50%	39%	52%	42%	44%	42%
Media advertising	-	-	-	30%	14%	34%	40%	31%	40%
Word of mouth/ co-worker, family, friend	5%	6%	3%	19%	19%	18%	18%	19%	17%
Through an ENSC representative during an in-store customer engagement event	9%	8%	11%	21%	61%	12%	13%	6%	14%
ENSC website	21%	22%	20%	11%	14%	10%	13%	13%	13%
Store personnel	1%	2%	-	13%	28%	9%	12%	16%	11%
Facebook	8%	8%	9%	4%	6%	3%	8%	6%	8%
Newspaper	20%	24%	17%	-	-	-	-	-	-
Radio	16%	20%	14%	-	-	-	-	-	-
Home show	2%	-	3%	-	-	-	-	-	-
Internet in general	9%	6%	14%	-	-	-	-	-	-
Store flyer	2%	4%	-	-	-	-	-	-	-
Others	4%	4%	6%	4%	3%	4%	6%	6%	6%
Don't know	4%	6%	3%	-	-	-	-	-	-
*Multiple responses									
**Base: Respondents who were aware of Instant Savings									

As indicated in the following table, most participants were aware of the discount before paying, which is consistent with the 2013 results. Purchasers of LED lamps are more likely to be aware of the discount than CFL purchasers. Given the higher discount amount for LED lamps and their higher initial cost, this higher awareness is not surprising.

Table 7: Discount Awareness

Discount Awareness	2012			2013			2014		
	Overall	CFL Purchasers	LED Lamp Purchasers	Overall	CFL Purchasers	LED Lamp Purchasers	Overall	CFL Purchasers	LED Lamp Purchasers
<i>Sample Size</i>	164	99*	65**	241	44*	91**	294	43*	251**
Yes, was aware of discount before paying	76%	70%	85%	93%	84%	95%	96%	86%	97%
No, was not aware of discount before paying	24%	30%	15%	7%	16%	5%	4%	14%	3%
*Base: Respondents who purchased CFLs on the day of the survey **Base: Respondents who purchased LED lamps on the day of the survey									

Nearly all participants had heard of ENSC, which is the case for both CFL and LED purchasers.

Table 8: ENSC Awareness

ENSC Awareness	2012			2013			2014		
	Overall	CFL Purchasers	LED Lamp Purchasers	Overall	CFL Purchasers	LED Lamp Purchasers	Overall	CFL Purchasers	LED Lamp Purchasers
<i>Sample Size</i>	164	96	61	241	44	191	294	43	256
Yes	87%	83%	90%	96%	100%	96%	94%	84%	95%
No	12%	16%	8%	2%	-	2%	5%	14%	4%
Don't know	1%	1%	2%	2%	-	2%	1%	2%	1%
*Base: Respondents who purchased CFLs on the day of the survey **Base: Respondents who purchased LED lamps on the day of the survey									

4.2.2 Purchases

Survey results from the table below suggest a shift in purchases from CFL lamps to LED lamps during the Instant Savings campaign periods since 2012. The majority of the interviews completed in 2014 were with LED purchasers. CFL purchasers were not included in the fall survey as CFLs were no longer discounted under Instant Savings at the time, though, it was obvious during the spring survey that LED bulbs were more likely to be purchased than CFL bulbs at retailers where interviews were being conducted.

Table 9: Type of Lamp Purchased

CFLs/LED Lamps Purchased	2012	2013	2014
<i>Sample Size</i>	164	241	294
CFLs only	59%	18%	13%
LED lamps only	37%	79%	85%
Both	4%	2%	2%

The number of CFLs and LED lamps purchased by each participant was counted. Both CFL and LED purchasers are likely to buy more than one or two bulbs during the campaign period; the average number of bulbs bought by each participant reaches five for both CFL and LED purchasers.

Table 10 summarizes the types of lamps installed by participants at the time when the survey was conducted. Despite the high number of LED lamps purchased in 2014, at the time of purchase a large percentage of participants only had CFLs installed in their home, which could be explained by the recent uptake of LED lamps.

Table 10: CFLs/LED Lamps Currently Installed

CFLs/LED Lamps Currently Installed	2012				2013				2014			
	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)
<i>Sample Size</i>	164	96	61	7	241	44	191	6	294	38	251	5
CFLs only	52%	73%	25%	1	32%	80%	20%	4	58%	61%	58%	3
LED lamps only	10%	1%	26%	-	9%	-	11%	1	22%	3%	26%	-
Both	35%	23%	49%	6	56%	18%	66%	1	18%	29%	16%	2
No	2%	3%	-	-	2%	2%	3%	-	-	-	-	-
Don't know	-	-	-	-	-	-	1%	-	1%	8%	-	-

4.2.3 Influence

Notably, the discount is less likely to influence the decision to purchase CFL bulbs than in the past. It should be noted that CFLs were no longer included as part of Instant Savings following the spring campaign, partly due to the lesser influence the discount was having on purchases. That said, the discount continues to influence LED purchasers, as shown in Table 11.

Table 11: Importance of Discount in Influencing Installation

Importance of Discount in Influencing Decision to Install Energy-efficient Products	2012		2013		2014	
	CFL Purchasers	LED Lamp Purchasers	CFL Purchasers	LED Lamp Purchasers	CFL Purchasers***	LED Lamp Purchasers
<i>Sample Size*</i>	68	55	39	100	37	249
Mean (0 = No influence at all, 10 = Extremely influential on purchase decision):**						
Importance of discount on purchase decision	6.7	8.0	7.6	8.7	5.5	7.8
*Base: Respondents who were aware of discount prior to purchase **Mean excludes responses of 'Refused' and 'Don't know' ***Interviews with CFL purchasers were conducted during the spring campaign only						

4.2.4 Other Discounted Products

Four in 10 participants are aware of other products discounted through Instant Savings (43%), which is similar to findings in 2013 (see Table 12). Participants who are aware of other energy-efficient products discounted through Instant Savings mention a number of different products. Top responses are similar to those collected in 2013, including refrigerators, programmable thermostats, power bars or smart strips and dimmer switches. One in four participants has already purchased other efficiency products that are discounted through Instant Savings.

Table 12: Other Discounted Products Awareness

Other Discounted Products Awareness	2012	2013	2014
<i>Sample Size*</i>	91	199	230
Yes, aware of other products	34%	45%	43%
No, not aware of other products	57%	44%	47%
Don't know	7%	11%	10%
Skipped	2%	-	-
*Base: Respondents who were aware of Instant Savings			

5 IMPACT EVALUATION

The objective of the 2014 Instant Savings impact evaluation is to determine the gross and net energy savings generated by the energy-efficient products bought through the program.

Both electrical energy and peak demand savings are estimated in the impact evaluation by analyzing the following parameters:

- › Unitary savings values used for each product type
- › Demand-to-energy ratio
- › Interactive effects factors
- › Free-ridership
- › Spillover

Contrary to the 2013 evaluation, no replacement ratio was applied to CFL and LED lighting products. This modification was made to conform to the newly published Uniform Method Project (UMP), and is further discussed in the Gross Savings section.

5.1 Gross Savings

The quantities of products sold through the Instant Savings spring and fall campaigns are captured in the tracking sheet. For each product category, ENSC used the unitary savings values from last year's evaluation report. These unitary savings values were revised by the Evaluator based on a variety of recent and reliable sources from the technical literature, such as the 2011 Ontario Power Authority (OPA) Prescriptive Measures and Assumptions report³ and the Pennsylvania Public Utility Commission 2014 Technical Reference Manual (TRM)⁴. In some cases, customized engineering calculations were also made to obtain the revised unitary savings.

The following sections describe the methodology used by ENSC to estimate the unitary savings value for each eligible product and present the Evaluator's review of these values based on the most recent studies.

5.1.1 Compact Fluorescent Lamps (CFLs)

Tracked Savings

The quantity of CFLs sold through the program was recorded in the tracking sheet according to these types of CFLs:

³ Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions Version 1*, March 2011.

⁴ Pennsylvania Public Utility Commission, *Technical Reference Manual*, State of Pennsylvania, June 2014.

- › ENERGY STAR® regular CFLs
- › ENERGY STAR® specialty CFLs

A unitary savings value of 48.3 kWh and a replacement ratio of 0.73 are used for regular CFLs, while the unitary savings for specialty CFLs is 45.4 kWh. Those values were obtained from the 2013 evaluation, using the following equations and parameters:

$$Annual\ Unitary\ Savings_{Regular} = \frac{(47.3\ W) \times 2.8 \frac{h}{day} \times 365 \frac{day}{yr}}{1000 \frac{W}{kW}} = 48.3 \frac{kWh}{yr}$$

$$Annual\ Unitary\ Savings_{Specialty} = \frac{(44.4\ W) \times 2.8 \frac{h}{day} \times 365 \frac{day}{yr}}{1000 \frac{W}{kW}} = 45.4 \frac{kWh}{yr}$$

The hours of operation were calculated using the operating hours from Hydro-Québec's study⁵ and the proportion of indoor and outdoor installation of CFLs estimated from the 2013 results of the Atlantic Quarterly survey⁶. The average displaced wattages were based on an analysis of light output equivalency. The replacement ratio was also obtained from the 2013 Atlantic Quarterly survey.

Revised Savings

Because both regular and specialty CFLs are no longer part of the Instant Savings rebated products as of the 2014 fall campaign, the unitary savings values were not reviewed this year, as last year's evaluation results are still considered valid.

Last year, the replaced lamp was assumed to be incandescent or halogen, and existing CFLs replaced by similar lamps were accounted for by applying a replacement ratio.

In 2014, the methodology was reviewed to better follow the recommendations of the UMP's Chapter 6⁷, which states that one of the following two approaches should be used to estimate the fraction of efficient lamps used to replace similar efficient lamps:

- 1 Assume that the baseline is the federal standard, even if the participant previously installed a CFL. Replacement of a CFL by another CFL is examined as part of the program attribution investigation, which is more likely to identify the participants who did so (i.e., replacing a CFL with another CFL) as free-riders.

⁵ Econoler, *Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel*, presented to Hydro-Québec, Quebec, March 30, 2011.

⁶ Based on the results of the third and fourth quarters, for n=800.

⁷ NREL, *Uniform Methods Protocol Chapter 6 : Residential Lighting Evaluation Protocol*, February 2014, p. 6-20, available at < http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf >

- 2 Revise the baseline wattage assumptions to reflect the share of in-kind replacement of CFLs. In this case, data is to be collected about the proportion of high-efficiency lamps distributed through the program to replace existing CFLs.

The Evaluator chose to apply the first option, and consequently the free-ridership survey estimated the percentage of participants that would not have bought a CFL in the absence of the program. As a result, the replacement ratio has not been applied.

5.1.2 LED Lamps

Tracked Savings

For rebated LED lamps, ENSC uses an annual unitary savings value of 44.8 kWh in the tracking sheet, which is based on last year's evaluation results.

In 2013, the average displaced wattage of LED lamps was calculated by comparing the average wattage of LED lamps sold through Instant Savings and the average equivalent wattage of standard lamps replaced using the manufacturers' specifications. This information was collected for the 12 LED best sellers, which covered 80 percent of all the LED lamps sold through Instant Savings. The analysis revealed that the average wattage of LED lamps was 10.1 watts and the average equivalent wattage for the replaced standard lamps was 53.9 watts, which corresponds to a displaced wattage of 43.8 watts (a daily use of 2.8 hours was used). This value was based on the same hours of operation for CFLs in the Hydro-Québec study, and on the proportions of indoor and outdoor CFLs (respectively 90% and 10%), as determined by the 2013 Atlantic Quarterly Surveys, which are considered applicable to LED lamps as well. The unitary savings value was therefore established at 48.3 kWh.

Revised Savings

This unitary savings value was reviewed by the Econoler team during the evaluation. To do so, the Evaluator analyzed the wattage values of LED lamps sold through the program and conducted a literature review to validate the hours of operation.

Displaced Wattage

In 2014, the displaced wattage was revised according to the LED wattage values found in the 2014 tracking sheet and the average equivalent lamp wattage values specified by the manufacturer. Last year, the replaced lamp was assumed to be incandescent or halogen, and existing LED lamps replaced by similar lamps were accounted for by applying a replacement ratio.

In 2014, the methodology was revised to better implement the recommendations the UMP's Chapter 6⁸, as explained in the CFL section. However, for LED lamps, the second approach proposed by the

⁸ NREL, *Uniform Methods Protocol Chapter 6 : Residential Lighting Evaluation Protocol*, February 2014, p. 6-20, available at < http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf >

UMP was applied, which involved adjusting the baseline wattage assumptions to reflect the share of each type of replaced lamps.

The Evaluator added questions to the Atlantic Quarterly Survey to estimate the percentage that incandescent or halogen lamps, CFLs and LED lamps accounted for in the replaced lamps. It was found that 47 percent of LED lamps that replaced existing lamps (i.e., excluding those lamps installed in new fixtures) actually replaced CFLs, while 10 percent of LED lamps replaced existing LED lamps. The remaining 43 percent of lamps replaced either halogen or incandescent lamps.

Consequently, the Evaluator established the baseline wattage by using the weighted averages of equivalent incandescent or halogen lamp wattages, CFL and LED lamps wattages. To do so, the Econoler team consulted the ENERGY STAR Qualified Lamps Product List⁹ and the website of participating retailers to investigate the equivalent incandescent lamp suggested for the most popular LED models sold through Instant Savings. For CFLs, the equivalent wattage was obtained by converting the incandescent equivalent wattage of each lamp to a CFL wattage, based on the typical replacements defined in the 2013 evaluation of CFLs' unitary savings. For instance, 9-watt CFLs in 2013 typically replaced 40-watt incandescents, while 13-watt CFLs were generally replacements for 60 watts.

It was found that on average, the 10 most popular LED lighting products, accounting for 63 percent of all LED lamps sold through Instant Savings, consumed 8.5 W each. The weighted average replacement wattage for those lamps was established at 27.0 W. As a result, the displaced wattage for LED lamps has been estimated at 18.5 W.

The Evaluator is aware that this displaced wattage reduction is very significant, and will have a large impact on the evaluated savings for Instant Savings. Nevertheless, this adjustment is in line with the recommendation made in the UMP. ENSC should also keep in mind that the UMP recommends to wait for six to twelve months after a new energy-efficiency baseline regulation is enacted before starting to apply this new baseline to allow stores enough time to sell their existing stock. As a result, starting from December 2015, using an incandescent baseline for bulbs equivalent to 60-watt or less will no longer be possible. Consequently, the Evaluator considers it a good practice to update the baseline in this evaluation.

Hours of Operation

To review the hours of operation, the Econoler team has applied some of the principles promoted by the UMP. A metering study specific to Nova Scotia would have been the ideal scenario, but this option was not available due to budgetary constraints. Instead, the Evaluator relied on a literature review of secondary data to establish the hours of operation of LED lamps sold through Instant Savings.

⁹ ENERGY STAR, *ENERGY STAR Qualified Lamps Product List*, Posted on January 30, 2013, <www.energystar.gov>.

As noted by the UMP, LED lamps are only beginning to represent significant percentages of savings in energy efficiency programs in North America. Consequently, few metering studies apply specifically to this type of lamp, and the literature review conducted by the Evaluator includes mainly studies focusing on the hours of operation of CFLs. Furthermore, many other jurisdictions that have included LED lamps in their energy efficiency programs also calculate the resulting savings based on metered hours of operation of CFLs. This is the case, for instance, for Massachusetts¹⁰, the California Municipal Utilities Association¹¹, Maine¹² and Illinois¹³. It was therefore assumed that all metering studies on residential lighting could be used to estimate the hours of operating of LED lamps.

Residential lighting metering studies were therefore selected by the Evaluator, based on the following criteria recommended by the UMP¹⁴:

- › Similarities in service territories
- › Appropriate sample size
- › Length of metering period

While the UMP suggests prioritizing studies that reflect varying hours of use by room type, it was not done in Instant Savings, as the rooms in which lamps are installed are unknown to the Evaluator.

The table below presents relevant metering studies conducted in northeastern United States and in Canada. Some studies already included in the 2013 evaluation were kept, while newer studies were added to this selection.

Table 13: Residential Lighting Metering Studies

Region and Year	Hours of Use (hrs/day)	Number of Homes	Number of Loggers	Metering Period
Hydro-Québec, 2011 ¹⁵	Indoor: 2.68 Outdoor: 3.6	200	787	2010
Michigan, 2012 ¹⁶	Indoor: 2.2 Outdoor: 3	152	628	2010–2012
New England States, 2014 ¹⁷	All bulbs: 2.7 Efficient bulbs: 3.0	848	4,462	2012-2013
Illinois, 2012	Indoor: 2.57 Outdoor: 5.0	67	527	2010-2011

¹⁰ Massachusetts Electric and Gas Energy, *Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, 2013-2015 Program Years*, 2012, p. 39

¹¹ Energy & Resource Solutions, *Savings Estimation Technical Reference Manual for the California Municipal Utilities Association*, May 5, 2014, 136 p.

¹² Efficiency Maine, *Residential Technical Reference Manual, version 2014.1*, July 1, 2013, p. 7

¹³ State of Illinois, *Illinois Statewide Technical Reference Manual for Energy Efficiency, version 3.0*, February 24, 2014, 675 p.

¹⁴ NREL, *Uniform Methods Protocol Chapter 6 : Residential Lighting Evaluation Protocol*, February 2014, p. 6-20, available at < http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf>

¹⁵ Econoler, *Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel*, presented to Hydro-Québec, Quebec, March 30, 2011.

¹⁶ Opinion Dynamics & The Cadmus Group, *CFL Hours of Use Study Summary of Approach and Results*, July 2012.

¹⁷ NMR Group inc. and DNV GL, *Northeast Residential Lighting Hours-of-Use Study*, May 5, 2014, 69 p.

The study for the New England states (Massachusetts, Rhode Island, Connecticut, New York) is of particular interest for the following reasons: (1) it is the most recent study, (2) its sample is by far the greatest of all studies and it includes a very detailed analysis of variations in hours of operation by type of lamps (including LEDs), geographical localisation and household type.

Some conclusions of this study allow for a better understanding of the lighting usage patterns that apply to Instant Savings participants. For instance, the study did not find many significant differences between areas, home types and income types, but it did reveal significant differences comparing hours of operation by bulb efficiency. Bulbs considered to be inefficient included halogen lamps and incandescent lamps, while efficient lamps consisted of CFLs, LED lamps and fluorescent lamps.

While it would seem logical to use the efficient bulb value of 3.0 hours/day for LED lamps, the explanation given in this study for the variation between the hours of operation of all bulbs and efficient bulbs suggests otherwise. Indeed, three different theories are put forward to explain why efficient bulbs are used a greater number of hours:

- › Differential socket selection: the assumption that in a household, most used sockets will be selected to install efficient bulbs.
- › Shifting usage: the assumption that once an efficient bulb is installed, it will be favoured over other sockets containing inefficient bulbs.
- › Snapback: the assumption that there is a tendency to use an efficient product more than the inefficient product it replaced.

It is assumed that differential socket selection and shifting usage will apply to lamps purchased as part of Instant Savings since participants are likely to buy only a limited amount of lamps, rather than change every lamp in their house. Consequently, the 0.2 hour of additional usage is included in the daily hours of operation considered for LED lamps. However, the hours of operation to be used for the LED lamps purchased through Instant Savings should not include the 0.1 additional hour that resulted from snapback, as this usage would not have occurred if an incandescent or halogen lamp (base case) had been installed. The Evaluator wants to avoid overestimating savings by making calculations based on operating hours that are greater than those of the base case. Accordingly, the average hours of operation for efficient bulbs without the snapback value—estimated at 2.9 hours per day—are considered the most appropriate value for the LED lamps sold through Instant Savings.

This value is slightly higher than the one used for tracked savings (2.8 hours) based on the Hydro-Québec's metering study. Both values account for a proportion of lamps installed outdoors, which is a good thing since LED lamps can also be installed outside. The Evaluator found it more adequate, however, to use the New England states study as it is more recent and based on a larger sample, which includes LED lamps. A small adjustment was therefore made to the hours of operation used in the tracked savings calculation, from 2.8 hours per day to 2.9 hours per day.

In-service Rate

For upstream programs like Instant Savings, the UMP has made the following recommendation:

“In-service rates should be calculated through an in-home audit. Since program bulbs cannot be easily identified, the in-service rate can be calculated as the number of bulbs purchased in a recent 12-month period that are installed divided by the total number of bulbs purchased in the same 12-month period. If the sample size of homes with bulbs purchased in the recent 12-month period is insufficient to provide the necessary levels of confidence and precision, a long term in-service rate can be used using all bulbs regardless of the time of purchase.”¹⁸

As it was the case in 2013, the Evaluator decided to claim all the savings within the year during which the lamps were purchased and not to use any in-service rate. The cost and complexities of the methodology to obtain an in-service rate specific to LED lamps in Nova Scotia are indeed prohibitive. Furthermore, the values for the literature cannot be used since all of the in-service rate studies available at the moment (as listed in the UMP Chapter 6) were conducted for CFLs and in-service rates for CFLs are deemed inapplicable to LED lamps for two main reasons:

- › All CFLs found in the tracking sheet were sold in multipacks while LED lamps are generally sold individually (67% of Instant Savings sales), and so it is more likely that more CFLs than required are bought by participants.
- › Even if the rebates for CFLs and LED lamps are approximately equivalent in relative terms (between 24% and 31% of the retail price), the investment required by the participant to buy LED lamps instead of CFLs is significantly higher, which means participants are less likely to stock multiple LED lamps for future use.

Unitary Savings

The unitary savings value was revised according to the displaced wattage of 18.5 watts and the hours of operation estimated at 2.9 hours per day using the following equation:

$$\text{Annual Unitary Savings} = \frac{(18.5) \times 2.9 \frac{h}{day} \times 365 \frac{day}{yr}}{1000 \frac{W}{kW}} = 19.6 \frac{kWh}{yr}$$

This new value of 19.6 kWh per year was used in the gross savings evaluation for all LED lamps sold through Instant Savings, both the spring and fall campaigns.

¹⁸ National Renewable Energy Laboratory. 4.1.2. *In-service Rates*. <<http://ump.pnnl.gov/showthread.php/4839-4.12-In-Service-Rate>>, (Last accessed February 16, 2014).

5.1.3 LED Recessed Downlight Fixtures

Tracked Savings

For LED recessed downlight fixtures, ENSC used an annual unitary savings value of 47.5 kWh, based on the value estimated during the 2013 evaluation.

The average displaced wattage value was calculated by comparing the average wattage of the nine best-selling models of LED recessed downlight fixtures during the 2013 campaign and the average equivalent halogen lamp wattage values using the manufacturers' specifications. The analysis revealed that the average wattage of the LED Recessed downlight fixtures was 10.0 watts and the average equivalent wattage for the replaced standard lamps was 58.6 watts, which corresponded to a displaced wattage of 48.6 watts. The annual hours of operation were established from a daily use of 2.68 hours, based on the indoor CFL use from the Hydro-Québec study.

Revised Savings

Both displaced wattage and hours of operation were reviewed during this evaluation.

Displaced Wattage

The displaced wattage was revised according to the real wattage values of the 10 best-selling models of LED recessed downlight fixtures found in the 2014 tracking sheet (which represented over 66% of all recessed LED lamps sold) and the average equivalent halogen lamp wattage values. To do so, the Evaluator consulted the website of participating retailers to investigate the replacement scenario specified by the manufacturer.

The analysis indicated that the average wattage value for those fixtures is 9.4 watts and the average equivalent wattage for the replaced halogen lamps is 57.2 watts, which results in a displaced wattage of 47.8 watts.

Hours of Operation

To the best of the Evaluator's knowledge, no organization has measured and released reliable and trustworthy statistics specifically on the hours of operation of LED recessed downlight fixtures installed in residential facilities. Since nothing indicated that this value should be significantly different from that of other efficient bulbs, the Evaluator decided to apply the estimated hours of operation of LED lamps from the 2014 New England states metering study (2.9 h/day).

Unitary Savings

The unitary savings value was revised according to the displaced wattage of 47.8 watts and the hours of operation estimated at 2.9 hours per day using the following equation:

$$\text{Annual Unitary Savings} = \frac{(47.8) \times 2.9 \frac{h}{day} \times 365 \frac{day}{yr}}{1000 \frac{W}{kW}} = 50.6 \frac{kWh}{yr}$$

This new value of 50.6 kWh per year was used in the gross savings evaluation for all LED recessed downlight fixtures sold through Instant Savings.

5.1.4 Dimmer Switches

Tracked Savings

For dimmer switches, ENSC used a unitary savings value of 23.5 kWh per year. This value is based on the 2011 OPA report and hours of operation for indoor bulbs estimated at 2.68 hrs/day. The calculation is shown in the table below.

Table 14: ENSC's Unitary Savings Calculations for Dimmer Switches

Parameter	Value
Wattage	2 × 60 W = 120 W
Dimmed Wattage	80% × 120 W = 96 W
Operating Time	2.68 h/day
Annual Savings	23.5 kWh

Revised Savings

The percentage of savings and wattage values, based on the 2011 OPA Measures and Assumptions report, are still considered appropriate. The Evaluator conducted a literature review of other TRMs from other jurisdictions to validate what wattage is typically used for residential lighting control measures. It was found that the OPA is the only entity which offers lighting control measures and uses a typical wattage to calculate savings. The State of Pennsylvania also offers such measures, but does not estimate controlled wattage as savings are based on real wattage for each participant (measure offered through a direct-install program). Moreover, the OPA updated its Prescriptive Measures and Assumptions report since the last evaluation and residential lighting controls, such as dimmer switches, are still considered to control on average two 60-watt bulbs.

Since it was assumed that dimmer switches are installed for standard bulbs, the average metered value for all bulbs of 2.7 hrs/day as suggested in the New England states' metering study was used. By changing only this value, the revised unitary savings value has now been estimated at 23.7 kWh per year.

5.1.5 Indoor Motion Sensors

Tracked Savings

For indoor motion sensors, ENSC used a unitary savings value of 63.5 kWh based on the 2010 OPA Prescriptive Measures and Assumptions report¹⁹ and the hours of operation used for indoor lighting products in the 2013 evaluation report, which are set at 2.68 hours per day. The unitary savings value for indoor motion sensors was revised in the 2011 OPA report, but the Evaluator concluded in past evaluations that the parameters used in OPA's 2010 report better reflected the residential market.

The table below presents the values used in this calculation.

Table 15: Tracked Unitary Savings Value for Indoor Motion Sensors

Parameter	Value
Fixture Wattage	$(2 \times 60 \text{ W}) = 120 \text{ W}$
Old Operating Time	2.68 h/day
New Operating Time – with sensor	$[2.68 \times (1 - 24\%)] = 1.23 \text{ h/day}$
Annual Savings	63.5 kWh

Revised Savings

As for dimmer switches, the controlled wattage, equal to two 60-watt bulbs, is still considered adequate. Since it is assumed that dimmer switches are installed for standard bulbs, the average metered value for all bulbs of 2.7 hrs/day as suggested in the New England states' study was used. So, the revised unitary savings value has been established at 63.9 kWh per year.

5.1.6 Indoor Motion Sensor with Dimmer Switches

Tracked Savings

For indoor motion sensors with dimmer switches, ENSC uses a unitary savings value of 74.3 kWh per year. This value is based on the Evaluator's calculation of the combined savings associated with the installation of a dimmer switch and a motion sensor, based on assumptions from the OPA reports.

Revised Savings

The Econoler team conducted a literature review to determine whether a more accurate unitary savings value could be established and concluded that no additional information had been published on this type of product. The same assumptions on the fixture wattage and dimmed wattage were

¹⁹ Ontario Power Authority (OPA), *2010 Prescriptive Measures and Assumptions*, January 1, 2010.

therefore used and the operating hours were adjusted to reflect the values applied by the Econoler team for indoor lighting.

Table 16 presents the details of the calculations.

Table 16: Revised Unitary Savings for Dimmer Switches with Motion Sensors

Parameter	Value
Fixture Wattage	$(2 \times 60 \text{ W}) = 120 \text{ W}$
Dimmed Wattage	$80\% \times 120 \text{ W} = 96 \text{ W}$
Old Operating Time	2.7 h/day
New Operating Time – with sensor	1.23 h/day
Annual Savings	74.8 kWh

5.1.7 Outdoor Motion Sensors

Tracked Savings

For this product, ENSC uses a unitary savings value of 159 kWh per year, based on a 1.8-hour reduction in hours of operation. This value comes from a detailed calculation in the 2011 OPA report that was reviewed as part of the 2012 evaluation report process and has remained unchanged ever since. The displaced wattage was assumed to be 242.6 W, based on an adaptation of the values contained in the OPA 2011 Prescriptive Measures and Assumptions.

Revised Savings

For this year's evaluation, the Econoler team reviewed the hours of operation and concluded that those contained in the 2011 OPA report (a baseline of 4.75 hours per day and a new operating time of 2.95 hours per day) should be kept, as no other more accurate studies were found. The only jurisdiction found to be offering this type of measures is the OPA, and their unitary savings for outdoor motion sensors has not been modified in the 2014 version of the Prescriptive Measures and Assumptions. Therefore, the values used for the calculation of unitary savings remain the same, as shown in Table 17.

Table 17: Revised Unitary Savings for Outdoor Motion Sensors

Parameter	Value
Fixture Wattage	242.6 W
Old Operating Time	4.75 h/day
New Operating Time – with sensor	2.95 h/day
Annual Savings	159 kWh

5.1.8 Power Bars with Integrated Timer

Tracked Savings

For this product, ENSC uses an average unitary savings value of 53.7 kWh per year. This original value was derived from the 2011 OPA report, with a small adjustment to the number of days used per year.

Revised Savings

The Evaluator reviewed Table 18 outlining the parameters used by the OPA to calculate the unitary savings value associated with power bars with an integrated timer. A literature review concluded that no recent research had been published. Therefore, the same approach as last year's was used. This resulted in a unitary savings of 53.7 kWh per year.

Table 18: Unitary Savings Calculations for Power Bars with Integrated Timer

Parameter	Entertainment Centre	Computer System	Lighting	Other
Proportion	40.3%	15.7%	19.4%	24.6%
Average Standby Wattage	38.1 W	28 W	60 W	28 W
Old Operating Time	9 h/day	14 h/day	6 h/day	11 h/day
New Operating Time – with timer	5 h/day	8 h/day	3 h/day	4 h/day
Operating Season	12 months	12 months	8.5 months	8.6 months
Number of Days	365	365	259	262
Calculated Unitary Savings (kWh/year)	55.6	61.3	46.5	51.3
Weighted Unitary Savings	53.7 kWh			

5.1.9 Load Sensing Power Bars (Smart Strips)

Tracked Savings

For this product, ENSC uses a unitary savings value of 53.8 kWh per year, based on the 2013 evaluation report. In last year's report, the Evaluator completely reviewed the unitary savings value for load sensing power bars based on the new information provided in the 2014 Pennsylvania Public Utility Commission TRM, which in turn cited documents produced by NYSERDA and the Energy Center of Wisconsin.²⁰

²⁰ NYSERDA, *Advanced Power Strip Research Report*, August 2011, and Energy Center of Wisconsin, *Energy Savings Opportunities with Home Electronics and Other Plug-Load Devices: Results from a Minnesota Field Study*, 2010.

According to these sources, the idle power values are separated into five-plug and seven-plug outlets and the idle time for both types of systems (home office equipment and entertainment centres) is 20 hours per day. This study also assumes that approximately three to five items will be plugged into each five-plug power strip, and that five to six items will be plugged into a seven-plug power strip. The following table contains the variables used in the 2014 Pennsylvania Public Utility Commission TRM unitary savings value for smart strip plug outlets.

Table 19: Calculation Assumptions for Load Sensing Power Bars

Parameter	Value
Idle power of home office equipment	4.9 W (five-plug) 5.88 W (seven-plug)
Daily hours of idle computer time	20 h/day
Unitary savings value for home office equipment	35.8 kWh (five-plug) 42.9 kWh (seven-plug)
Idle power of entertainment systems	8.5 W (five-plug) 10.2 W (seven-plug)
Daily hours of idle TV time	20 h/day
Unitary savings value for entertainment systems	62.1 kWh (five-plug) 74.5 kWh (seven-plug)
Unitary savings value for unspecified use or multiple purchases	48.9 kWh (five-plug) 58.7 kWh (seven-plug)

Revised Savings

This year, the Evaluator once again consulted the spring campaign tracking system report and concluded that the six-plug power bar was the most common product sold, accounting for 81 percent of total sales. Information on where the units were to be used was, however, not available. Therefore, an average was calculated for a six-plug unit based on the unspecified use unitary savings listed in the table above.

For these reasons, the Econoler team kept the same unitary savings value as last year, which is 53.8 kWh for a six-plug unit sold for an unspecified use or multiple purchases.

5.1.10 Heavy Duty Outdoor Timers

Tracked Savings

For this product, ENSC uses a unitary savings value of 384 kWh per year. It is based on the 2011 OPA report and was reviewed in the evaluation reports from previous years. This unitary savings value was calculated for a pool pump application, as it is the most often recommended application on the product specifications.

Revised Savings

The Econoler team reviewed the content of the tracking sheet to validate the types of heavy duty timers that were sold in 2014. Online information about the four most popular models (more than 20 units sold during the spring campaign) was consulted. It was found that approximately 60 percent of the units sold had outdoor lighting control as a primary use, while the remaining 40 percent were mainly meant to be installed on water ponds or pool pumping systems.

Those findings are consistent with the results of the OPA's 2012 Consumer Program Evaluation²¹, which stated that 73% of the heavy duty timers bought as part of their biannual coupon program were meant for outdoor lighting control. Pool pumps represented another major use, while some were used for car block heater or holiday lights controlled. The average unitary savings obtained in the OPA program evaluation was 122 kWh based on survey results aimed at identifying the ways participants used their timers. This value is considered more appropriate for the heavy duty timers sold as part of Instant Savings.

5.1.11 Programmable Thermostats

Tracked Savings

For this product, ENSC has been using a unitary savings value of 221 kWh per year since the 2011 evaluation. This value is based on results from Hydro-Québec's 2009 program evaluation on electronic thermostats in residential new construction²² and includes energy savings generated by thermostat accuracy and by temperature setback for three types of dwellings (single-detached, duplex/triplex/townhouses and apartment). The unitary savings value was calculated through a weighted average based on the proportion of each dwelling type in Nova Scotia's residential market, as defined in the 2011 ENSC Socket Study.

Table 20: Tracked Unitary Savings Estimation Based on Results from Hydro-Québec's Evaluation of Electronic Thermostat Savings

Calculation Parameter	Housing Type		
	Single-Detached	Duplex/Triplex/Townhouse	Apartment
Proportion of Each Dwelling Type ²³	70.4%	10.6%	19.0%
Gross Energy Savings per Thermostat			
Unitary Savings for Electronic Thermostat Accuracy	121 kWh	94 kWh	61 kWh
Unitary Savings for Temperature Setback	100 kWh	201 kWh	118 kWh
Total Savings per Dwelling Type	221 kWh	295 kWh	179 kWh
Average Weighted Value	221 kWh		

²¹ Research into action, *Final Report: 2012 Consumer Program Evaluation*, Report presented to OPA, October 11, 2013, 154 p.

²² Econoler, *Évaluation du programme thermostats électroniques – Volet nouvelle construction au marché résidentiel*, Final Report presented to Hydro-Québec, February 9, 2009.

²³ Statistics Canada, 2011 Nova Scotia census data

Revised Savings

The Evaluator conducted a literature review to determine if more recent or more accurate studies had been published. While the Evaluator found many studies that concluded that energy savings for programmable thermostats were small or negligible, those studies were all over 10 years old and based on a small sample of houses. Another study published recently by the ACEEE questioned the assumptions made to calculate energy savings of programmable thermostats, in particular the assumption that manual thermostats are operated at a steady set point and that programmable thermostats are used programmatically. While it is agreed that participants do not always use thermostats in that manner, metering studies eliminate this type of error because energy savings are based on the analysis of real energy bills for both types of thermostats and on a large sample of homes.

Table 21 presents other recent studies on energy savings from programmable thermostats.

Table 21: Measuring Studies on Programmable Thermostats Energy Savings

Organization	Location & Year	Sample Size	Conclusions
GasNetworks	Northeast 2006	7,000 homes	75 ft ³ gas consumption reduction per PT. In the control group with MT, 36% of respondents manually control their MT, and their usage increased by 25 ft ³ compared to other respondents with MT. ²⁴
KeySpan Energy Delivery	Georgia, 2002	N/A	3.6% savings based on a metering study which accounts for variability of actual setback/setup settings ²⁵
Hydro-Québec LTE	Quebec, 2004	> 25,000 homes	From 197 kWh for apartments to 221 kWh for single-family homes

Hydro-Québec's 2009 report on electronic thermostats in residential new construction can still be used to estimate the most accurate savings, since it was obtained from a billing analysis conducted with a very large sample of participants using room heating (rather than central heating). It was in fact verified that the most common models of thermostats bought through Instant Savings were all made for room-by-room control.

The Evaluator therefore recommends to keep using the unitary savings value of 221 kWh.

²⁴ RLW Analytics, *Validating the Impact of Programmable Thermostats*, prepared for GasNetworks, January 2007, page 2.

²⁵ Cited in Cadmus Group inc., *Home Energy Services Impact Evaluation, Part of the Massachusetts Residential Retrofit and Low Income Program Area Evaluation*, prepared for The Electric and Gas Program Administrators of Massachusetts, August 2012, available at < http://ma-eeac.org/wordpress/wp-content/uploads/Home-Energy-Services-Impact-Evaluation-Report_Part-of-the-Massachusetts-2011-Residential-Retrofit-and-Low-Income-Program-Area-Evaluation.pdf> (Last accessed October 16, 2014)

5.1.12 Clotheslines and Outdoor Drying Racks

Tracked Savings

As for clotheslines and outdoor drying racks, ENSC uses a unitary savings value of 150.5 kWh per year. The value is based on the OPA calculations, using an average number of 416 loads per year with the displacement of 68 loads per year if an outdoor method is used for clothes drying. NRCan data are also used, which state that the average unit energy consumption of electric clothes dryers was 921 kWh per year for 2009. The following equations were thus used to calculate the unitary savings value associated with the displacement of 68 laundry loads.

$$\text{Clothes dryer consumption per load} = \frac{921 \text{ kWh/year}}{416 \text{ loads/year}} = 2.214 \frac{\text{kWh}}{\text{load}}$$

$$\text{Unitary savings value} = 2.214 \frac{\text{kWh}}{\text{load}} \times 68 \frac{\text{loads}}{\text{year}} = 150.5 \frac{\text{kWh}}{\text{year}}$$

Revised Savings

The Evaluator reviewed the parameters used by ENSC to estimate the unitary savings value of clotheslines and still considers this methodology to be adequate. The energy consumption of clothes dryers was still updated to reflect the consumption of the average dryers currently in use in households. This year, the Evaluator used the results of the annual survey for RDI, where the average age of clothes washers was set at 7 years. It is assumed that washers are usually bought in pairs with a dryer, resulting in the same average age for both appliances. Consequently, the energy consumption was adjusted with the average value for 2007, which is 912 kWh per year.²⁶ The unitary savings value was recalculated at 149 kWh per year with this energy consumption value, while all other variables remaining identical.

$$\text{Clothes dryer consumption per load} = \frac{912 \text{ kWh/year}}{416 \text{ loads/year}} = 2.192 \frac{\text{kWh}}{\text{load}}$$

$$\text{Unitary savings value} = 2.192 \frac{\text{kWh}}{\text{load}} \times 68 \frac{\text{loads}}{\text{year}} = 149 \frac{\text{kWh}}{\text{year}}$$

²⁶ Natural Resources Canada, *Energy Consumption of Major Household Appliances Shipped in Canada, Summary Report, Trends for 1900-2007*, December 2009, p. 43.

5.1.13 CEE Tier III Refrigerators

Tracked Savings

For this product, ENSC uses a unitary savings value of 179 kWh per year. This value was calculated based on the following:

- › An average annual energy consumption of 408 kWh, obtained from the values extracted from the Natural Resources Canada (NRCAN) EnerGuide document²⁷ for all refrigerators sold in the 2013 spring campaign;
- › An average annual energy consumption for standard refrigerators estimated at 587 kWh, corresponding to the weighted average energy consumption of the standard refrigerator equivalents for all the units sold in the spring campaign, as defined by a recent CEE qualifying product list²⁸.

Revised Savings

The Econoler team reviewed both of the above parameters to validate the unitary savings value for this year's evaluation.

The six most popular models, based on all Tier III refrigerators sold in Instant Savings for 2014, were identified. Those refrigerators accounted for more than 50 percent of the 2014 sales of this product. For each model, the annual energy consumption information was retrieved from the August 2014 CEE qualifying product list²⁹. In fact, the Evaluator chose to use this list because the CEE specifications have been changed since September 2014 to align with the new American energy efficiency standard. For 2014, ENSC did not modify its list of eligible products and so, the August list was the last one listing all eligible refrigerators. Using this methodology, the average energy consumption of CEE Tier III refrigerators was established at 396 kWh.

The revised standard refrigerator energy consumption was established at 567 kWh per year. This weighted average value was based on the standard refrigerator equivalents for the same six models, as defined by the CEE qualifying product list.

²⁷ Natural Resources Canada, *Choosing and Using Appliances with EnerGuide*, 2013.

²⁸ CEE Qualifying Residential Refrigerators, available at < <http://library.cee1.org/content/qualifying-product-lists-residential-refrigerators> >, November 15, 2013.

²⁹ CEE Qualifying Residential Refrigerators, available at < <http://library.cee1.org/content/qualifying-product-lists-residential-refrigerators> >, August 15, 2014.

Using these baseline and new annual consumption values, the unitary savings value for the CEE Tier III refrigerators was estimated at 171 kWh per year.

Table 22: Revised Unitary Savings Value for CEE Tier III Refrigerators

Parameters	Values
Base Annual Consumption – Standard Refrigerator	567 kWh
New Annual Consumption – CEE Tier III Refrigerator	396 kWh
Annual Unitary Savings	171 kWh

5.1.14 CEE Tier III Clothes Washers

Tracked Savings

For CEE Tier III clothes washers, ENSC uses a unitary savings value of 350 kWh per year. This value is based on the 2013 program evaluation, which took the following elements into account:

- › The Modified Energy Factor (MEF) and average capacity, which allowed the Evaluator to estimate the baseline and efficient annual energy consumption for all three components of the washing process, namely: water heating, clothes washer drum and clothes dryer;
- › Adjustments to energy consumption values made to consider the percentage of clothes washer water heated electrically, and the cold-water washing habits of participants.

Using this methodology, the annual consumption of a standard clothes washer was established at 766 kWh, while the consumption of CEE Tier III clothes washers was determined to be 397 kWh, leading to a unitary savings value of 350 kWh/year.

Revised Savings

To revise the savings of CEE Tier III clothes washers, the same methodology as last year's was used. The most popular models sold through Instant Savings were identified based on the data in the tracking sheet; the Evaluator selected the twelve most popular ones, which made up 51 percent of all of this product's sales in 2014. For each of them, information about their MEF and capacity was found in the Office of Energy Efficiency's searchable directory of clothes washers available in Canada³⁰. To determine their annual energy use, the following equation was used:

$$\text{Clothes washer consumption} = \frac{\frac{\text{Loads}}{\text{year}} * \text{Capacity}}{\text{MEF}}$$

³⁰ Office of Energy Efficiency, *Search: Clothes Washers |Energy Efficiency Ratings*, <<http://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESWASHERS>> (Last accessed January 27, 2015)

In this equation, the capacity is the capacity of the clothes washer in litres, and the number of loads per year is assumed to be 290³¹, based on a survey conducted to evaluate Hydro-Québec's ENERGY STAR appliances program. For the efficient washers, the weighted average based on the frequency of each model has yielded an MEF value of 87.5 L/kWh/cycle and a capacity of 106 L; therefore, the annual consumption value has been established at 351 kWh.

To estimate the baseline consumption (standard clothes washers), the Evaluator used the same capacity as that for new clothes washers, and then found the MEF values for each non-compact non-ENERGY STAR clothes washer from the Energy Efficiency Ratings directory³². Since it was found that the average MEF did not vary significantly between small and large capacities, all 267 non-Tier III models were kept to obtain a value of 49.7 L/kWh/cycle. Using the same capacity of 106 L, their annual energy consumption has been established at 619 kWh.

The same calculation algorithm as last year's was applied to establish electricity savings. First, the energy consumption of both efficient and standard clothes washers was broken down for each stage of the washing process, as shown in the following tables, in order to apply correction factors separately to each stage.

Table 23: Energy Consumption Breakdown for Standard and Efficient Clothes Washers

Energy Consumption Breakdown for Clothes Washers	Proportion of Overall Consumption ³³	Standard Clothes Washer Electricity Consumption (kWh)	Efficient Clothes Washer Electricity Consumption (kWh)
Water Heating System	24.8%	154	87
Clothes Dryer	68.1%	421	239
Clothes Washer Drum	7.1%	44	25
Total	100.0%	619	351

To estimate the savings attributable to the water-heating system energy consumption, the percentage of hot water produced electrically was determined. First, the percentage of the washers with their own electrical resistance to heat water was obtained from the ENERGY STAR database for the six most popular models sold through Instant Savings in 2013. This same percentage was applied to standard clothes washers. Where an internal heater was present, it was assumed that 100 percent of the water heating savings were to be claimed. For clothes washers using the DHW tank as their heating source,

³¹ Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, p. 18, available at < http://www.regie-energie.qc.ca/audiences/Suivis/Suivi-R-3644-2007-ProcedurePGEE/HQD_RapportEvaluationPGEE_Electro_02fev2012.pdf>

³³ idem

the proportion of electric DHW tanks in Nova Scotia³⁴ was used to calculate the overall proportion of electrically heated water for both standard and efficient clothes washers.

Table 24: Water-heating Sources for Clothes Washers

Source of Hot Water for Clothes Washers	Clothes Washer Water-heating	DHW Tank Type	Proportion	Clothes Washer Energy Source
Internal Electric Heater	40%	-	-	40%
DHW Tank	60%	Electric	27%	16%
		Non-electric	73%	43%

By adding the proportion of internal electric heaters to the proportion of electric DHW tanks, the proportion of electric water-heating was established at 56 percent of the total water-heating energy for clothes washers.

For water-heating consumption, an adjustment factor for cold water washing was applied, similarly to last year's calculation. Thus, to account for the usage of cold water for washing, the water-heating energy consumption value was multiplied by a factor of 0.67 (1-33%=67%).

Table 25 and Table 26 show the calculations of the total electricity consumption for both standard and efficient clothes washers.

Table 25: Electricity Consumption for Standard Clothes Washers

Energy Consumption Component	Energy Consumption	Electricity Consumption (kWh)	Adjustment Factor	Adjusted Electricity Consumption (kWh)
Water-heating System	154	87	0.67	58
Internal Clothes Dryer	421	421	-	421
Washing Machine Drum	44	44	-	44
Total	619	552	-	523

Table 26: Electricity Consumption by Efficient Clothes Washers

Energy Consumption Component	Energy Consumption	Electricity Consumption (kWh)	Adjustment Factor	Adjusted Electricity Consumption (kWh)
Water-heating System	87	49	0.67	33
Internal Clothes Dryer	239	239	-	239
Washing Machine Drum	25	25	-	25
Total	351	313	-	297

³⁴Natural Resources Canada, *Residential Sector Nova Scotia* Table 10: Water Heating Secondary Energy Use – shares (%) <<http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=10&page=4&CFID=31970021&CFTOKEN=fed6e0b3f51f8fc8-C05E90B0-B973-A582-25DA340381F0B679>> (Last accessed February 14, 2014)

Therefore, the average electricity consumption value has been established at 523 kWh for a standard clothes washer and 297 kWh for an average efficient clothes washer. As a result, the unitary savings has been established at 226 kWh.

5.1.15 Demand-to-Energy Ratio

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.158 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by Instant Savings in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

5.1.16 Revised Gross Savings

The annual energy and peak demand gross savings for each category of products installed through Instant Savings are presented in Table 27. They were calculated using the revised unitary savings values and the demand-to-energy ratio presented in the previous section. Overall, the total gross energy and peak demand savings amount to 9.776 GWh and 1.545 MW respectively at the meter.

The gross savings at the generator level were also estimated in this table using a line loss factor between the meter and the generator of 1.100 provided by Nova Scotia Power for residential customers. They corresponded to energy and peak demand savings of 10.754 GWh and 1.699 MW respectively.

Table 27: Evaluation Results – Gross Energy and Peak Demand Savings by Product – Lighting Products

Product Category	Regular CFL	Specialty CFL	LED Lamp	LED Recessed Downlight	Dimmer Switch	Indoor Motion Sensor	Motion Sensor with Dimmer Switch	Outdoor Motion Sensor
Number of Units								
Number of Units – Spring	66,790	4,246	59,572	1,298	1,842	153	13	2
Number of Units – Fall	20	0	122,951	2,268	3,449	226	0	13
Number of Units – Spring + Fall	66,810	4,246	182,523	3,566	5,291	379	13	15
Energy Savings								
Unitary savings Value (kWh)	48.3	45.4	19.6	50.6	23.7	63.9	74.8	159
Gross Energy Savings – at Meter (GWh)	3.227	0.193	3.577	0.180	0.125	0.024	0.001	0.002
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Gross Energy Savings – at Generator (GWh)	3.550	0.212	3.935	0.198	0.138	0.027	0.001	0.003
Peak Demand Savings								
Demand-to-Energy Ratio (MW/GWh)	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158
Gross Peak Demand Savings – at Meter (MW)	0.510	0.030	0.565	0.029	0.020	0.004	0.000	0.000
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Gross Peak Demand Savings – at Generator (MW)	0.561	0.034	0.622	0.031	0.022	0.004	0.000	0.000

Table 28: Evaluation Results – Gross Energy and Peak Demand Savings by Product – Other Products

Product Category	Power Bar with Timer	Smart Power Bar	Heavy Duty Timer	Clothes-lines	Program-mable Thermostat	CEE Tier III Refrigerator	CEE Tier III Clothes Washer	Total for All Products
Number of Units								
Number of Units – Spring	48	94	259	776	736	388	1,231	137,448
Number of Units – Fall	63	298	1,985	0	4,543	551	1,872	138,239
Number of Units – Spring + Fall	111	392	2,244	776	5,279	939	3,103	275,687
Energy Savings								
Unitary savings value (kWh)	53.7	53.8	122	149	221	171	226	-
Gross Energy Savings – at Meter (GWh)	0.006	0.021	0.274	0.116	1.167	0.161	0.702	9.776
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Gross Energy Savings – at Generator (GWh)	0.007	0.023	0.301	0.127	1.283	0.177	0.772	10.754
Peak Demand Savings								
Demand-to-Energy Ratio (MW/GWh)	0.158	0.158	0.158	0.158	0.158	0.158	0.158	-
Gross Peak Demand Savings – at Meter (MW)	0.001	0.003	0.043	0.018	0.184	0.025	0.111	1.545
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Gross Peak Demand Savings – at Generator (MW)	0.001	0.004	0.048	0.020	0.203	0.028	0.122	1.699

5.2 Interactive Effects

In a residence, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating or cooling systems. For instance, replacing incandescent lighting products with CFLs or LED lamps causes the heating load to increase in winter and the cooling load to decrease in summer. Energy-efficient lighting, such as CFLs and LED lamps, releases less heat than the less efficient lighting it replaces.

For CFLs, LED lamps and LED recessed downlights, the evaluation of the interactive effects factor was based on a study conducted by ADS in 1992 for Hydro-Québec. The work carried out in that study involved modifying certain parameters in simulations of an average home in Quebec to

determine the impact of these changes on the interactive effects. The simulations were performed with the DOE-2 software³⁵ and focused on homes heated entirely by electricity. The simulations were carried out based on three scenarios for interactive effects, namely low, moderate and high interactive effects. The scenario with minimum interactive effects was finally selected for the calculations because it reflected the evolution of homes since 1992.

The following table presents the calculations of interactive effects. It reflects the proportion of residences in Nova Scotia heated by electricity³⁶ and the residences with air-conditioning units or systems³⁷. Those proportions remain unchanged in comparison with last year, as the statistical sources used have not been updated.

Table 29: Interactive Effects Calculations for Lighting Products

Parameters	% of Residences	Interactive Effects ³⁸
Electric heating with air-conditioning	$33\% \times 18\% = 5.9\%$	-54.4%
Electric heating without air-conditioning	$33\% \times 82\% = 27.1\%$	-58.0%
Non-electric heating with air-conditioning	$67\% \times 18\% = 12.1\%$	3.6%
Non-electric heating without air-conditioning	$67\% \times 82\% = 54.9\%$	0%
Weighted Interactive Effects Factor	100%	-18.5%

These interactive effects occur only when the products are installed inside the house. As CFLs and LED lamps installed through the program can also be used for outdoor lighting, the interactive effects factor for these products was adjusted to take that fact into account. To do so, the Econoler team used the results from the Atlantic Quarterly survey conducted for ENSC in 2014³⁹. This study showed that 86 percent of CFLs were installed inside houses and the remaining 14 percent installed in outdoor sockets, while for LED lamps, the indoor and outdoor proportions were 88 percent and 12 percent respectively. For LED recessed downlight fixtures, the interactive effects factor remained -18.5 percent since this product is only used for indoor applications.

Table 30: Interactive Effects Factor for CFLs, LED Lamps and LED Recessed Downlights

Product Category	% Indoor	% Outdoor	Interactive Effects Factor
CFL	86%	14%	$(86\% \times -18.5\%) + (14\% \times 0\%) = \mathbf{-15.9\%}$
LED Lamp	88%	12%	$(88\% \times -18.5\%) + (10\% \times 0\%) = \mathbf{-16.3\%}$
LED Recessed Downlight	100%	0%	-18.5%

³⁵ DOE-2 is a widely used and accepted software building energy analysis program developed under funding from the U.S. Department of Energy.

³⁶ ENSC, from the 2011 socket study.

³⁷ Statistics Canada (CANSIM), *Households having air conditioning*, Nova Scotia, 2009.

³⁸ ADS ASSOCIÉS, *Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale*, report presented to Hydro-Québec, 1992.

³⁹ Based on the results of the second and third quarters, for n=800.

No interactive effects factor was calculated for the other lighting devices sold through the program, i.e., indoor and outdoor motion sensors and heavy-duty timers.

For refrigerators, since the compressor in this appliance releases heat, the replacement of an old refrigerator with a more efficient unit would have the effect of releasing less heat. However, this effect is reduced when the refrigerator is built -in or leans against an exterior wall. Given that these elements reduce the interactive effects of refrigerator replacement and that only 33 percent of the houses in Nova Scotia were electrically heated, the interactive effects associated with the purchase of CEE TIER III refrigerators were not considered in the program net savings calculations.

For all other products, interactive effects were also considered to be negligible.

5.3 Net-to-gross Ratio

This section presents the evaluation of NTGR for Instant Savings, which included the assessment of free-ridership and spillover (through market effects) for two specific products: regular CFLs and LED lamps. These products were selected since they are the two highest-selling product categories of the program, accounting for 69 percent of the total tracked gross savings.

5.3.1 Free-ridership

The free-ridership levels for regular CFLs were assessed through the intercept survey, using the same algorithm as in the previous evaluations. The algorithm is presented in Appendix VII. For the LED lamps, a free-ridership level of 0 percent was assumed by applying the approach proposed by the UMP to estimate savings, as discussed in Section 5.1.2.

CFLs

The free-ridership level obtained for CFLs sold during the spring campaign is 54 percent. This value is higher than the 44 percent obtained in 2013.

It was expected that the percentage of free-ridership would increase in 2014 as CFLs are becoming the standard product to install. The Canadian regulation has banned the manufacturing of 100-watt and 75-watt incandescent lamps since January 2014. As a consequence, many stores only offer CFLs for this type of lamps. The quantity of incandescent lamps in the market will continue to decrease because the production of 60-watt and 40-watt incandescent lamps has been forbidden since December 31, 2014. This shows that ENSC made the right decision of excluding CFLs from Instant Savings rebated products after the 2014 spring campaign.

This free-ridership level was only applied on regular CFLs. Specialty CFLs accounted for less than 6 percent of CFLs sold through the program and are different from regular CFLs in many ways, such as higher prices and a lower penetration rate. Therefore, a NTGR of 1 was more accurate for this category of products. Indeed, a huge sample would have been necessary to reach enough specialty CFL buyers for a statistically representative analysis.

5.3.2 Spillover

Instant Savings discounts were offered during two distinct periods: in the spring and in the fall. During and between these two periods, eligible product sales may have occurred due to program influence, even if participants were unaware of the discount. This influence can be due to greater knowledge and awareness of energy-efficient products and from a change in retailers' offers. These sales should be attributable to the program in the form of market effects.

The retailer interviews were used to estimate the level of spillover by measuring the market effects attributable to the program for two eligible products: CFLs and LED lamps. The methodology used to calculate the level of internal spillover is presented in Appendix VIII.

For CFLs, a decrease in the percentage of attribution was observed in 2014. Program attribution for CFLs was estimated at 7 percent in 2014, compared to 13 percent in 2013 and 17 percent in 2012. For LED lamps, program attribution was estimated at 28 percent in 2014, which was similar to 2013 (30%) and higher than in 2012 (10%).

Results have shown that retailers consider that a portion of their sales, which are influenced by factors other than the discount, can still be attributable to Instant Savings. For CFLs, the number of eligible products attributable to general program influence corresponded to 28 percent of the CFLs purchased by participants during the spring campaign. For LED lamps, sales corresponded to 20 percent of the eligible LED lamps purchased by participants during the spring and fall campaigns.

5.3.3 NTGR Calculation

The NTGR values for regular CFLs and LED lamps were established using the free-ridership and spillover levels, based on the equation below.

$$NTGR = (1 - \% \text{ free-ridership} + \% \text{ spillover})$$

The table below summarizes the results of these calculations. For all other products, a NTGR of 1 was used. The distortion effects for these products could not be assessed through this evaluation. Products such as dimmer switches, occupancy sensors and power bars with integrated timer are specialized products grouped into larger retail categories, which made it difficult for retailers to estimate program influence on their sales. Moreover, the population of buyers for these products was smaller, making it difficult to reach them using a general population telephone survey.

Table 31: Net-to-Gross Ratios

Product Category	Free-Ridership	Spillover	NTGR
Regular CFLs	54%	28%	0.74
Specialty CFLs	-	-	1.00
LED Lamps	0%	20%	1.20
All Other Products	-	-	1.00

5.4 Net Savings

Net energy savings were estimated by adding the interactive effects and the NTGR to the gross energy savings, using the equation below.

$$\text{Net Energy Savings} = \text{Gross Energy Savings} \times (1 + \text{Interactive Effects Factor}) \times \text{NTGR}$$

The net energy savings were first calculated separately for each product because the interactive effects factors and NTGR differed from one product to another. Table 32 presents the details on this calculation.

Overall, the total net energy and peak demand savings amounted to respectively 8.509 GWh and 1.344 MW at the meter and respectively 9.360 GWh and 1.479 MW at the generator.

Table 32: Evaluation Results – Net Energy and Peak Demand Savings by Product – Lighting Products

Product Category	Regular CFL	Specialty CFL	LED Lamp	LED Recessed Downlight	Dimmer Switch	Indoor Motion Sensor	Motion Sensor with Dimmer Switch	Outdoor Motion Sensor
Energy Savings								
Gross Energy Savings – at Meter (GWh)	3.227	0.193	3.577	0.180	0.125	0.024	0.001	0.002
Interactive Effects Factor	-15.9%	-15.9%	-16.3%	-18.5%	0%	0%	0%	0%
NTGR	0.74	1.00	1.20	1.00	1.00	1.00	1.00	1.00
Net Energy Savings – at Meter (GWh)	2.008	0.162	3.593	0.147	0.125	0.024	0.001	0.002
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Net Energy Savings – at Generator (GWh)	2.209	0.178	3.953	0.162	0.138	0.027	0.001	0.003
Peak Demand Savings								
Gross Peak Demand Savings – at Meter (MW)	0.510	0.030	0.565	0.029	0.020	0.004	0.000	0.000
Interactive Effects Factor	-15.9%	-15.9%	-16.3%	-18.5%	0.0%	0.0%	0.0%	0.0%
NTGR	0.74	1.00	1.20	1.00	1.00	1.00	1.00	1.00
Net Peak Demand Savings – at Meter (MW)	0.317	0.026	0.568	0.023	0.020	0.004	0.000	0.000
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Net Peak Demand Savings – at Generator (MW)	0.349	0.028	0.624	0.026	0.022	0.004	0.000	0.000

Table 33: Evaluation Results – Net Energy and Peak Demand Savings by Product – Other Products

Product Category	Power Bar with Timer	Smart Power Bar	Heavy Duty Timer	Clothes-lines	Program-mable Ther-mostat	CEE Tier III Refrige-rator	CEE Tier III Clothes Washer	Total for All Product s
Energy Savings								
Total Gross Energy Savings – at Meter (GWh)	0.006	0.021	0.274	0.116	1.167	0.161	0.702	9.776
Interactive Effects Factor	0%	0%	0%	0%	0%	0%	0%	-
NTGR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-
Total Net Energy Savings – at Meter (GWh)	0.006	0.021	0.274	0.116	1.167	0.161	0.702	8.509
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Net Energy Savings – at Generator (GWh)	0.007	0.023	0.301	0.127	1.283	0.177	0.772	9.360
Peak Demand Savings								
Total Gross Demand Savings – at Meter (MW)	0.001	0.003	0.043	0.018	0.184	0.025	0.111	1.545
Interactive Effects Factor	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-
NTGR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-
Total Net Peak Demand Savings – at Meter (MW)	0.001	0.003	0.043	0.018	0.184	0.025	0.111	1.344
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Net Peak Demand Savings – at Generator (MW)	0.001	0.004	0.048	0.020	0.203	0.028	0.122	1.479

The table below compares the energy and demand savings established by this evaluation with the savings calculated in the 2014 tracking sheet.

Table 34: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR*	Net Savings
Energy Savings					
Tracked Savings from ENSC	16.879 GWh	15.921 GWh	13.916 GWh	1.08	15.026 GWh
Evaluation Results	10.754 GWh	10.754 GWh	9.478 GWh	0.99	9.360 GWh
Peak Demand Savings					
Tracked Savings from ENSC	2.414 MW	2.277 MW	1.99 MW	1.08	2.149 MW
Evaluation Results	1.699 MW	1.699 MW	1.497 MW	0.99	1.479 MW
*NTGRs varied for each category of products. The NTGRs presented in this table correspond to the rounded averages obtained by dividing the net savings by the installed gross savings (with interactive effects).					

Both energy and peak demand evaluated gross savings are much below their corresponding tracked values. This is largely explained by the reduction in unitary savings for three products: LED lamps, heavy duty timers and clothes washers. The baseline wattage for LED lamps, the highest selling product, was adjusted to take into account the percentage of participants who bought LED lamps to replace CFLs and LED lamps, rather than incandescent lamps. This reduced the unitary savings of LED lamps by 57 percent, and therefore had a significant impact on evaluated gross savings.

Additionally, the NTGR calculated this year for regular CFLs was lower than the value obtained in the 2013 evaluation. For CFLs, the decrease is due mainly to the free-ridership level increase of 10 percentage points, reaching 54 percent. For LED lamps, a decrease in the spillover level was observed, but the absence of free-ridership, due to the new methodology used to calculate savings, resulted in the same NTGR value of 1.20 as last year.

This results in evaluated net energy savings being 38 percent below their tracked counterparts, while evaluated net peak demand savings stands 31 percent below the tracked value. This also means that the net energy savings fell below ENSC's target of 13.4 GWh. The variation between evaluated and tracked peak demand savings is smaller, as the demand-to-energy ratio used for peak demand savings calculation has increase from 2013 to 2014 (respectively 0.143 and 0.158).

CONCLUSION

The 2014 evaluation of Instant Savings demonstrated that most of the recommendations made specifically for Instant Savings in the previous evaluations were implemented. The Evaluator commends ENSC on the efforts it made to improve and optimize Instant Savings. Among the improvements, the Evaluator noticed that efforts had been made to modify the range of appliances offered to cover the most energy-efficient models on the market, to better promote products other than CFLs and LEDs and to improve the accuracy of the wattage values for LED lamps entered in the tracking sheet. Furthermore, ENSC phased out CFLs from Instant Savings, with a final removal in July 2014. Given that the market was at an advanced stage of transformation with regards to CFLs, they were removed from the program to facilitate stronger market penetration for LED lamps.

The in-depth interviews showed that the DA was pleased with the program's success, program marketing, outreach activities and the relationship with ENSC staff. The DA was also satisfied that its relationship with the retailers had improved over time because everyone was getting increasingly familiar with the program management and delivery requirements. However, the DA mentioned that retailers showed varying levels of engagement and commitment towards promoting the program among customers; this remains one of the main barriers to the proper delivery of Instant Savings. According to the DA, weak engagement of the retailers often resulted in shortcomings in the installation of POP. During the in-store visits, the Evaluator did notice that POP displays were not properly installed in some of the stores.

The retailers interviewed gave the highest overall satisfaction ratings to their relationship with ENSC and the DA, as well as the program-related support and communication. Regarding communication and rebate-processing, some retailers did raise a few concerns about the wait time to have the list of eligible products approved and the wait time for receiving the reimbursement.

In terms of awareness and education, the partners believed that Instant Savings had been very successful in improving general awareness about energy efficiency and about ENSC in particular. Furthermore, the customer engagement events were quite successful in informing clients about eligible Instant Savings products. That said, the evaluation revealed issues with the in-store representatives having inadequate knowledge about other ENSC programs.

To calculate the net savings of Instant Savings in 2014, the Econoler team reviewed the unitary savings values estimated by ENSC for each eligible product and assessed free-ridership and spillover levels. Those distortion effects were measured through intercept surveys and interviews with distributors for the two best-selling products, namely regular CFLs and LED lamps. It was found that for CFLs' free-ridership had increased to 54 percent, while their spillover was established at 28 percent. As for LED lamps, only spillover was evaluated and it was established at 20 percent, thus resulting in an NTGR of 1.20.

The impact evaluation has revealed that Instant Savings generated 9.360 GWh in net energy savings and 1.479 MW in peak demand savings at the generator in 2014, compared to 26.524 GWh and 3.793 MW respectively in 2013, 10.767 GWh and 1.895 MW respectively in 2012, and 13.802 GWh and 1.388 MW respectively in 2011. The decline in net savings was attributable in part to the budget reduction made to Instant Savings in 2014. Additionally, the unitary savings of some products have been evaluated at a lower value than what was tracked, especially for the LED lamps. Finally, the NTGR was also reduced for regular CFLs. As a result, the evaluated net savings have been established at 38 percent lower than the tracked value.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix summarizes all the recommendations made by the Evaluator throughout this report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Continue monitoring the retailers' commitment to meeting POP requirements. The DA mentioned that though its interactions with retailers improved over time, challenges remain in engaging some of the retailers. The DA pointed out that weak retailer engagement can often lead to issues with proper POP installation. When making in-store visits, the Evaluator did notice some shortcomings in the in-store signage installation, which could mislead both salespeople and customers about which products are discounted. The Evaluator recommends continuing to check on POP displays to ensure that retailers fully meet the POP requirements.
	2 Improve training among in-store event representatives. The evaluation results indicate that there is room for improving in-store event representatives' knowledge and training. For instance, during the three customer engagement events visited by a mystery shopper in the fall campaign, no representative offered information about the other programs offered by ENSC. The DA reported receiving participant complaints about event representatives providing inaccurate information about other ENSC programs. Additionally, one nationwide retailer questioned the level of knowledge of an event representative in one of its stores. All this feedback highlights the need for ENSC and the DA to improve training among event representatives to strengthen the program's educational components. Customer engagement events in general have been successful and considered useful over the years by both the DA and the Evaluator; such training would further improve the positive impact of those events.
	3 Better communicate with the retailers regarding the program processes and timeline. This year, some retailers expressed some dissatisfaction with the time waited to obtain a final list of approved product SKUs and receive their payments after submitting their sales data. However, ENSC claimed that it had sent the list of eligible product categories and rebates within the 90-day timeframe prior to campaign deadline (which is verbally agreed upon with the retailers). In fact, the retailers had to send the list of product SKUs to ENSC and the DA; failure to provide complete information could lead to delays in approving the final list. ENSC also claimed that the processing of the rebate payment had never taken more than 45 days, as required by the contract signed with the retailers. The Evaluator thinks that the reason why some retailers thought that ENSC failed to meet their expectations could have been due to a lack of clear and effective communication concerning timelines and the information required.

Sections	Recommendations
	4 Continue to closely monitor the evolution of the market for lighting products. This year, the evaluated savings of LED lamps were significantly reduced in comparison with the tracked values, because the baseline wattage was lowered. Indeed, the Atlantic Survey showed that more than half of the LEDs purchased were used to replace CFLs. The Evaluator believes that ENSC should continue to use surveys and other tools to monitor the evolution of the market, as incandescent have already started being phased out as required by the federal regulation. ENSC should also expect unitary savings of lighting products to continue decreasing in the years to come.
	5 Analyze the CEE Tier III appliances offered. In September of 2014, the CEE Tier III energy performance requirements for refrigerators increased significantly in order to align with the new American federal standards. As a result, the availability of Tier III qualified refrigerators is currently very limited, and ENSC has so far applied the previous Tier III specifications as an eligibility requirement for Instant Savings. In 2015, ENSC will have to determine a new eligibility criterion, because the list of the refrigerators complying with the old CEE standard will no longer be available. This new criterion must take into account the availability of eligible products in Nova Scotia, while ensuring that the promoted products can perform significantly better than the average products on the market. This recommendation also applies to clothes washers, for which the CEE Tier III was considered to be too close to the baseline (e.g., many distributors said in 2012 that they only sold Tier III models). Therefore, an energy consumption criterion was added in 2013 and should be reassessed periodically.
Tracking System	6 Ensure the model number field is completed and accurate for all the appliances. Since the unitary savings value is based on the most popular appliance models sold, it is necessary to have this field accurately completed for all those products.
	7 Ensure retailers enter all requested info. Some of the independent retailers do not provide pricing, SKU numbers or technical information on the products. This information is valuable for some activities included in the impact evaluation, such as validating the technical specifications of the products sold.

APPENDIX II

INTERVIEW GUIDE WITH DELIVERY AGENT

How to complete this form

This is a Word document that integrates some form features. To enter your answers, simply position your cursor on the shaded sections and begin typing. Since this is a form, you cannot write anywhere else in the document. For the boxes, just click on the one next to your answer. Click again to uncheck it.

Please complete this form within the next 48 hours, save the file and send it back to us at cperreault@cra.ca

Thank you!

Part A: General Questions

Please indicate your company name.

QA1a. How would you describe your role(s) as an Efficiency Nova Scotia Corporation (ENSC) partner for the Instant Savings program?

QA1b. How long have you held that role/those roles (specify months or years)?

QA2a. Would you consider your involvement in the Instant Savings program to be straight forward or complicated?

☐ Straight forward

☐ Complicated

QA2b. If you checked "complicated," please indicate what makes your involvement in the program complicated.

Part B: Questions Specific to the Instant Savings Program

QB1. On a scale from 1 to 10, where 1 is very poor and 10 is excellent, please rate your satisfaction in regard to the following aspects of the Instant Savings program.

Aspects of the program	Score 1 = very poor 10 = excellent NA = Not applicable	Reason Please share the reason(s) for your score
The overall program		
The program marketing and outreach activities		
Your relationship with ENSC staff		
Your relationship with retailers		

QB2a. Over the past year, a few modifications have been made to the Instant Savings program, specifically in terms of in-store signage, the introduction of an App to show possible savings, the elimination of CFLs and clotheslines from rebated products this fall, changes to the rebate amounts, and the elimination of giveaways. Overall, have these changes...?

- ☐ Required minor changes in the way you work;
☐ Require major changes in the way you work; or
☐ Not affected the way you work

QB2b. If you answered "Required major changes in the way you work," would you say those major changes have caused problems in the way the program is managed or delivered?

- ☐ Yes
☐ No

QB2c. If you answered "Yes," what have those problems been?

QB2d. ENSC introduced the Instant Savings App this year, to demonstrate savings that can be achieved by taking part in the Instant Savings program. Have you heard any comments from the event representatives regarding this App?

- ☐ Yes
☐ No

QB2e. If yes, what comments have you heard regarding the App?

QB3. In your opinion, what impedes the delivery of the Instant Savings program?

Please list barriers in order of importance, with the first one listed being the greatest impediment.

QB4a. Apart from achieving increased energy efficiency, the Instant Savings program also aims at educating retailers and consumers on energy efficiency in general as well as promoting Efficiency Nova Scotia and its programs and services. To what extent do you believe that this objective has been achieved this year?

QB4b. What else could be done to improve the educational component of the program?

QB5a. Do you believe that Efficiency Nova Scotia gives you sufficient opportunity to provide input on the Instant Savings program?

☐ Yes

☐ No

QB5b. If you answered "No", what else can Efficiency Nova Scotia do to involve its program partners?

Part C: Interactions

Thinking about your interactions with program participants...

QC1a. Approximately how many complaints have you received from participants thus far in 2014?

Please do not consider concerns or questions from participants regarding the program coverage or incentive as a complaint in this context.

Number of complaints: _____

No complaints ☐

QC1b. (If complaints) What was the complaint/were the complaints about?

QC1c. (If complaints) How are participant complaints generally handled internally?

Please also specify who is involved in reviewing the complaints.

QC1d. (If complaints) Under what circumstances are participant complaints shared with management within your organization?

☐ Yes

☐ No

QC1e. How much time does it take for a complaint to be addressed with participants after it is received?

QC1f. What may cause a delay between the time a complaint is received and when it is addressed with participants?

QC1g. (If complaints) How do you ensure complaints are resolved to the satisfaction of participants?

Part D: General Comments

QD1. What suggestions do you have to improve the Instant Savings program performance?

QD2. More precisely, what suggestions do you have concerning program marketing and outreach activities?

Thank you very much for your time and co-operation.

Your answers will be treated in strict confidence—no names will ever be mentioned in the evaluation report. Our hope is that these results will contribute to improving program performance. You may be contacted by phone if we need to clarify your answers.

Date	
Your name	
Area code and phone number	
Email	

APPENDIX III

INTERVIEW GUIDE WITH RETAILER PARTNERS

Hello, may I please speak with _____?

INTRODUCTION

Hello, my name is _____, from Corporate Research Associates Inc. I am calling on behalf of Efficiency Nova Scotia Corporation for the Instant Savings Program.

IDENTIFICATION AND SCREENING OF RESPONDENT

According to our records, your company has participated in the Instant Savings program from Efficiency Nova Scotia. Corporate Research Associates and Econoler have been mandated by Efficiency Nova Scotia to conduct an evaluation of this program. We have a few questions about your company's participation in this program. Specifically, I'd like to speak with someone from the head office who is knowledgeable about the stocking and supplying of products that were discounted by the program. These products include ENERGY STAR[®] CFLs and LED light bulbs. Would that person be you?

- › Person responsible available [CONTINUE]
- › Person responsible currently unavailable [ARRANGE CALL BACK WITH THE RIGHT PERSON]
- › No person responsible for stocking or management of products [CONTINUE INTERVIEW WITH CORPORATE MANAGER - CONTINUE]
- › Don't know [CONTINUE INTERVIEW WITH CORPORATE MANAGER - CONTINUE]
- › Refused [THANK AND TERMINATE]

Confidentiality

Please note that your responses will be kept strictly confidential and that we will not share the information you provide with any other party in a way that could identify your individual or corporate responses.

Recording of the Interview

Please note that the interview will be recorded for transcription purposes only. The recording will remain strictly confidential.

SECTION V – VERIFICATION OF PRODUCTS FROM DATABASE

- V1. From the database, check the products that received the program discount for each campaign and validate the information with the interviewee.

	April-May Campaign	October-November Campaign
Regular Energy Star CFLs	☐	n/a
Energy Star LED bulbs (Including LED recessed downlights)	☐	☐

SECTION C – Regular ENERGY STAR CFLs

ASK IF REGULAR ENERGY STAR CFLs WERE DISCOUNTED THROUGH THE PROGRAM – AND DURING WHICH CAMPAIGN(S)

- C1. I now have a few questions about your sales of regular Energy Star CFLs. Please note that we are considering here regular CFLs only and not specialty CFLs. However, if you are unable to dissociate both types of CFLs, you can talk about CFLs in general.

To begin, we would like to know your approximate sales volume for regular ENERGY STAR CFLs for the spring campaign this year and for 2014 overall, in number of units [IF RESPONDENT CANNOT ANSWER FOR REGULAR ENERGY STAR CFLs, ASK FOR ALL CFLs).

- a. According to our information, you sold _____ regular ENERGY STAR CFLs DURING the spring campaign (April-May)? Is this accurate?

☐ Yes

☐ No - Record Sales:

- b. Roughly what percentage of the regular Energy star CFLs you sold/intend to sell in 2014 has occurred during the spring campaign (that is April-May)?

Is your answer based on a number of units or a number of packs? [IF ANSWER IS A NUMBER OF CFL PACKS, ASK HOW MANY CFLs ON AVERAGE ARE IN EACH PACK]

- C2. Do you think that your sales of regular Energy Star CFL bulbs during the spring campaign would have been about the same, lower or higher without the discount program?

☐ Same [SKIP TO C6]

☐ Lower

☐ Higher [SKIP TO C6]

☐ Don't know [SKIP TO C6]

☐ Refused [SKIP TO C6]

- C2aa. [IF HIGHER] Why do you think your sales would have been higher without the program?

C2a. By what percentage do you estimate the number of regular Energy Star CFL bulbs sold in your store would have been lower during the April-May campaign if the discount had not been available?

RECORD PERCENTAGE ____%

C6. What influence did the Instant Savings program have on each of the following aspects? Please answer using a scale where 0 means "Not at all influential" and where 10 means "Very influential."

a. Your salespersons' knowledge of CFLs technology and products

Scale:

Please explain your response:

b. Your consumers' knowledge of CFLs products

Scale:

Please explain your response:

c. The variety of CFL products stocked in your stores

Scale:

Please explain your responses:

d. The quantity of CFLs stocked in your stores

Scale:

Please explain your responses:

C7. While the Instant Savings' discounts on CFLs were only offered during the spring campaign, Efficiency Nova Scotia promotes energy-efficient products including CFLs throughout the year, through other energy efficiency programs and services, its website and advertisement activities, such as home shows. It is likely that the discount has a direct impact on sales of CFLs, but Efficiency Nova Scotia's promotion of energy-efficiency throughout the year may indirectly influence the sales of CFLs as well. For instance:

- › your sales people may have a better knowledge of CFLs, thus being more apt to recommend these products to customers outside of the campaign; or perhaps
- › your offer of CFLs may change and be more diversified and attractive throughout the year due to program influence; or maybe
- › awareness of energy-efficiency among customers may have increased due to ENSC's programs or general promotion of energy efficiency.

With this in mind, approximately what percentage of the number of CFLs you sold in 2014 outside of the spring campaign can you directly or indirectly attribute to the program - in essence sales you would not have if the program did not exist?

Enter %:

C7a. Please explain your response.

- C8a. With Canada's minimum energy performance standards for 60-watt and 40-watt incandescent light bulbs coming into force at the end of the year, do you still stock and sell these types of lights?
- ☐ Yes [GO TO C8b]
☐ No [GO TO C8c]
- C8b. When do you think your stock of 60-watt and 40-watt incandescent light bulbs will all be sold?
- C8c. When did you stop selling 60-watt and 40-watt incandescent light bulbs?
- C9a. Have you seen an increase in your sales of incandescent light bulbs in 2014 resulting from the announcement of Canada's minimum energy performance standards for incandescent light bulbs? [FOR INTERVIEWER: Some customers might have purchased more incandescent lamps to stock them before they are not available anymore]
- ☐ Yes
☐ No
- C9b. [IF C9a=YES] Do you believe that ENSC's Instant Savings program, with its promotion of energy efficiency lighting, has slowed down your sales increase of incandescent light bulbs this year? How?
- ☐ Yes (RECORD EXPLANATION)
☐ No
- C9c. [IF C9a=NO] Do you think ENSC's Instant Savings program, with its promotion of energy efficiency lighting, contributed to limiting the increase in sales of incandescent light bulbs this year? How?
- ☐ Yes (RECORD EXPLANATION)
☐ No

SECTION L – ENERGY STAR LED BULBS

ASK IF ENERGY STAR LED BULBS WERE DISCOUNTED THROUGH THE PROGRAM – AND DURING WHICH CAMPAIGN(S)

- L1. I now have a few questions about your sales of Energy Star LED bulbs. By Energy Star LED bulbs, we refer to Energy Star LED screw-in bulbs and Energy Star LED recessed downlights discounted through the program.

To begin, we would like to know your approximate sales volume for ENERGY STAR LED bulbs for each of the spring and fall campaigns this year and for 2014 overall, in number of units.

- a. According to our information, you sold _____ Energy Star LED bulbs DURING the spring campaign (April-May)? Is this accurate?
- ☐ Yes
- ☐ No - Record Sales:
- b. Based on the information you have at this time, will your sales of Energy Star LED bulbs during the October-November fall campaign be higher, lower, or about the same as your sales of Energy Star LED bulbs recorded during the April-May spring campaign? What will be your estimated sales during the fall campaign?
- c. Roughly what percentage of the Energy Star LED bulbs you sold/intend to sell in 2014 will have occurred during the spring and fall campaigns combined (that is April-May and October-November)?
- d. Is your answer based on a number of units or a number of packs? [IF ANSWER IS A NUMBER OF PACKS, ASK HOW MANY LED BULBS ON AVERAGE ARE IN EACH PACK]

- L2. Do you think that your sales of Energy Star LED bulbs during the spring campaign would have been about the same, lower or higher without the discount program?

- ☐ Same [SKIP TO L3]
- ☐ Lower
- ☐ Higher [SKIP TO L3]
- ☐ Don't know [SKIP TO L3]
- ☐ Refused [SKIP TO L3]

- L2aa. [IF HIGHER] Why do you think your sales would have been higher without the program?

- L2a. By what percentage do you estimate the number of Energy Star LED bulbs sold in your store would have been lower during the April-May campaign if the discount had not been available?

RECORD PERCENTAGE ____%

- L3. As you likely know, the discount is also available during the October-November fall campaign. Do you think that your sales of Energy Star LED bulbs during the fall campaign are about the same, lower or higher than they would have been without the discount program?

- ☐ Same [SKIP TO L6]
- ☐ Lower
- ☐ Higher [SKIP TO L6]
- ☐ Don't know [SKIP TO L6]
- ☐ Refused [SKIP TO L6]

L3aa. [IF HIGHER] Why do you think your sales would have been higher without the program?

L3a. Why do you think your sales were lower?

L3b. By what percentage do you estimate the number of Energy Star LED bulbs sold in your store would be lower during the fall campaign if the discount was not available? [SINCE THE SECOND CAMPAIGN IS NOT OVER YET, ASK THE RESPONDENT TO ANSWER BASED ON A PROJECTION]

RECORD PERCENTAGE ____%

L6. What influence did the Instant Savings program have on each of the following aspects? Please answer using a scale where 0 means “Not at all influential” and where 10 means “Very influential.”

a. Your salespersons’ knowledge of Energy Star LED bulbs and technology

Scale:

Please explain your response:

b. Your consumers’ knowledge of Energy Star LED bulbs

Scale:

Please explain your response:

c. The variety of Energy Star LED bulbs stocked in your stores

Scale:

Please explain your response:

d. The quantity of Energy Star LED bulbs stocked in your stores

Scale:

Please explain your response:

L7. While the Instant Savings’ discounts are only offered during the spring and fall campaigns, Efficiency Nova Scotia promotes energy-efficient products including LED bulbs throughout the year, through other energy efficiency programs and services, its website and advertisement activities, such as home shows. It is likely that the discount has a direct impact on sales of LEDs, but Efficiency Nova Scotia’s promotion of energy-efficiency throughout the year may indirectly influence the sales of LEDs as well. For instance:

- › your sales people may have a better knowledge of LEDs, thus being more apt to recommend these products to customers outside of the campaigns; or perhaps
- › your offer of LEDs may change and be more diversified and attractive throughout the year due to program influence; or maybe

- › awareness of energy-efficiency among customers may have increased due to ENSC's programs and general promotion of energy-efficiency.

With this in mind, approximately what percentage of the number of Energy Star LED bulbs you sold outside of the two campaigns can you directly or indirectly attribute to the program – in essence sales you would not have if the program did not exist?

[SINCE THE DISCOUNT CAMPAIGN IS NOT OVER YET, ASK THE RESPONDENT TO ANSWER BASED ON A PROJECTION] [IF THE RESPONDENT HAS DIFFICULTY PROVIDING AN EXACT PERCENTAGE, ASK FOR A RANGE]

Enter %:

L7a. Please explain your response.

SECTION I – INSTANT SAVINGS PROGRAM'S IMPACT

- I1. Have you noticed an increase in sales of other lighting-related products, such as smart power strips, dimmers, motion sensors, and outdoor heavy duty timers during the spring or fall campaigns?
- I2. If so, please specify what products saw an increase in sales that can be directly or indirectly attributed to the Instant Savings program, if any.

SECTION S – SATISFACTION WITH ENSC'S INSTANT SAVINGS PROGRAM

For the last part of our discussion today, I will ask you questions on your satisfaction with different aspects of Efficiency Nova Scotia's Instant Savings on Energy Efficient Products.

QS. On a scale of 1 to 10, where 1 is very poor and 10 is excellent, please rate your satisfaction in regard to the following aspects of the Instant Savings program.

Aspects of the program	Score 1 = very poor 10 = excellent NA = Not applicable	Reason Please share the reason(s) for your score
S1. The overall program		
S2. The preparation process to the campaign		
S3. The program marketing and advertising		
S4. The program support and communications		
S5. The items covered by the program		
S6. The discount amounts		
S7. The discount processing, tracking and reporting		

SECTION R – RELATIONSHIP WITH THE DELIVERY AGENT

QR. Using the same 10-point scale, how satisfied are you with the following aspects of the service provided by Summerhill.

Service aspects	Score 1 = very poor 10 = excellent NA = Not applicable	Reason Please share the reason(s) for your score.
R1. The staff's professionalism when communicating with you		
R2. Providing satisfactory answers to your questions		
R3. Providing the program information that was promised to you		
R4. Other aspects of your interactions with Summerhill		

QR5. On average, how many days did it take for Summerhill to respond to your requests and inquiries?

Insert the number of days, on average: _____

QR6. Approximately how long did it take for you to receive the discounts, following the receipt of final sales data? Would it be...?

45 days or less

45 to 60 days

60 days or more

SECTION BR – BARRIERS AND RECOMMENDATIONS

BR1. In your opinion, what impedes the delivery of the Instant Savings program? Please list barriers in order of importance, with the first one listed being the greatest impediment.

BR3. And finally, what suggestions do you have, if any, to improve the program?

END: That concludes my questions. Thank you for your time and your collaboration.

APPENDIX IV IN-STORE VISIT PROTOCOL

Spring Visit Report

Store Name: _____
Address: _____
Date of Visit: _____

Eligible Products

\$3 - Energy Star Regular CFLs (multipacks of 2 or more)
 \$3 - Energy Star Specialty CFLs (single or double packs)
 \$5 - Energy Star Specialty CFLs (multipacks of 3 or more)
 \$Up to 8 - Energy Star LED light bulbs
 \$Up to 10 - Energy Star LED Recessed Downlights
 \$10 – 30 - Programmable Thermostats for Baseboard Heaters
 \$5 - Power Bars with Timers/Load Sensing Power Bars
 \$3-4 - Indoor or Outdoor Motion Sensors (hard-wired)
 \$3 - Dimmer Switches (hard-wired)
 \$10 - Heavy Duty Outdoor Timers (plug-in)
 \$5 - Outdoor Clothesline Kits and Outdoor Clothes Dryer
 \$100 - Energy Star CEE Tier III Refrigerators
 \$75 - Energy Star CEE Tier III Clothes Washers

Product Purchase Details

Table 35: Product Purchase Situation

- In the table below, please check off the items which apply to your product.*

Product Purchase Situation			
Product to purchase:			
Instant rebate received directly at the counter upon presentation of the product to purchase			
Instant rebate received at the counter only after having provided a coupon (Home Hardware and Walmart)			
Indicate if the rebate was clearly presented on the bill (Atlantic Superstores, only the price after rebate will be displayed)			
The cashier mentioned something about the rebate			
Problems encountered when purchasing the product(s) at the cash register			
If applicable, description of the problem met:			

Promotional Display Evaluation

Table 36: In-Store Promotional Material

- In the table below, please indicate by using Yes/No for each product category whether the promotional material was displayed in store as well as the quantity of each type of promotional material (store may choose not to use POP provided by ENSC).*
- If needed, please provide additional observations or comments in the Comments section below.*

Canadian Tire

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
Bin Violators												
Posters												
Stickers												
Street signs												
Vertical Hang tabs												
Basket signs												
Manual Signs												
Comments:												

Atlantic Superstore

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
Bin Violators												
Posters												
Stickers												
Manual Signs												
Comments:												

Home Depot

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
Shelf Talkers												
Posters												
Handle Hangers												
Stickers												
Bin Violators												
Coupons												
Manual Signs												
Comments:												

Home Hardware

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
Bin Violators												
Posters												
Horizontal Posters												
Stickers												
Coupons												
Horizontal Hang Tabs												
Manual Signs												
Comments:												

Central

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
In-house Shelf Talkers												
In-house posters												
In store displays												
Comments:												

Kent

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
Shelf Talker												
Stickers												
Bin Violators												
Posters												
Manual Signs												
Aisle Interrupters												
Handle Hangers												
Horizontal Hang Tabs												
Comments:												

Sears

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
Shelf Talkers (On top Wash.)												
Posters												
Door Hangers (Refrig.)												
Coupons												
Manual Signs												
Appliance Price Inserts												
Comments: (Store may choose to only use Appliance Price Inserts and not the door hangers or shelf talkers)												

Costco

Promotional Material	Lighting			Controls			Thermostats			Appliances/Clotheslines		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
Manual Signs												
Posters												
Stickers												
Bin Violators												
Comments:												

Observations

Table 37: Identification of eligible products

- In the table below, please indicate by using Yes/No for each observation whether the products eligible for rebates were easily identified.*

The products are located at eye level on the shelf.	Yes	No
Indicate the percentage of available products that are eligible versus ineligible		
The mystery shopper was able to identify eligible products by themselves. (Comment on the percentage of products identified, the size of promotional material on the shelf, whether or not they are grouped together, etc.)	Yes	No
The mystery shopper had to ask a salesperson for help finding eligible products.	Yes	No
Was the salesperson able to indicate which products were eligible?	Yes	No
How did you learn about the rebate?		
You saw the instant rebate coupon (Home Hardware and Walmart).	Yes	No
You saw promotional material announcing a rebate on certain products.	Yes	No

Comments:

Is the overall in-store exposure of the promotional material optimal?

Indicate the number of promotional items (use the number of promotional items indicated in the promotional display section) versus store size (large retailer, small hardware store).		
Describe the location where promotional material is displayed (ex.: at the store entrance, in the same sections as target products).		
The promotional material is located near eligible products.	Yes	No

Comments:

In-store Event

- Do not ask the following questions directly to the representative. Simply show interest in the product/event.

In-Store Event				
Section of the Store where the Event Takes Place				Comments
Location of the event (which section in the store). Is it a high traffic area?				
Information Provided by the Representative	Yes	No	N/A	Comments
Did the representative provide you with information on the products (products rebates and where to find them in-store)?				
Did the representative provide you with information on the rebate offered (amounts & how they are processed)?				
Did the representative provide you with information on other programs promoted by ENSC?				
Visibility of the event	Yes	No	N/A	Comments
Event promotional material: Tent cards				
Event T-shirt with name badges				
Other Comments (The reps are using an Instant Savings App)				

Knowledge of The Program And Products

- *Note to mystery shopper: For the next section (Knowledge of the Program), ask 2 of the following 4 questions.*

Knowledge of the Program

1. Are there rebates that apply to this type of product?

2. What is the amount of the rebate?

3. Is it the same amount for all products?

4. Until when does the rebate apply?

Knowledge of Products

5. Could you tell me how these products (products eligible for the instant rebate) differ from other products sold in your store?

Fall

Visit Report

Store Name:

Address:

Date of Visit:

Eligible Products

\$3 – Energy Star LED lights (Aline, GU10, Candle/Chandelier)

\$5 – Energy Star LED lights (PAR, MR and BR)

\$8 – Energy Star LED light bulbs (packs of 2 or more)

\$15 – Energy Star LED Recessed Downlight Fixtures

\$15-45 – Programmable Thermostats for Baseboard Heaters

\$5 – Power Bars with Timers

\$15 – Smart Power Strips

\$3-4 – Indoor or Outdoor Motion Sensors (hard-wired)

\$5 – Dimmer Switches (hard-wired)

\$10 – Outdoor Heavy Duty Timers (plug-in)

\$100 – Energy Star CEE Tier III Refrigerators

\$75 – Energy Star CEE Tier III Clothes Washers

Product Purchase Details

Table 38: Product Purchase Situation

- In the table below, please check off the items which apply to your product.

Product Purchase Situation	
Product purchased:	
Instant rebate received directly at the counter upon presentation of the product purchased	
Instant rebate received at the counter only after having provided a coupon (Home Hardware & Walmart)	
Indicate if the rebate was clearly shown on the bill (Atlantic Superstores, only the price after rebate will be displayed)	
The cashier mentioned something about the rebate	
Problems encountered when purchasing the product(s) at the cash register	
If applicable, description of the problem met:	

Promotional Display Evaluation

Table 39: In-Store Promotional Material

- In the table below, please indicate by using Yes/No for each product category whether the promotional material was displayed in store as well as the quantity of each type of promotional material (store may choose not to use all POP provided by ENSC – at a minimum, products on rebate must be clearly marked with sticker talkers and horizontal or vertical hang tabs).
- If needed, please provide additional observations or comments in the Comments section below.

Canadian Tire

Promotional Material	Lighting			Controls			Thermostats		
	Yes	No	#	Yes	No	#	Yes	No	#
Bin Violators									
Posters									
Stickers									
Street Signs									
Vertical Hang Tabs									
Basket Signs									
Comments:									

Atlantic Superstore

Promotional Material	Lighting		
	Yes	No	#
Bin Violators			
Posters			
Stickers			
Manual Signs			
Comments:			

Home Depot

Promotional Material	Lighting			Controls			Thermostats			Appliances		
	Yes	No	#	Yes	No	#	Yes	No	#	Yes	No	#
Shelf Talkers												
Posters												
Handle Hangers (fridge)												
Stickers												
Bin Violators												
Manual Signs												
Aisle Interrupters												
Tent Cards (washer)												
Comments:												

Home Hardware

Promotional Material	Lighting			Controls			Thermostats			Appliances		
	Yes	No	#	Yes	No	#	Yes	No	#	Yes	No	#
Bin Violators												
Posters												
Horizontal Posters												
Stickers												
Coupons												
Horizontal Hang Tabs												
Manual Signs												
Appliance Shelf Talkers												
Handle Hangers (fridge)												
Tent Cards (washer)												
Comments:												

Central

Promotional Material	Lighting			Controls			Thermostats			Appliances		
	Yes	No	No.	Yes	No	No.	Yes	No	No.	Yes	No	No.
In-house Shelf Talkers												
In-House Posters												
In-Store Displays												
Comments:												

Kent

Promotional Material	Lighting			Controls			Thermostats			Appliances		
	Yes	No	#	Yes	No	#	Yes	No	#	Yes	No	#
Stickers												
Bin Violators												
Posters												
Manual Signs												
Aisle Interrupters												
Comments:												

Sears

Promotional Material	Appliances		
	Yes	No	#
Shelf Talkers (washer)			
Tent Cards (washer)			
Posters			
Door Hangers (fridge)			
Coupons			
Plastic Sleeve Inserts			
Comments:			

Costco

Promotional Material	Lighting		
	Yes	No	#
Manual Signs			
Posters			
Stickers			
Bin Violators			
Comments:			

Walmart

Promotional Material	Lighting			Thermostats		
	Yes	No	#	Yes	No	#
Bin Violators						
Posters						
Stickers						
Aisle Interrupter						
Coupons						
Comments:						

Observations

Table 40: Identification of eligible products

- In the table below, please indicate by using Yes/No for each observation whether the products eligible for rebates were easily identified.*

The products are located at eye level on the shelf.	Yes	No
Indicate the percentage of available products that are eligible versus ineligible		
The mystery shopper was able to identify eligible products by themselves. (Comment on the percentage of products identified, the size of promotional material on the shelf, whether or not they are grouped together, etc.)	Yes	No
The mystery shopper noticed in-store signage that redirected them towards other eligible products. (Comment on the clarity and effectiveness of this signage, and if it was placed properly and strategically.)	Yes	No
The mystery shopper had to ask a salesperson for help finding eligible products.	Yes	No
Was the salesperson able to indicate which products were eligible?	Yes	No
How did you learn about the rebate?		
You saw the instant rebate coupon (Home Hardware & Walmart).	Yes	No
You saw promotional material announcing a rebate on certain products.	Yes	No

Comments:

Is the overall in-store exposure of the promotional material optimal?

Indicate the number of promotional items (use the number of promotional items indicated in the promotional display section) versus store size (large retailer, small hardware store).	
Describe the location where promotional material is displayed (ex.: at the store entrance, in the same sections as target products).	
The promotional material is located near eligible products.	Yes No

Comments:

In-Store Event

- Do not ask the following questions directly to the representative. Simply show interest in the product/event.

In-Store Event				
Section of the Store where the Event Takes Place				Comments
Location of the event (which section in the store). Is it a high traffic area?				
Information Provided by the Representative	Yes	No	N/A	Comments
Did the representative provide you with information on the products (products rebates and where to find them in-store)?				
Did the representative provide you with information on the rebate offered (amounts & how they are processed)?				
Did the representative provide you with information on other programs promoted by ENSC?				
Visibility of the Event	Yes	No	N/A	Comments
Event promotional material: Tent cards				
Event T-shirt with name badges				
Other Comments (The reps are using an Instant Savings App.)				

Knowledge of The Program And Products

Knowledge of the Program and Products

1. Are there rebates that apply to this type of product?

2. What is the amount of the rebate?

3. Is it the same amount for all products?

4. Until when does the rebate apply?

5. (If salesperson mentions Instant Savings program or ENSC) Besides this product, are there any other products that have a rebate similar to this one?

APPENDIX V

PARTICIPANT INTERCEPT SURVEY QUESTIONNAIRE

Spring

INTRODUCTION AND ELIGIBILITY

Hello, my name is _____ and I am with Corporate Research Associates, and we are performing the evaluation of the Instant Savings program provided by Efficiency Nova Scotia Corporation. We are gathering information from customers who just purchased energy efficient lights, also known as CFLs, and L-E-Ds.

- I1. Did you purchase either CFLs or L-E-Ds today? [CODE ONE ONLY]
- 1. CFLs
 - 2. L-E-Ds
 - 3. Both
 - 98. (Don't Know) [ASK AGAIN. IF STILL DK, THANK AND TERMINATE].
 - 99. (Refused) [THANK AND TERMINATE].
- I2. [IF CODE 1 IN I1] To the best of your knowledge, was the price of this/these CFL light bulb(s) discounted at the cash register? [CODE ONE ONLY]
- 1. Yes
 - 2. No [ASK AGAIN. IF STILL SAYS NO, THANK AND TERMINATE].
 - 98. (Don't Know) [ASK AGAIN. IF STILL DK, THANK AND TERMINATE].
 - 99. (Refused) [THANK AND TERMINATE].
- I2a. [IF CODE 2 IN I1] To the best of your knowledge, was the price of this/these L-E-D light bulb(s) discounted at the cash register? [CODE ONE ONLY]
- 1. Yes
 - 2. No [ASK AGAIN. IF STILL SAYS NO, THANK AND TERMINATE].
 - 98. (Don't Know) [ASK AGAIN. IF STILL DK, THANK AND TERMINATE].
 - 99. (Refused) [THANK AND TERMINATE].

- I2b. [IF CODE 3 IN I1] To the best of your knowledge, was the price of these CFL and/or L-E-D light bulb(s) discounted at the cash register? [CODE ONE ONLY – PROBE FOR DETAILS]
1. Yes – CFLs only
 2. Yes – L-E-Ds only
 3. Yes – Both
 4. No [ASK AGAIN. IF STILL SAYS NO, THANK AND TERMINATE].
 98. (Don't Know) [ASK AGAIN. IF STILL DK, THANK AND TERMINATE].
 99. (Refused) [THANK AND TERMINATE].
- I3. The survey will take about five minutes. You will receive a \$5 incentive as a thank you for your cooperation. Would you be willing to answer the survey?
1. Yes [CONTINUE – GO TO P1].
 2. No [THANK AND TERMINATE].

Purchase (P Series)

- P1. Are there any CFLs or L-E-Ds currently installed in your home? CODE ONE ONLY – PROBE FOR SPECIFIC YES RESPONSE
1. Yes – CFLs only
 2. Yes – L-E-Ds only
 3. Yes – Both
 4. No
 98. (Don't Know)
 99. (Refused)
- P2_CFL. How many [BASED ON RESPONSE TO Q.I1 (QI1 MUST=1 OR 3), ASK SEPARATELY FOR 'CFLs' AND 'L-E-Ds'] did you purchase today? [ENTER THE NUMBER OF BULBS NOT PACKAGES. PROBE TO AVOID ACCEPTING A RANGE]

Enter number of CFLs bought: ____ [POSE Q.P4]

98. (Don't Know) [GO TO Q.P4]
99. (Refused) [GO TO Q.P4]

- P2_LED. How many [BASED ON RESPONSE TO Q.I1, ASK SEPARATELY FOR 'CFLs' AND 'L-E-Ds'] did you purchase today? [ENTER THE NUMBER OF BULBS NOT PACKAGES. PROBE TO AVOID ACCEPTING A RANGE]

Enter number of L-E-Ds bought: ____ [POSE Q.AW1, BUT FIRST POSE Q.P4]

98. (Don't Know) [GO TO Q.P4]
99. (Refused) [GO TO Q.P4]

[IF 1=0 AND 2=0 CONFIRM THAT THE RESPONDENT BOUGHT L-E-D OR CFL BULBS TODAY, AS PER RESPONSE IN I1. IF NO SUCH PURCHASE, THANK AND TERMINATE.]

P2a_CFL. You just mentioned that you did not purchase any CFL bulbs today. Earlier you stated that you did purchase CFL bulbs. Can you confirm if you purchased CFL bulbs today?

- 1 Yes [GO TO P2_CFLconfirm]
- 2 No [CANCEL INTERVIEW]

P2a_LED. You mentioned that you did not purchase any L-E-D bulbs any L-E-D bulbs today. Earlier you stated that you did purchase L-E-D bulbs. Can you confirm if you purchased L-E-D bulbs today?

- 1 Yes [GO TO P2_LEDconfirm]
- 2 No [CANCEL INTERVIEW]

P2_CFLconfirm. How many CFLs did you purchase today?

98. (Don't Know) [GO TO Q.P4]
- 99 (Refused) [GO TO Q.P4]

P2_LEDconfirm. How many L-E-Ds did you purchase today?

98. (Don't Know) [GO TO Q.P4]
- 99 (Refused) [GO TO Q.P4]

P4. When you purchase CFLs or L-E-Ds to replace regular incandescent or halogen light bulbs, on what do you usually rely to select the right wattage for your CFLs or L-E-Ds? [DO NOT READ, ONE RESPONSE]

1. (I use the guideline about equivalent wattage/power that appears on the package)
2. (I ask a salesperson)
3. (I use the guideline on equivalent wattage from the Energy Star website)
4. (I use the general 4-to-1 conversion rule where I divide the wattage of the bulb to be replaced by 4 to select the right CFL or L-E-D light bulb)
5. (I use the same wattage as with the less efficient bulbs to be replaced)
6. (I use a lower wattage than with the less efficient bulbs to be replaced)

- 7. (I use a higher wattage than with the less efficient bulbs to be replaced)
- 8. (It depends on the quantity of light that I need - lumens)
- 96. (Other, specify)
- 98. (Don't know)
- 99. (Refused)

Awareness of Program and Efficiency Nova Scotia (AW Series)

AW1. Have you ever heard of the Efficiency Nova Scotia program which offers instant savings at the cash register for the purchase of energy-efficient products such as CFLs or L-E-D light bulbs, programmable thermostats and appliances? [CODE ONE ONLY]

- 1. Yes [GO TO CS1]
- 2. No [GO TO AW3]
- 98. (Don't Know) [GO TO AW3]
- 99. (Refused) [GO TO AW3]

CS1. How did you find out about this program? [DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]

- 1. (Media advertising)
- 2. (In-store promotions)
- 3. (Store personnel)
- 4. (Efficiency Nova Scotia website)
- 5. (Facebook or other social media)
- 6. (Word of mouth)
- 7. (Through an Efficiency Nova Scotia representative during an in-store engagement event)
- 97. (Other [SPECIFY _____])
- 98. (Don't know)
- 99. (Refused)

AW3. Prior to today, had you ever heard of Efficiency Nova Scotia, the organization that has the responsibility for helping Nova Scotians reduce their energy use? CODE ONE ONLY

- 1. Yes
- 2. No
- 98. (Don't Know)
- 99. (Refused)

Free-Ridership (FR Series)

[ONLY ASK ONE FR SECTION PER PARTICIPANT]:

[IF A RESPONDENT GETS I2, THEN THEY GET THE CFL FR SEQUENCE]

[IF A RESPONDENT GETS I2A, THEY GET THE LED FR SEQUENCE]

[IF A RESPONDENT GETS I2B, IF THEIR RESPONSE IS CODE 1 OR 3, THEN THEY GET THE CFL FR SEQUENCE. IF THEY SAY CODE 2, THEN THEY GET THE LED FR SEQUENCE]

CFL SEQUENCE

[SKIP IF I1=2]

FR0a. You bought CFLs today. Efficiency Nova Scotia offered a discount on packages of CFLs. Before paying at the cash register, were you aware that a discount was offered on the purchase of CFLs? [CODE ONE ONLY]

1. Yes [GO TO FR0c]
2. No [GO TO FR0b]
98. (Don't Know) [GO TO FR0b]
99. (Refused) [GO TO FR0b]

FR0b. [ASK IF NOT AWARE OF THE DISCOUNT (FR0a=2, DK, REF)] I just want to make sure I understand - You did not know about the discount on specific packages of CFLs before paying at the register? [CODE ONE ONLY]

1. Yes, I knew about the discount
2. No [GO TO SECTION PR OR LED SEQUENCE, AS APPROPRIATE]
98. (Don't know) [GO TO SECTION PR OR LED SEQUENCE, AS APPROPRIATE]
99. (Refused) [GO TO SECTION PR OR LED SEQUENCE, AS APPROPRIATE]

[ASK IF AWARE OF THE DISCOUNT (FR0a=1) OR (FR0b=1)]

FR0c. How did you learn about the discount offered on the purchase of specific packages of CFLs? [DO NOT READ RESPONSES – CODE AS MANY AS APPLY]

1. (Radio ads)
2. (Newspaper ads)
3. (In-store signage)
4. (Efficiency Nova Scotia website)
5. (Store personnel)

- 6. (Facebook/Social Media)
- 7. (Internet in general)
- 8. (Through an Efficiency Nova Scotia representative during an in-store customer engagement event)
- 9. (Friends/Word of Mouth)
- 96. (Other SPECIFY: _____)
- 98. (Don't Know)
- 99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0a=1) OR (FR0b=1)]

FR0c1. Did you see the stickers, shelf signs or posters in the light bulbs section of the store promoting the discount offered on CFLs? [CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0a=1) OR (FR0b=1)]

FR1. You mentioned that you were aware, before paying at the cash register, that a discount is offered on the purchase of CFLs. Did knowing this play a part in your decision to buy CFLs today? [CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0a=1) OR (FR0b=1)]

FR3. How likely would you have been to buy the CFLs that you purchased today if the discount had NOT been offered? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely Would Not Have Bought these CFLs" and a 10 indicating that you "Definitely Would Have Bought these CFLs." [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___98 Don't Know ___99 Refused

[ASK IF AWARE OF THE DISCOUNT (FR0a=1) OR (FR0b=1)]

FR4. If the discount had NOT been offered, when would you have purchased the CFLs that you purchased today? Would it have been...? [CODE ONE ONLY]

1. Definitely today
2. Probably today
3. Probably at a later date
4. Definitely at a later date
96. (Would not have purchased them at all)
98. (Don't Know)
99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0a=1) OR (FR0b=1)]

FR5. Without the discount, would you have definitely purchased the same number of CFLs, probably purchased the same number, probably purchased fewer or definitely purchased fewer? [CODE ONE ONLY]

1. Definitely the same number
2. Probably the same number
3. Probably fewer
4. Definitely fewer
98. (Don't know
99. Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0a=1) OR (FR0b=1)]

FR7. How influential was the discount offered by Efficiency Nova Scotia on your decision to purchase the CFLs that you purchased today? Please give your answer on a scale of 0 to 10, where 0 indicates the discount 'had no influence at all on your purchase decision' and 10 indicates that the discount was 'extremely influential on your purchase decision. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

LED SEQUENCE

[SKIP IF I1=1]

FR0aa. You bought L-E-Ds today. Efficiency Nova Scotia offered a discount on packages of L-E-Ds. Before paying at the cash register, were you aware that a discount was offered on the purchase of L-E-Ds? [CODE ONE ONLY]

1. Yes [GO TO FR0cc]
2. No [GO TO FR0bb]
98. (Don't Know) [GO TO FR0bb]
99. (Refused) [GO TO FR0bb]

FR0bb. [ASK IF NOT AWARE OF THE DISCOUNT (FR0aa=2, DK, REF)] I just want to make sure I understand - You did not know about the discount on specific packages of L-E-Ds before paying at the register? [CODE ONE ONLY]

1. Yes, I knew about the discount
2. No [GO TO SECTION PR OR CFL SEQUENCE, AS APPROPRIATE]
98. (Don't know) [GO TO SECTION PR OR CFL SEQUENCE, AS APPROPRIATE]
99. (Refused) [GO TO SECTION PR OR CFL SEQUENCE, AS APPROPRIATE]

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR0cc. How did you learn about the discount offered on the purchase of specific packages of LEDs? [DO NOT READ RESPONSES – CODE AS MANY AS APPLY]

1. (Radio ads)
2. (Newspaper ads)
3. (In-store signage)
4. (Efficiency Nova Scotia website)
5. (Store personnel)
6. (Facebook/Social Media)
7. (Internet in general)
8. (Through an Efficiency Nova Scotia representative during an in-store customer engagement event)
9. (Friends/Word of Mouth)
96. (Other SPECIFY: _____)
98. (Don't Know)
99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR0cc1. Did you see the stickers, shelf signs or posters in the light bulbs section of the store promoting the discount offered on L-E-Ds? [CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR11. You mentioned that you were aware, before paying at the cash register, that a discount is offered on the purchase of L-E-Ds. Did knowing this play a part in your decision to buy L-E-Ds today? [CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR31. How likely would you have been to buy the L-E-Ds that you purchased today if the discount had NOT been offered? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely Would Not Have Bought these L-E-Ds" and a 10 indicating that you "Definitely Would Have Bought these L-E-Ds." [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR41. If the discount had NOT been offered, when would you have purchased the L-E-Ds that you purchased today? Would it have been...? [CODE ONE ONLY]

- 1. Definitely today
- 2. Probably today
- 3. Probably at a later date
- 4. Definitely at a later date
- 96. (Would not have purchased them at all)
- 98. (Don't Know)
- 99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR51. Without the discount, would you have definitely purchased the same number of L-E-Ds, probably purchased the same number, probably purchased fewer or definitely purchased fewer? [CODE ONE ONLY]

1. Definitely the same number
2. Probably the same number
3. Probably fewer
4. Definitely fewer
98. (Don't know
99. Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR71. How influential was the discount offered by Efficiency Nova Scotia on your decision to purchase the L-E-Ds that you purchased today? Please give your answer on a scale of 0 to 10, where 0 indicates the discount 'had no influence at all on your purchase decision' and 10 indicates that the discount was 'extremely influential on your purchase decision. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

Products Rebated (PR Series)

PR1. [ASK IF AW1=1] Besides the [CFLs or L-E-Ds] that you purchased with a discount today, are you aware of any other energy efficiency products that are discounted through the Instant Savings program? [CODE ONE ONLY]

1. Yes [GO TO PR2]
 2. No [GO TO PR3]
- VOLUNTEERED
97. (Skipped) [GO TO PR3]
 98. (Don't Know) [GO TO PR3]
 99. (Refused) [GO TO PR3]

PR2. [ASK IF PR1 = 1] What are those products? Any others? [DO NOT READ RESPONSES – CODE AS MANY AS APPLY]

1. (Regular or specialty CFLs)
2. (L-E-D lamps and recessed downlights)
3. (Hardwired dimmer switches)
4. (Motion sensors)
5. (Power bars or Smart strips)

- 6. (Outdoor timers)
- 7. (Programmable thermostats)
- 8. (CEE Tier III refrigerators)
- 9. (CEE Tier III clothes washers)
- 10. (Outdoor clotheslines/outdoor drying racks)
- 11. (Refrigerators – No efficiency level specified)
- 12. (Clothes washers – No efficiency level specified)
- 96. (Other SPECIFY: _____)
- 97. (Skipped) [GO TO PR3]
- 98. (Don't Know)
- 99. (Refused)

PR2a. Did you already purchase, or do you plan on purchasing any of those other energy efficiency products before the middle of May this year? [CODE ONE ONLY, EXCEPT PERMIT TWO 'YES' RESPONSES IF APPLICABLE]

- 1. Yes, I have already purchased those other energy efficiency products
- 2. Yes, I plan on purchasing those other energy efficiency products
- 3. No
- 98. (Don't Know)
- 99. (Refused)

PR3. [ASK ALL RESPONDENTS] Besides CFLs or L-E-Ds, are there any other energy efficiency products you would like to see rebated through the Instant Savings program? We are referring here to products that lead to reduced consumption of electricity. [ACCEPT MULTIPLE. RECORD VERBATIM RESPONSE] Any others?

97. (Skipped) [GO TO D1]

98. (Don't Know)

99. (Refused)

Demographics (D Series)

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

[ASK ALL RESPONDENTS]

D1. What type of residence do you live in? [READ FIRST SEVEN RESPONSES; SELECT ONE RESPONSE]

- 1. Detached single-family house
- 2. Semi-detached house
- 3. Mobile home or house trailer

- 4. Townhouse or duplex which share adjacent walls
- 5. Row house (Single story apartment building)
- 6. Apartment or condo building that has fewer than five stories
- 7. Apartment or condo building that has five or more stories
- 96. Other [SPECIFY: _____]
- 98. (Don't know)
- 99. (Refused)

D3. Do you own or rent this residence? [CODE ONE ONLY]

- 1. Own/buying [GO TO D10]
- 2. Rent/lease [GO TO D4]
- 96. (Other (Describe)) _____ [GO TO D4]
- 99. (Refused) [GO TO D4]

D4. Do you or does your landlord pay the electric bills for your residence? [CODE ONE ONLY]

- 1. (I pay the electric bills)
- 2. (My landlord pays the electric bills)
- 96. (Other (Describe)) _____
- 98. (Don't Know)
- 99. (Refused)

D10. [DO NOT READ] Gender: [CODE ONE ONLY]

- 1. Male
- 2. Female

END. Those are all the questions I have for you. I thank you very much for your time and cooperation.
Here is your \$5 for participating in our survey.

Fall

Introduction and Eligibility

Hello, my name is _____ and I am with Corporate Research Associates, and we are performing the evaluation of the Instant Savings program provided by Efficiency Nova Scotia Corporation. We are gathering information from customers who just purchased L-E-D energy efficient lights.

[NOTE FOR THE HOME DEPOT STORE LOCATIONS: Please know that this survey was commissioned by Efficiency Nova Scotia Corporation, not the Home Depot, but that the results will be shared with the Home Depot Canada in all confidentiality.]

- I1. Did you purchase L-E-Ds today? [CODE ONE ONLY]
- 1. Yes
 - 2. No
 - 98. (Don't Know) [ASK AGAIN. IF STILL DK, THANK AND TERMINATE].
 - 99. (Refused) [THANK AND TERMINATE].
- I2. [IF CODE 1 IN I1] To the best of your knowledge, was the price of this/these L-E-D light bulb(s) discounted at the cash register? [CODE ONE ONLY]
- 1. Yes
 - 2. No [ASK AGAIN. IF STILL SAYS NO, THANK AND TERMINATE].
 - 98. (Don't Know) [ASK AGAIN. IF STILL DK, THANK AND TERMINATE].
 - 99. (Refused) [THANK AND TERMINATE].
- I3. The survey will take about five minutes. You will receive a \$5 cash incentive as a thank you for your cooperation. Would you be willing to answer the survey?
- 1. Yes [CONTINUE – GO TO P1].
 - 2. No [THANK AND TERMINATE].

Purchase (P Series)

P1. Are there any L-E-Ds currently installed in your home? CODE ONE ONLY

1. Yes
2. No
98. (Don't Know)
99. (Refused)

P2_LED. How many L-E-Ds did you purchase today? [ENTER THE NUMBER OF BULBS NOT PACKAGES. PROBE TO AVOID ACCEPTING A RANGE]

Enter number of L-E-Ds bought: ____ [POSE Q.AW1, BUT FIRST POSE Q.P4]

98. (Don't Know) [GO TO Q.P4]
99. (Refused) [GO TO Q.P4]

[IF=0 CONFIRM THAT THE RESPONDENT BOUGHT L-E-D BULBS TODAY, AS PER RESPONSE IN I1. IF NO SUCH PURCHASE, THANK AND TERMINATE.]

P2a_LED. You just mentioned that you did not purchase any L-E-D bulbs today. Earlier you stated that you did purchase L-E-D bulbs. Can you confirm if you purchased L-E-D bulbs today?

- 1 Yes [GO TO P2_LEDconfirm]
- 2 No [CANCEL INTERVIEW]

P2_LEDconfirm. How many L-E-Ds did you purchase today?

Enter number of L-E-Ds bought: ____ [POSE Q.AW1, BUT FIRST POSE Q.P4]

98. (Don't Know) [GO TO Q.P4]
99. (Refused) [GO TO Q.P4]

P4. When you purchase L-E-Ds to replace regular incandescent or halogen light bulbs, on what do you usually rely to select the right wattage for your L-E-Ds? [DO NOT READ, ONE RESPONSE]

1. (I use the guideline about equivalent wattage/power that appears on the package)
2. (I ask a salesperson)
3. (I use the guideline on equivalent wattage from the Energy Star website)
4. (I use the general 4-to-1 conversion rule where I divide the wattage of the bulb to be replaced by 4 to select the right L-E-D light bulb)
5. (I use the same wattage as with the less efficient bulbs to be replaced)

- 6. (I use a lower wattage than with the less efficient bulbs to be replaced)
- 7. (I use a higher wattage than with the less efficient bulbs to be replaced)
- 8. (It depends on the quantity of light that I need - lumens)
- 96. (Other, specify)
- 98. (Don't know)
- 99. (Refused)

Awareness of Program and Efficiency Nova Scotia (AW Series)

AW1. Have you ever heard of the Efficiency Nova Scotia program which offers instant savings at the cash register for the purchase of energy-efficient products such as L-E-D light bulbs, programmable thermostats and appliances? [CODE ONE ONLY]

- 1. Yes [GO TO CS1]
- 2. No [GO TO AW3]
- 98. (Don't Know) [GO TO AW3]
- 99. (Refused) [GO TO AW3]

CS1. How did you find out about this program? [DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]

- 1. (Media advertising)
- 2. (In-store promotions)
- 3. (Store personnel)
- 4. (Efficiency Nova Scotia website)
- 5. (Facebook or other social media)
- 6. (Word of mouth)
- 7. (Through an Efficiency Nova Scotia representative during an in-store engagement event)
- 100. (Other [SPECIFY _____])
- 101. (Don't know)
- 102. (Refused)

AW3. Prior to today, had you ever heard of Efficiency Nova Scotia, the organization that has the responsibility for helping Nova Scotians reduce their energy use? CODE ONE ONLY

- 1. Yes
- 2. No
- 98. (Don't Know)
- 99. (Refused)

[ASK IF AW3=1]

AW4. Have you or someone from your household ever participated in one or more of Efficiency Nova Scotia Corporation's energy efficiency programs? [CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't Know)
- 99. (Refused)

[ASK IF AW4=1]

AW5. Which energy efficiency program(s) from Efficiency Nova Scotia Corporation have you participated in? [ACCEPT MULTIPLE. RECORD VERBATIM RESPONSE] Any others?

- 98. (Don't Know)
- 99. (Refused)

[ASK IF RESPONSE TO AW5]

AW6. In what year did you participate in this/these program(s)? [RECORD YEAR FOR EACH RESPONSE TO AW5. PROBE FOR SPECIFIC YEAR.]

- 98. (Don't Know)
- 99. (Refused)

Free-Ridership (FR Series)

FR0aa. You bought L-E-Ds today. Efficiency Nova Scotia offered a discount on packages of L-E-Ds. Before paying at the cash register, were you aware that a discount was offered on the purchase of L-E-Ds? [CODE ONE ONLY]

- 1. Yes [GO TO FR0cc]
- 2. No [GO TO FR0bb]
- 98. (Don't Know) [GO TO FR0bb]
- 99. (Refused) [GO TO FR0bb]

FR0bb. [ASK IF NOT AWARE OF THE DISCOUNT (FR0aa=2, DK, REF)] I just want to make sure I understand - You did not know about the discount on specific packages of L-E-Ds before paying at the register? [CODE ONE ONLY]

- 1. Yes, I knew about the discount
- 2. No, I did not know about the discount [GO TO SECTION PR]
- 98. (Don't know) [GO TO SECTION PR]
- 99. (Refused) [GO TO SECTION PR]

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR0cc. How did you learn about the discount offered on the purchase of specific packages of LEDs?

[DO NOT READ RESPONSES – CODE AS MANY AS APPLY]

1. (Radio ads)
2. (Newspaper ads)
3. (In-store signage)
4. (Efficiency Nova Scotia website)
5. (Store personnel)
6. (Facebook/Social Media)
7. (Internet in general)
8. (Through an Efficiency Nova Scotia representative during an in-store customer engagement event)
9. (Friends/Word of Mouth)
96. (Other, SPECIFY: _____)
98. (Don't Know)
99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR0cc1. Did you see the stickers, shelf signs or posters in the light bulbs section of the store promoting the discount offered on L-E-Ds? [CODE ONE ONLY]

1. Yes
2. No
98. (Don't know)
99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR11. You mentioned that you were aware, before paying at the cash register, that a discount is offered on the purchase of L-E-Ds. Did knowing this play a part in your decision to buy L-E-Ds today? [CODE ONE ONLY]

1. Yes
2. No
98. (Don't know)
99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR31. How likely would you have been to buy the L-E-Ds that you purchased today if the discount had NOT been offered? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely Would Not Have Bought these L-E-Ds" and a 10 indicating that you "Definitely Would Have Bought these L-E-Ds." [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR41. If the discount had NOT been offered, when would you have purchased the L-E-Ds that you purchased today? Would it have been...? [CODE ONE ONLY]

1. Definitely today
2. Probably today
3. Probably at a later date
4. Definitely at a later date
97. (Would not have purchased them at all)
98. (Don't Know)
99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR51. Without the discount, would you have definitely purchased the same number of L-E-Ds, probably purchased the same number, probably purchased fewer or definitely purchased fewer? [CODE ONE ONLY]

1. Definitely the same number
2. Probably the same number
3. Probably fewer
4. Definitely fewer
98. (Don't know)
99. Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR61a. If the discount on LEDs had NOT been offered today, would you have bought a different type of bulb?

1. Yes
2. No
98. (Don't know)
99. (Refused)

FR61b. [ASK IF FR61a=1] Which type(s) of bulb or lamp would you have purchased instead today?
[ALLOW MULTIPLE]

1. Incandescent
2. Halogen
3. CFLs
- 99 Other: Specify:
98. (Don't know)
99. (Refused)

[ASK IF AWARE OF THE DISCOUNT (FR0aa=1) OR (FR0bb=1)]

FR71. How influential was the discount offered by Efficiency Nova Scotia on your decision to purchase the L-E-Ds that you purchased today? Please give your answer on a scale of 0 to 10, where 0 indicates the discount 'had no influence at all on your purchase decision' and 10 indicates that the discount was 'extremely influential on your purchase decision. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

Products Rebated (PR Series)

PR1. [ASK IF AW1=1] Besides the L-E-Ds that you purchased with a discount today, are you aware of any other energy efficiency products that are discounted through the Instant Savings program? [CODE ONE ONLY]

1. Yes [GO TO PR2]
2. No [GO TO PR3]
98. (Don't Know) [GO TO PR3]
99. (Refused) [GO TO PR3]

PR2. [ASK IF PR1 = 1] What are those products? Any others? [DO NOT READ RESPONSES – CODE AS MANY AS APPLY]

1. (Regular or specialty CFLs)
2. (L-E-D lamps and recessed downlights)
3. (Hardwired dimmer switches)
4. (Motion sensors)

- 5. (Power bars or Smart strips)
- 6. (Outdoor timers)
- 7. (Programmable thermostats)
- 8. (CEE Tier III refrigerators)
- 9. (CEE Tier III clothes washers)
- 10. (Refrigerators – No efficiency level specified)
- 11. (Clothes washers – No efficiency level specified)
- 96. (Other, SPECIFY: _____)
- 98. (Don't Know)
- 99. (Refused)

PR2a. Did you already purchase, or do you plan on purchasing any of those other energy efficiency products before the end of October this year? [CODE ONE ONLY, EXCEPT PERMIT TWO 'YES' RESPONSES IF APPLICABLE]

- 1. Yes, I have already purchased those other energy efficiency products
- 2. Yes, I plan on purchasing those other energy efficiency products
- 3. No
- 98. (Don't Know)
- 99. (Refused)

PR3. Besides L-E-Ds, are there any other energy efficiency products you would like to see rebated through the Instant Savings program? We are referring here to products that lead to reduced consumption of electricity. [ACCEPT MULTIPLE. RECORD VERBATIM RESPONSE] Any others?

- 98. (Don't Know)
- 99. (Refused)

Demographics (D Series)

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

[ASK ALL RESPONDENTS]

D1. What type of residence do you live in? [READ FIRST SEVEN RESPONSES; SELECT ONE RESPONSE]

- 1. Detached single-family house
- 2. Semi-detached house
- 3. Mobile home or house trailer
- 4. Townhouse or duplex which share adjacent walls
- 5. Row house (Single story apartment building)

- 6. Apartment or condo building that has fewer than five stories
- 7. Apartment or condo building that has five or more stories
- 97. Other [SPECIFY: _____]
- 100. (Don't know)
- 101. (Refused)

D3. Do you own or rent this residence? [CODE ONE ONLY]

- 1. Own/buying [GO TO D10]
- 2. Rent/lease [GO TO D4]
- 96. (Other (Describe)) _____ [GO TO D4]
- 99. (Refused) [GO TO D4]

D4. Do you or does your landlord pay the electric bills for your residence? [CODE ONE ONLY]

- 1. (I pay the electric bills)
- 2. (My landlord pays the electric bills)
- 96. (Other (Describe)) _____
- 98. (Don't Know)
- 99. (Refused)

D10. Do you allow me to record your gender? [DO NOT READ.CODE ONE ONLY]

- 1. (Male)
- 2. (Female)
- 99. (Refused)

END. Those are all the questions I have for you. I thank you very much for your time and cooperation.
Here is your \$5 for participating in our survey.

APPENDIX VI

PARTICIPANT SURVEY RESULTS

The participant survey results are presented in the following tables.

CS1. How did you find out about this program?

Sources of Awareness*	2012			2013			2014		
	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.
<i>Sample Size**</i>	91	51	35	199	36	159	231	32	203
Total Advertising	79%	78%	83%	81%	72%	84%	78%	75%	79%
In-store promotions	37%	33%	43%	50%	39%	52%	42%	44%	42%
Media advertising	-	-	-	30%	14%	34%	40%	31%	40%
Word of mouth/ co-worker, family, friend	5%	6%	3%	19%	19%	18%	18%	19%	17%
Through an ENSC representative during an in-store customer engagement event	9%	8%	11%	21%	61%	12%	13%	6%	14%
ENSC website	21%	22%	20%	11%	14%	10%	13%	13%	13%
Store personnel	1%	2%	-	13%	28%	9%	12%	16%	11%
Facebook	8%	8%	9%	4%	6%	3%	8%	6%	8%
Newspaper	20%	24%	17%	-	-	-	-	-	-
Radio	16%	20%	14%	-	-	-	-	-	-
Home show	2%	-	3%	-	-	-	-	-	-
Internet in general	9%	6%	14%	-	-	-	-	-	-
Store flyer	2%	4%	-	-	-	-	-	-	-
Others	4%	4%	6%	4%	3%	4%	6%	6%	6%
Don't know	4%	6%	3%	-	-	-	-	-	-
*Multiple responses									
**Base: Respondents who were aware of Instant Savings									

FR0a/FR0aa/FR0b/FRObb. You bought CFLs/LEDs today, Efficiency Nova Scotia offered a discount on packages of CFLs/LEDs. Before paying at the cash register, were you aware that a discount was offered on the purchase of CFLs/LEDs?

Discount Awareness	2012			2013			2014		
	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.
Sample Size	164	99*	65**	241	44*	91**	294	43*	251**
Yes, was aware of discount before paying	76%	70%	85%	93%	84%	95%	96%	86%	97%
No, was not aware of discount before paying	24%	30%	15%	7%	6%	5%	4%	14%	3%
*Base: Respondents who purchased CFLs on the day of the survey **Base: Respondents who purchased LED lamps on the day of the survey									

FR0c/FR0cc. Did you see the stickers, shelf signs or posters in the light bulbs section of the store promoting the discount offered on L-E-Ds?

In-store Promotion Awareness	2012			2013			2014		
	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.
Sample Size*	120	65**	55	229	38	185	281	37	249
Yes, saw stickers, shelf signs, posters	93%	91%	96%	97%	100%	96%	93%	89%	94%
No, did not see stickers, shelf signs, posters	6%	8%	4%	2%	-	3%	6%	11%	5%
Don't know	1%	2%	-	1%	-	1%	1%	-	1%
*Base: Respondents who were aware of discount prior to purchase **Sample size lower than full base due to programming change									

AW1. Have you ever heard of the Efficiency Nova Scotia program which offers instant savings at the cash register for the purchase of energy-efficient products such as CFLs or L-E-D light bulbs, programmable thermostats and appliances?

ENSC Awareness	2012*				2013				2014			Both CFL/LED Lamp Purch. (#)
	Overall	CFL Purch.	LED Lamp Purch.	Both CFL/LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.	Both CFL/LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.	
Sample Size	156	88	61	7	241	44	191	6	294	38	251	5
Yes	58%	58%	57%	5	83%	82%	83%	4	78%	74%	79%	4
No	40%	40%	41%	2	12%	14%	12%	2	19%	26%	19%	-
Don't know	2%	2%	2%	-	5%	5%	5%	-	2%	-	2%	1
*Wording in 2012: Have you ever heard of the Efficiency Nova Scotia Instant Savings program?												

AW3. Prior to today, had you ever heard of Efficiency Nova Scotia, the organization that has the responsibility for helping Nova Scotians reduce their energy use?

ENSC Awareness	2012			2013			2014		
	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.	Overall	CFL Purch.	LED Lamp Purch.
Sample Size	164	96	61	241	44	191	294	43	256
Yes	87%	83%	90%	96%	100%	96%	94%	84%	95%
No	12%	16%	8%	2%	-	2%	5%	14%	4%
Don't know	1%	1%	2%	2%	-	2%	1%	2%	1%
*The wording of the 2012 question read as follows: Efficiency Nova Scotia Corporation is an independent organization responsible for helping Nova Scotians reduce their energy consumption and improve their energy efficiency at home and at work. Before I read you this description, had you ever heard of Efficiency Nova Scotia?									

AW4. Have you or someone from your household ever participated in one or more of Efficiency Nova Scotia Corporation's energy efficiency programs?

Previous Participation in ENSC Programs	2014
	Overall (LED Only)
Sample Size*	162
Yes	43%
No	51%
Don't know	6%
*Base: Respondents who heard of ENSC, during the fall interview period	

AW5. Which energy efficiency program(s) from Efficiency Nova Scotia Corporation have you participated in?

ENSC Programs Participated in Previously	2014
	Overall (LED only)
<i>Sample Size</i>	70
Lighting/Light bulb replacement/exchange	31%
Energy audit	23%
Appliance Retirement	16%
Water saving/low flow shower heads/faucet aerators/toilets	9%
Hot water tank wrap	4%
Insulation	4%
Windows/doors	4%
Clothesline	4%
Home Energy Assessment	4%
Low Income Homeowner	3%
Home Energy Report	1%
Others	11%
Base: Respondents who previously participated in ENSC programs, during the fall interview period	

AW6. In what year did you participate in this/these program(s)?

Year Previously Participated in Programs	2014
	Overall (LED only)
<i>Sample Size</i>	70
2010 or earlier	30%
2011	7%
2012	23%
2013	23%
2014	19%
Base: Respondents who previously participated in ENSC programs, during the fall interview period	

I1. Did you purchase either CFLs or L-E-Ds today?

CFLs/LED Lamps Purchased	2012	2013	2014
Sample Size	164	241	294
CFLs only	59%	18%	13%
LED lamps only	37%	79%	85%
Both	4%	2%	2%

P2. How many CFLs/LEDs did you purchase today?

Number Purchased	2012				2013				2014			
	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)
CFLs												
Sample Size*	103	96	n/a	7	50	44	n/a	6	43	38	n/a	5
1-2 CFLs	13%	14%	n/a	-	44%	48%	n/a	1	19%	21%	n/a	-
3-4	23%	24%	n/a	1	30%	30%	n/a	2	33%	32%	n/a	2
5-7	22%	23%	n/a	1	10%	9%	n/a	1	30%	32%	n/a	1
8-10	24%	25%	n/a	1	6%	7%	n/a	-	12%	11%	n/a	1
11 or more	17%	15%	n/a	4	10%	7%	n/a	2	7%	5%	n/a	1
Average***	7.7	7.3	n/a	13.4	4.5	4.1	n/a	7.0	5.1	4.8	n/a	7.2
LED Lamps												
Sample Size**	68	n/a	61	7	197	n/a	191	6	256	n/a	251	5
1-2 LED Lamps	49%	n/a	49%	3	28%	n/a	27%	4	32%	n/a	32%	2
3-4	25%	n/a	23%	3	25%	n/a	25%	1	32%	n/a	33%	1
5-7	15%	n/a	16%	-	19%	n/a	20%	-	17%	n/a	17%	1
8-10	6%	n/a	7%	-	12%	n/a	12%	1	11%	n/a	10%	1
11 or more	6%	n/a	5%	1	15%	n/a	16%	-	8%	n/a	8%	-
Average***	4.0	n/a	3.9	4.6	6.1	n/a	6.9	3.2	4.8	n/a	4.8	4.2
*Base: Respondents who purchased CFLs **Base: Respondents who purchased LED lamps ***Average excludes responses of 'Refused' and 'Don't know'												

P4. When you purchase L-E-Ds to replace regular incandescent or halogen light bulbs, on what do you usually rely to select the right wattage for your CFLs/L-E-Ds?

Determining Wattage of CFLs and LEDs	2014		
	Overall (%)	CFL Purchasers (%)	LED Lamp Purchasers (%)
<i>Sample Size</i>	294	43	256
Use guideline about equivalent wattage/power on package	59%	51%	61%
Ask salesperson	5%	14%	4%
Use guideline on equivalent wattage on Energy Star website	4%	-	4%
Use general 4-1 conversion rule (divide wattage of bulb by 4)	1%	-	1%
Use same wattage as with the less efficient bulbs to be replaced	15%	7%	16%
Use lower wattage than with the less efficient bulbs to be replaced	2%	-	3%
Use a higher wattage than with the less efficient bulbs to be replaced	1%	-	1%
It depends on the quantity of light needed - lumens	5%	7%	5%
Others	4%	12%	2%
Don't know	4%	9%	4%

P1. Are there any CFLs or L-E-Ds currently installed in your home?

CFLs/LED Lamps Currently Installed	2012				2013				2014			
	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)	Overall (%)	CFL Purch. (%)	LED Lamp Purch. (%)	Both CFL/LED Lamp Purch. (#)
<i>Sample Size</i>	164	96	61	7	241	44	191	6	294	38	251	5
CFLs only	52%	73%	25%	1	32%	80%	20%	4	58%	61%	58%	3
LED lamps only	10%	1%	26%	-	9%	-	11%	1	22%	3%	26%	-
Both	35%	23%	49%	6	56%	18%	66%	1	18%	29%	16%	2
No	2%	3%	-	-	2%	2%	3%	-	-	-	-	-
Don't know	-	-	-	-	-	-	1%	-	1%	8%	-	-

FR7. How influential was the discount offered by Efficiency Nova Scotia on your decision to purchase the CFLs/L-E-Ds that you purchased today? Please give your answer on a scale of 0 to 10, where 0 indicates the discount 'had no influence at all on your purchase decision' and 10 indicates that the discount was 'extremely influential on your purchase decision'.

Importance of Discount in Influencing Decision to Install Energy-efficient Products	2012		2013		2014	
	CFL Purchasers	LED Lamp Purchasers	CFL Purchasers	LED Lamp Purchasers	CFL Purchasers	LED Lamp Purchaser s
<i>Sample Size*</i>	68	55	39	100	37	249
Mean (0 = Had no influence at all, 10 = Extremely influential on purchase decision):**						
Importance of discount on purchase decision	6.7	8.0	7.6	8.7	5.5	7.8
*Base: Respondents who were aware of discount prior to purchase **Mean excludes responses of 'Refused' and 'Don't know'						

PR1. Besides the CFLs/L-E-Ds that you purchased with a discount today, are you aware of any other energy efficiency products that are discounted through the Instant Savings program?

Other Discounted Product Awareness	2012	2013	2014
<i>Sample Size*</i>	91	199	230
Yes, aware of other products	34%	45%	43%
No, not aware of other products	57%	44%	47%
Don't know	7%	11%	10%
Skipped	2%	-	-
*Base: Respondents who were aware of Instant Savings			

PR2. What are those products?

Other Discounted Products*	2012	2013	2014
<i>Sample Size**</i>	31	90	99
Refrigerators (no efficiency level specified)	-	38%	30%
Programmable thermostats	29%	38%	27%
Power bars or smart strips	19%	20%	25%
Regular or specialty CFLs	10%	17%	25%
Hard-wired dimmer switches	19%	18%	23%
LED lamps and recessed downlights	19%	10%	21%
Outdoor clotheslines/Outdoor drying racks	-	12%	15%
Clothes washers (no efficiency level specified)	-	26%	14%
Motion sensors	29%	11%	12%
Outdoor timers	26%	17%	11%
CEE Tier III refrigerators	16%	6%	6%
CEE Tier III clothes washers	13%	4%	3%
Heat pumps	-	2%	3%
Hot water tank	-	-	2%
Insulation	-	2%	1%
CEE Tier II refrigerators	-	4%	-
Stoves	-	3%	-
Windows/Doors	-	2%	-
Others	10%	9%	6%
Don't know	6%	7%	2%
*Multiple responses			
**Base: Among those aware of other discounted products			

PR2a. Did you already purchase, or do you plan on purchasing any of those other energy efficiency products before the middle of May/end of October this year?

Purchase Intentions for Other Products*	2013	2014
<i>Sample Size</i>	90	99
Yes, I already purchase those other energy efficiency products.	34%	26%
Yes, I plan on purchasing those other energy efficiency products.	20%	27%
No	38%	36%
Don't know	8%	11%
*Base: Among those aware of other discounted products		

PR3. Besides CFLs or L-E-Ds, are there any other energy efficiency products you would like to see rebated through the Instant Savings program? We are referring here to products that lead to reduced consumption of electricity.

Which Products Should Be Discounted*	2012***	2013***	2014
<i>Sample Size**</i>	73	103	119
Appliances	30%	31%	28%
Heat pumps	12%	31%	24%
Solar panels/products	5%	3%	8%
Water heater/Tankless water heater	8%	9%	7%
Air conditioners	-	-	7%
Heating systems	-	-	5%
Heaters/Furnaces	8%	11%	2%
Insulation	4%	9%	2%
Thermostats	8%	6%	2%
Motion sensor lights	-	-	2%
Outdoor lights or fixtures	4%	3%	1%
Everything/Anything	11%	1%	-
Windows/Doors	5%	1%	-
Water saving devices/Low-flow toilets/Low-flow showerheads	8%	-	-
Power bars	3%	-	-
Others	16%	14%	27%
*Multiple responses **"Don't know", "Refused", and "None/No others" removed from calculations ***Base: Among those who would like to see other energy efficiency products rebated through Instant Savings			

D1. What type of residence do you live in?

Type of Home	2012				2013				2014*			
	Overall (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (#)	Overall (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (#)	Overall (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (#)
Sample Size	164	96	61	7	241	44	191	6	257	30	223	4
Single-family detached house	77%	72%	84%	6	88%	86%	87%	6	84%	70%	86%	3
Semi-detached house	9%	9%	8%	-	3%	5%	3%	-	6%	10%	6%	-
Mobile home or house trailer	4%	4%	5%	-	2%	2%	2%	-	4%	7%	3%	1
Townhouse or duplex which shares adjacent walls	4%	6%	-	-	3%	2%	3%	-	4%	10%	3%	-
Apartment or condo building that has five or more stories	1%	1%	2%	-	2%	2%	2%	-	1%	3%	1%	-
Apartment or condo building that has fewer than five stories	5%	7%	2%	1	2%	2%	2%	-	1%	-	1%	-
Others	-	-	-	-	-	-	1%	-	-	-	-	-
*Refused removed from calculations												

D3. Do you own or rent this residence?

Home Ownership	2012				2013				2014*			
	Overall (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (#)	Overall (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (#)	Overall (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (%)
Sample Size	163	96	60	7	241	44	191	6	257	30	223	4
Own/ buying	92%	88%	98%	7	95%	93%	96%	5	93%	87%	94%	4
Rent/lease	8%	13%	2%	-	5%	7%	4%	1	7%	13%	6%	-
*Refused removed from calculations												

D4. Do you or does your landlord pay the electric bills for your residence?

You Pay Electric Bills	2012				2013				2014**			
	Overall (#)	CFL Purch. (#)	LED Purch. (#)	Both CFL/LED Purch. (#)	Overall (#)	CFL Purch. (#)	LED Purch. (#)	Both CFL/LED Purch. (#)	Overall (#)	CFL Purch. (#)	LED Purch. (#)	Both CFL/LED Purch. (#)
Sample Size*	13	12	1	0	11	3	7	1	17	4	13	0
I pay the electricity bill	10	10	-	-	9	2	7	-	14	2	12	-
My landlord pays the electricity bill	2	1	1	-	2	1	-	1	3	2	1	-
Other	1	1	-	-	-	-	-	-	-	-	-	-
*Base: Respondents who rent or lease their home **Refused removed from calculations												

D10. Gender.

Gender	2012				2013				2014			
	Overall (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (%)	Overall* (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (%)	Overall** (%)	CFL Purch. (%)	LED Purch. (%)	Both CFL/LED Purch. (%)
Sample Size	163	95	61	7	229	44	179	6	285	36	244	5
Male	66%	58%	77%	5	61%	32%	69%	3	59%	56%	60%	3
Female	34%	42%	23%	2	39%	68%	31%	3	41%	44%	40%	2
*Not full sample size due to interviewer error **Refused removed from calculations												

APPENDIX VII

ALGORITHM FOR FREE-RIDERSHIP CALCULATION

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

FR0a. Before paying at the cash register, were you aware that a discount was offered on the purchase of [CFLs or LEDs]?	IF 1. Yes : GO TO FR1 IF 2 OR 9 : Ask FR0b
FR0b. I just want to make sure I understand - You did not know about the discount on specific packages of [CFLs or LEDs] before paying at the register?	IF 1. Yes : GO TO FR1 IF 2. No: FR0 = 100% IF 9 DK: FR0 = EMPTY
PA1 Score:	IF FR0 = 100% OR EMPTY: FR0 and FINISH OTHERWISE CONTINUE
FR1. Did knowing that a discount was offered on the purchase of [CFLs or LEDs] play a part in your decision to buy [CFLs or LEDs] today?	IF 1. Yes: FR1 = 0% IF 2 OR 9 : FR1 = 100%
FR3. How likely would you have been to buy the [CFLs or LEDs] that you purchased today if the discount had not been offered? (Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0%: FR3/2 IF FR1 = 100% : FR3
FR4. If the discount had not been offered, when would you have purchased the [CFLs or LEDs] that you purchased today? 1. Definitely today 2. Probably today 3. Probably at a later date 4. Definitely at a later date 4. (Would not have purchased them at all) 9. (Don't know / Refused)	IF 1: FR4 = 100% IF 2: FR4 = 50% IF 3: FR4 = 25% IF 4. : FR4 = 0% IF 6. : FR4 = 0% IF 9. : FR4 = 0%
PA3 Score:	FR4
FR5. [ASK IF AWARE OF THE DISCOUNT (FR0a=1 OR FR0b=1)] Without the discount, would you have purchased the same number of [CFLs or LEDs]? 1. Definitely the same number 2. Probably the same number 3. Probably fewer 4. Definitely fewer 9. (Don't know / Refused)	IF 1: FR5 = 100% IF 2: FR5 = 50% IF 3: FR5 = 25% IF 4. : FR5 = 0% IF 9. : FR5 = 0%
PA4 Score:	FR5
FR7. How influential was the discount offered by ENSC on your decision to purchase the [CFLs or LEDs] that you purchased today? (Scale 0 to 10)	FR7 = (10 – Answer) x 10%
PA5 Score:	FR7
Final Free-Ridership	MEAN VALUE OF : (PA1 ; PA2 ; PA3 ; PA4 ; PA5)
Inconsistency Test #1	IF FR3 ≥ 70% AND IF FR1 = 0%: PA2 = EMPTY
Inconsistency Test #2	IF ABS(FR5-FR7) ≥ 30%: KEEP MIN (PA4 ; PA5)
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4 ; PA5)

APPENDIX VIII INTERNAL SPILLOVER METHODOLOGY

The retailer interviews were used to estimate the level of spillover by measuring the market effects attributable to the program for two eligible products: CFLs and LED lamps. Instant Savings discounts were offered during two distinct periods: in the spring and in the fall. During and between these two periods, eligible product sales may have occurred due to program influence, even if participants were unaware of the discount. This influence can be due to greater knowledge and awareness of energy-efficient products and from a change in retailers' offers. These sales should be attributable to the program in the form of market effects.

Market effects were evaluated by asking the retailers to Estimate program attribution for eligible products sold outside of the campaigns. Their answers were analyzed to measure the market effects attributable to Instant Savings and estimate the spillover effects for each product targeted. Market effects were obtained by applying the percentage of program attribution declared by the retailers to the sales of eligible products outside the two campaigns.

The figures below illustrate the methodology used to calculate the internal spillover level.

CFL

C1a. According to our information , you sold _____ regular ENERGY STAR CFLs <u>DURING</u> the spring campaign (April-May)? Is this accurate?	IF Yes: CONTINUE IF No: RECORD SALES
CFLs Sales during Spring Campaign :	ME1
C1b. Roughly what percentage of the regular ENERGY STAR CFLs you sold/intend to sell in 2014 has occurred during the spring campaign (that is April-May)?	RECORD PERCENTAGE ____ %
CFLs Sales outside Spring Campaign :	ME2 = (ME1/C1b) - ME1
C7. With this in mind, approximately what percentage of the number of CFLs you sold in 2014 outside of the spring campaign can you directly or indirectly attribute to the program - in essence sales you would not have if the program did not exist ?	RECORD PERCENTAGE ____ %
Program Attribution Level :	ME3
Market Effects (CFLs) = $\frac{ME2 \times ME3}{ME1}$	

LED

L1a. According to our information, you sold _____ regular ENERGY STAR LEDs <u>DURING</u> the spring campaign (April-May)? Is this accurate?	IF Yes: CONTINUE IF No: RECORD SALES
LEDs Sales during Spring Campaign:	ME1
L1b. Based on the information you have at this time, will your sales of Energy Star LED bulbs during the October-November fall campaign be higher, lower, or about the same as your sales of Energy Star LED bulbs recorded during the April-May spring campaign? What will be your estimated sales during the fall campaign?	RECORD PERCENTAGE OR ESTIMATED FALL SALES
LEDs Sales during Fall Campaign:	ME2 = ME1 x (1+L1b)
LEDs Sales during Spring and Fall Campaigns:	ME3 = ME1 + ME2
L1c. Roughly what percentage of the ENERGY STAR LED bulbs you sold/ intend to sell in 2014 will have occurred during the spring and fall campaigns combined (that is April-May and October-November)?	RECORD PERCENTAGE ____%
LEDs Sales outside Spring and Fall Campaigns:	ME4 = (ME3/L1c) – ME3
L7. With this in mind, approximately what percentage of the number of LEDs you sold in 2014 outside of the spring and fall campaigns can you directly or indirectly attribute to the program - in essence sales you would not have if the program did not exist?	RECORD PERCENTAGE ____%
Program Attribution Level:	ME5
Final Market Effects (LEDs) = $\frac{ME4 \times ME5}{ME3}$	



ECONOLER



HOME ENERGY ASSESSMENT

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

CATI	Computer-Assisted Telephone Interviewing
CEA	Certified Energy Advisor
CRA	Corporate Research Associates
DA	Delivery Agent
DSM	Demand-side Management
EEH	EnerGuide for Existing Houses
ENSC	Efficiency Nova Scotia Corporation
HEA	Home Energy Assessment
NRCan	Natural Resources Canada
NTGR	Net-to-Gross Ratio
PRISM	Princeton Scorekeeping Method

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Billing calibration	An activity that consists in adjusting the expected energy savings based on the relative difference between the results of the building energy simulations and the actual energy consumption of the building.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioural or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
EnerGuide rating	An EnerGuide rating shows a standard measure of the home's energy performance. It does not take into account occupants' behaviour and is thus just a measure of the house's efficiency. It shows how energy-efficient the home is through modelled heat losses of the home, based on several factors including heating systems and air leakage.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.

Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VII
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	2
2.1 Presentation of the Team	2
2.2 Methodology Description	2
3 VALIDATED SAVINGS	4
3.1 Gross Savings	4
3.1.1 Building Envelope Measure Savings	4
3.1.2 Peak Demand Savings	4
3.1.3 Validated Gross Savings	5
3.2 Net-to-gross Ratio	5
3.2.1 Free-ridership	6
3.2.2 Internal Spillover	6
3.2.3 NTGR Calculation	6
3.3 Net Savings	6
4 UNCONVERTED D STUDY SAVINGS	8
5 OVERALL HEA RESULTS	10
APPENDIX I PARTICIPANT SURVEY QUESTIONNAIRE	11
APPENDIX II PARTICIPANT SURVEY RESULTS	22
APPENDIX III ALGORITHM FOR FREE-RIDERSHIP CALCULATION	32
APPENDIX IV INTERNAL SPILLOVER METHODOLOGY	34

LIST OF TABLES

Table 1: Distortion Effects and Net-to-Gross Ratio	vii
Table 2: Validated Savings at the Generator	viii
Table 3: Annual Survey Sample Size and Margin of Error	3
Table 4: Validated Gross Energy and Peak Demand Savings	5
Table 5: Validated Net Energy and Peak Demand Savings	7
Table 6: Unconverted D Study Electrical Savings	9
Table 7: Validated Savings at the Generator	10

EXECUTIVE SUMMARY

The 2014 evaluation of Home Energy Assessment (HEA) involved validated Efficiency Nova Scotia Corporation's (ENSC) tracked savings as well as re-evaluating free-ridership and internal spillover. This report presents the validated gross and net savings for the year 2014.

Program Overview

HEA encourages homeowners in Nova Scotia to improve the energy efficiency and comfort of their homes. HEA focuses on building envelope insulation measures, such as draft proofing, installation of ENERGY STAR-qualified windows, doors or skylights, as well as exterior walls, exposed floors, basements and crawl spaces insulation.

HEA provides financial incentives in the form of rebates or zero-interest financing to homeowners as to reduce consumption of electrical energy and other fuels. The incentives provided by ENSC for measures aimed at reducing electricity consumption are funded by electricity ratepayers, whereas ENSC's incentives for measures aimed at reducing consumption of other fuels are funded by taxpayers.

HEA includes a pre- and post-retrofit assessment. The pre-retrofit assessment is conducted to propose energy efficiency measures in the form of a report, and the purpose of the post-retrofit assessment is to verify the installation of measures and establish an EnerGuide rating for the house.

Key Findings

Econoler reviewed the content of the 2014 HEA tracking sheet, which includes a total of 2,343 participants.

As part of the 2014 evaluation, the Evaluator validated the content of the tracking system report, verified that the parameters used in the gross savings calculations matched the 2013 evaluation results, and applied the established net-to-gross ratio (NTGR) by considering the free-ridership and spillover measured during the annual survey. In addition, the Evaluator performed an analysis of the savings generated through measures implemented by former participants who had received a D assessment but were removed from the program for not having completed an E assessment during the 12-month time limit of the program.

Table 1: Distortion Effects and Net-to-Gross Ratio

Parameter	2014 Result
Free-ridership Level	31%
Spillover Level	6%
NTGR	0.75

Based on these parameters, the net electrical energy savings for 2014 are estimated at 5.785 GWh and peak demand savings at 1.423 MW at the generator.

Table 2: Validated Savings at the Generator

	Gross Savings	NTGR	Net Savings
Energy Savings			
Validated Savings	4.943 GWh	0.75	3.707 GWh
Unconverted D Study Validated Savings	2.078 GWh	-	2.078 GWh
Total Validated Energy Savings	7.020 GWh	-	5.785 GWh
Peak Demand Savings			
Validated Savings	1.216 MW	0.75	0.912 MW
Unconverted D Study Validated Savings	0.511 MW	-	0.511 MW
Total Validated Peak Demand Savings	1.727 MW	-	1.423 MW

1 PROGRAM DESCRIPTION

Efficiency Nova Scotia Corporation's (ENSC) Home Energy Assessment (HEA) encourages homeowners in Nova Scotia to improve energy efficiency and comfort in their homes, while reducing their environmental impact and the burden of high energy costs. HEA was formerly known as EnerGuide for Existing Houses (EEH). On April 1, 2012, following changes made to eligible measures and rebates, and after the withdrawal of federal government rebates, the program component was redesigned and relaunched under the name HEA to avoid confusion among participants. A number of EEH participants have just completed their upgrades in 2014 and are considered in this evaluation.

HEA focuses on building envelope insulation measures, such as draft proofing, installation of ENERGY STAR-qualified windows, doors or skylights, as well as exterior walls, exposed floors, basements and crawl spaces insulation.

HEA provides incentives in the form of rebates or zero-interest financing from ENSC (ratepayer's funds) for demand-side management (DSM) measures in order to reduce electricity consumption. It also provides incentives with financial support from the Province of Nova Scotia for efficiency measures to reduce consumption of other fuels. ENSC acts as a single administrator for all participants, regardless of the source of energy savings.

HEA is supported by five delivery agents (DAs) across Nova Scotia, who provide pre- and post-retrofit assessments (also called "D assessment" and "E assessment" respectively). The pre-retrofit assessment is carried out to examine the house, complete a blower door test and collect information, such as the levels of insulation (attic, exterior wall, etc.), the number and types and of doors and windows, as well as the types of heating and hot water systems. Once the pre-retrofit assessment is completed, a home energy assessment report is sent to the homeowner within a few weeks. The report includes a pre-retrofit EnerGuide rating and outlines the efficiency of optional upgrades. This EnerGuide rating, along with the efficiency of the proposed measures, is calculated using HOT2000, a simulation tool developed by Natural Resources Canada (NRCan). Homeowners then have 12 months to complete the upgrades they have decided to undertake and schedule a post-retrofit assessment meant to assess the upgrades completed and give their home an EnerGuide rating.

HEA aimed to achieve net electricity savings of 4.8 GWh and peak demand savings of 1.2 MW for 2014. Electrical energy savings generated by HEA are accounted for under the Existing Residential program.

2 METHODOLOGY

This section presents the Econoler team and the methodology used to evaluate HEA.

2.1 Presentation of the Team

To carry out the 2014 evaluation, Econoler worked together with Corporate Research Associates (CRA). Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all the deliverables.
- › CRA performed the telephone survey with participants.

2.2 Methodology Description

In 2014, a full-scale evaluation of HEA was not carried out. As part of the 2014 evaluation, the Econoler team validated ENSC's tracked savings, verified that the evaluation parameters—such as the billing calibration factor—matched those established in the 2013 evaluation and reassessed free-ridership and internal spillover. Also for 2014, the evaluation included an analysis of the savings generated through measures implemented by former participants who had received a D assessment but were removed from the program for not having completed an E assessment during the 12-month time limit of the program. These former participants are designed as “Unconverted D Study” participants within this report. The resulting total gross and net energy and peak demand savings were then compiled.

In order to revise the free-ridership and internal spillover levels, an annual telephone survey of 100 participants was conducted by CRA staff in Halifax. Even though a process evaluation was not required for HEA in 2014, the Evaluator made sure to optimize the survey planned for this evaluation and include questions on satisfaction with HEA and ENSC. The questionnaire and survey results are presented in Appendices I and II respectively.

The interviews were conducted in October and November 2014 using a computer-assisted telephone interviewing (CATI) technology. The average length of the survey was 15.5 minutes. The table below shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 annual telephone surveys.

Table 3: Annual Survey Sample Size and Margin of Error

Annual Survey	Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
2014 Participants	2,343	100	±8.0%
2013 Participants	1,647	101	±7.9%
2012 Participants	1,839	80	±9.0%

The margin of error is used to determine the level of precision¹ of the measurement, and its associated confidence level indicates the probability that a measure will fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling error or bias, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

¹ *Precision* refers to how close the measured values are to each other. It does not, however, take into consideration how close the measured value is to the true value, which would be defined as *accuracy*.

3 VALIDATED SAVINGS

This section presents the gross and net savings for HEA in 2014.

3.1 Gross Savings

The gross savings evaluation was divided into two different sections: building envelope measure savings and peak demand savings.

A total of 2,343 participants participated in HEA in 2014, which represents an increase compared to 2013 (1,647 participants) and 2012 (1,839 participants).

3.1.1 Building Envelope Measure Savings

For building envelope measures, energy savings were calculated by comparing the modelled heating consumption values of the HOT2000 D and E assessments from participants. This method was used for all participants who implemented envelope measures in 2014. When a fuel switch occurs, energy savings are credited to the “former” fuel (D assessment).

For the 2012 evaluation of HEA, a billing analysis was performed for 416 participants² to evaluate the accuracy of the modelled heating consumption values obtained from HOT2000 simulations. The regression model used for the billing analysis follows the Princeton Scorekeeping Method (PRISM). The average deviation observed between the modelled energy consumption values from HOT2000 simulations and the actual consumption values of participants (electrical billing data) resulted in an overestimate of 18 percent. This overestimation ratio is used by ENSC to calculate building envelope savings in the tracking sheet.

In short, the savings calculation for building envelope measures is based on the equation below:

$$\text{Building Envelope Measure Electric Gross Savings (kWh)} = \frac{\% \text{Electric Heating}_{D \text{ Audit}} \times [SHEC (MJ)_{D \text{ Audit}} - SHEC (MJ)_{E \text{ Audit}}] \times (1 - 18\%)}{3.6 \text{ MJ/kWh}}$$

In this equation, SHEC corresponds to the total space heating energy consumption, with all fuel types combined.

For the 2014 evaluation, this calculation was validated for all participants in the tracking sheet.

3.1.2 Peak Demand Savings

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.246 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak

² 94 were from LIH and 322 from HEA.

demand savings and energy savings for a projected deployment of measures supported by HEA in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

3.1.3 Validated Gross Savings

The annual gross savings tracked for the building envelope measures and the prescriptive measures implemented in 2014 were validated by the Evaluator and are presented in the table below. Overall, the validated gross energy and peak demand savings amount to 4.493 GWh and 1.105 MW at the meter.

The gross savings at generator level are also estimated, using a line loss factor of 1.100 between the meter and the generator. This line loss factor value was provided by Nova Scotia Power for residential customers. As a result, the validated gross energy and peak demand savings at the generator are 4.943 GWh and 1.216 MW respectively.

Table 4: Validated Gross Energy and Peak Demand Savings

Parameter	2014 Result
Energy Savings	
Total Gross Energy Savings – at meter (GWh)	4.493
Line Loss Factor	1.100
Total Gross Energy Savings – at generator (GWh)	4.943
Peak Demand Savings	
Demand-to-Energy Ratio (MW/GWh)	0.246
Total Gross Peak Demand Savings – at meter (MW)	1.105
Line Loss Factor	1.100
Total Gross Peak Demand Savings – at generator (MW)	1.216

3.2 Net-to-gross Ratio

The NTGR evaluation is based on a self-report approach which relies on a series of questions designed to measure the influence of HEA on the decision of participants to implement eligible energy efficiency upgrades and measures.

This section presents the methodology used to transform responses to survey questions into an NTGR. It includes the assessment of two distortion effects: free-ridership and internal spillover.

3.2.1 Free-ridership

In the case of HEA, free-ridership can occur when participants would have still implemented the energy efficiency upgrades and measures in the absence of the program. The free-ridership level was measured through the annual survey using a sample of 100 participants and the same algorithm as for the 2011, 2012 and 2013 evaluations. The algorithm behind the free-ridership calculation is presented in Appendix III.

The 2014 annual survey results revealed a global free-ridership level of 31 percent for HEA. This free-ridership level is similar to that obtained during the evaluations of the last three years, i.e., 30 percent in 2013, 30 percent in 2012 and 31 percent in 2011.

3.2.2 Internal Spillover

The annual participant survey was also used to assess internal spillover, which can occur when participants, following their previous participation, implement additional energy efficiency measures that were recommended in their initial energy assessment.

The methodology used to calculate the level of internal spillover is presented in Appendix IV.

The 2014 annual survey results revealed an internal spillover effect factor of six percent for 2014. This result is higher than in past evaluations with three percent in 2013 and zero percent in 2012.

Prescriptive measures were removed from HEA on April 1, 2012, but certified energy advisors (CEAs) still recommend implementing these energy efficiency measures in the Homeowner Upgrade Report. More and more participants claimed in the annual survey conducted by CRA that they had implemented additional energy efficiency measures on their own after participating in HEA (12 participants in 2013 and 19 participants in 2014).

3.2.3 NTGR Calculation

The NTGR is calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership} + \% \text{ internal spillover})$$

Using the free-ridership and spillover levels established for HEA, the NTGR value is estimated at 0.75.

3.3 Net Savings

The net savings were estimated using the NTGR presented above. The equation below was used to calculate both peak demand and energy net savings.

$$\text{Net Savings} = \text{Gross Evaluation Savings} \times NTGR$$

The 2014 net energy savings for HEA are estimated at 3.370 GWh at the meter and 3.707 GWh at the generator. The total peak demand savings are estimated at 0.829 MW at the meter and 0.912 MW at the generator. The detailed results are presented in the following table.

Table 5: Validated Net Energy and Peak Demand Savings

Parameter	2014 Result
Energy Savings	
Total Gross Energy Savings – at meter (GWh)	4.493
NTGR	0.75
Total Net Energy Savings – at meter (GWh)	3.370
Line Loss Factor	1.100
Total Net Energy Savings – at generator (GWh)	3.707
Peak Demand Savings	
Total Gross Peak Demand Savings – at meter (MW)	1.105
NTGR	0.75
Total Net Peak Demand Savings – at meter (MW)	0.829
Line Loss Factor	1.100
Total Net Peak Demand Savings – at generator (MW)	0.912

4 UNCONVERTED D STUDY SAVINGS

In 2013, many participants did not complete the E assessment. The partner's interviews from the 2013 process evaluation showed that the main reason for this was the length of time to complete the E assessment getting reduced from 18 months to the current 12-month timeline. Hundreds of participants had not yet implemented energy efficiency measures before the deadline and were removed consequently from the program. ENSC found, however, that many of them had decided to implement measures on their own. The following section thus presents the methodology used to assess this unconverted D study savings.

The whole database contains 3,088 "Unconverted D study" participants who have not completed the E assessment. This population includes clients whose participation expired in 2013, as well as some clients whose participation expired prior to 2013 since potential savings from the implementation of efficiency measures could also have occurred with them.

A survey was conducted in early 2013 with 400 "Unconverted D study" participants to determine whether they had implemented energy efficiency measures that resulted in savings. The results of the survey showed that 73 percent of respondents had installed at least one measure.

A sample of 76 respondents who installed at least one measure was selected from the database to conduct an E assessment and to calculate the resulting savings. The sample was representative of the whole database for the type of fuel (electricity: 37%, oil: 62%, others: 1%). The method used is the same as the HEA participant's methodology, i.e. based on the D and E modelled energy consumptions resulting from the HOT2000 simulations and the percentage of electrical heating estimated during the D assessment. The survey included 28 respondents with electrical heating.

Each participant's electrical savings were weighted based on the level of influence that the Homeowner Upgrade Report and/or the Certified Energy Advisor had on their decision to proceed with the upgrades. . The final survey determined to what extent did the HEA report and/or the advice provided by the energy auditor during the visit influence their decision to proceed with the upgrades. The average influence for the electrically heated participants is estimated to be 6.3 on a scale of 0 to 10, where 0 means "no influence at all" and 10 means "a great deal of influence".

The unconverted D study savings are calculated using the following equation:

$$\begin{aligned}
 & \text{UNCONVERTED D STUDY SAVINGS} \\
 &= (\text{Total Number of unconverted D participants}) \\
 &\times (\% \text{ who declared having implemented measures after their D assessment}) \\
 &\times \left(\text{average electrical savings per house that have been visited and weighted} \right. \\
 &\quad \left. \text{with \% of influence from ENSC} \right)
 \end{aligned}$$

Since the influence of ENSC is already considered in the calculation, those savings are considered net and therefore include free-ridership. The 2014 unconverted D study net energy savings for HEA are estimated at 1.889 GWh at the meter and at 2.078 GWh at the generator respectively.

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.246 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by HEA in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

The unconverted D study net peak demand savings are estimated at 0.465 MW at the meter and at 0.511 MW at the generator respectively.

The detailed results are presented in the following table.

Table 6: Unconverted D Study Electrical Savings

	Unconverted D Study Electrical Savings
Total Number of Unconverted D Study Participants	3,088
Ratio of Unconverted D Study Participants Who Implemented at Least One Measure	73%
Total Number of Unconverted D Study Participants Who Implemented at Least One Measure	2,254
Average Electrical Savings per Participant in kWh (with influence from ENSC)	838 kWh
Energy Savings	
Overall Net Energy Savings – at meter (GWh)	1.889 GWh
Line Loss Factor	1.10
Overall Net Energy Savings – at generator (GWh)	2.078 GWh
Peak Demand Savings	
Demand-to-Energy Ratio (MW/GWh)	0.246
Overall Net Peak Demand Savings – at meter (MW)	0.465 MW
Line Loss Factor	1.10
Overall Net Peak Demand Savings – at generator (MW)	0.511 MW

5 OVERALL HEA RESULTS

The table below summarizes the overall results for HEA. With combined net savings generated from both validated savings and the unconverted D study savings, the total energy and peak demand savings amounted to 5.785 GWh and 1.423 MW respectively.

Table 7: Validated Savings at the Generator

Parameter	Gross Savings	NTGR	Net Savings
Energy Savings			
Validated Savings	4.943 GWh	0.75	3.707 GWh
Unconverted D Study Validated Savings	2.078 GWh		2.078 GWh
Total Validated Energy Savings	7.020 GWh		5.785 GWh
Peak Demand Savings			
Validated Savings	1.216 MW	0.75	0.912 MW
Unconverted D Study Validated Savings	0.511 MW		0.511 MW
Total Validated Peak Demand Savings	1.727 MW		1.423 MW

APPENDIX I

PARTICIPANT SURVEY QUESTIONNAIRE

Hello may I please speak with [INSERT NAME]?

- 1 Yes [GO TO INTRODUCTION]
- 2 No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

Hello, my name is _____ and I am with CRA, Corporate Research Associates, a Halifax-based survey research company. We are performing an evaluation of energy efficiency programs and services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your household recently participated in Efficiency Nova Scotia Corporation's Home Energy Assessment program. This program encourages homeowners to improve the energy efficiency of their home by having an energy advisor conduct an assessment of the home and provide them with a set of upgrade recommendations. We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about ten minutes. Is this a good time for you?

Verification and Recall (Series V)

V1. We understand you participated in the Home Energy Assessment program. Is that correct?

1. Yes [CONTINUE]
2. No [PROMPT: "Are you sure? Someone would have come to your house to evaluate the energy efficiency of your home and sent you a Homeowner Upgrade report telling you about upgrades you could make to your home to improve its energy efficiency. They might have talked about the possibility of you getting rebates to cover some of the cost of these upgrades." RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO: "Is there someone else in the household who would know about having participated in the Home Energy Assessment program?"]

___ Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]

___ No [THANK & TERMINATE]

98. Don't know [PROMPT IF NOT ALREADY READ TO RESPONDENT: "Someone would have come to your house to evaluate the energy efficiency of your home and sent you a Homeowner Upgrade report telling you about upgrades you could make to your home to improve its energy efficiency. They might have talked about the possibility of you getting rebates to cover some of the cost of these upgrades." RECODE AS "YES" IF THE

PROMPT WORKS; IF RESPONDENT STILL SAYS DON'T KNOW: "Is there someone else in the household who would know about having participated in the Home Energy Assessment program?"

1. ☐ Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
2. ☐ No [THANK & TERMINATE]
99. Refused [THANK AND TERMINATE]

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"]

[SCHEDULED, IF NECESSARY, FOR: _____]

Satisfaction with Program (CS Series)

CS1. How did you first learn about this program? **[DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]**

1. Media advertising
2. Contacted directly by Efficiency Nova Scotia
3. Through a third party contractor or service provider
4. Efficiency Nova Scotia website
5. Facebook or other social media
6. Word of mouth
97. (Other **[SPECIFY** _____ **])**
98. (Don't know)
99. (Refused)

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the Home Energy Assessment program? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

1. Yes
2. No
98. (Don't know)
99. (Refused)

IF YES IN CS2, CONTINUE. OTHERWISE, SKIP TO CS27

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with **[READ AND ROTATE. CODE ONE RESPONSE FOR EACH STATEMENT]**

- b. The responsiveness of employees to your requests and enquiries in a timely manner
- e. The length of time prior to your first appointment
- g. The value of the program relative to the time and cost involved

___ Response ___ 98 Don't Know ___ 99 Refused

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

___ Response ___ 98 Don't Know ___ 99 Refused

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO CS27.

CS7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

- CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's... **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**
- a. Service attitude
 - b. Knowledge of programs available
 - c. Ability to provide advice
- 1. Completely satisfied
 - 2. Mostly satisfied
 - 3. Mostly dissatisfied
 - 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
 - 98. (Don't know)
 - 99. (Refused)
- CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others? **[CODE ONE ONLY]**
- 1. Definitely
 - 2. Probably
 - 3. Probably not
 - 4. Definitely not
- 97. (Not eligible to any other programs)
 - 98. (Don't know)
 - 99. (Refused)
- CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs? **[CODE ONE ONLY]**
- 1. Definitely
 - 2. Probably
 - 3. Probably not
 - 4. Definitely not
- 98. (Don't know)
 - 99. (Refused)
- S10. Thinking of when your post-retrofit assessment was conducted by the energy advisor, how long, in days, was it before you received your rebate? **[RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]**

Verification of Actions Taken (VR Series)

VR1. I am going to read you a list of upgrades that may have been recommended by the Energy Advisor for your home. For each one, can you please tell me if that upgrade was recommended for your home? [DO NOT ROTATE - CODE ONE ONLY PER STATEMENT]

[1 = YES, RECOMMENDED, 2 = NO, NOT RECOMMENDED, 98 = DON'T KNOW / DON'T REMEMBER, 99 = REFUSED] [READ]

- a. High efficiency air to air (or air source) heat pump with electric backup
- b. High efficiency air to air (or air source) heat pump with NON electric backup
- c. High efficiency ground source (or geothermal) heat pump
- d. Electronic programmable thermostats
- e. Drain water heat recovery
- f. Solar domestic water heating system
- g. High efficiency ductless mini split heat pump
- h. Electric water heater tank insulation
- i. Electric water heater exposed pipe insulation
- j. Ceiling Insulation
- k. Exterior Wall Insulation
- l. Exposed Floor Insulation
- m. Basement Insulation
- n. Crawlspace Insulation
- o. Draft proofing
- p. Windows/Doors/Skylights

[ASK VR2A-B IF ANY ITEM IN VR1A THRU S=1 ("YES, RECOMMENDED")]

VR2a. IF **MORE THAN ONE** ITEM IN VR1a-s=YES, READ: Through the Home Energy Assessment program, have you implemented at least one, all or none of the energy efficiency recommendations, meaning that you received a rebate or incentive for installing the upgrades? Have you... [READ. ACCEPT ONE RESPONSE]

1. Implemented at least one upgrade
2. Implemented all the upgrades
3. Or Not implemented any upgrades
98. (Don't know)
99. (Refused)

VR2b. IF ONLY ONE ITEM IN VR1a-s=YES, READ: Through the Home Energy Assessment program, have you implemented this energy efficiency recommendation, meaning that you received a rebate or incentive for installing the upgrade? Have you... [READ. ACCEPT ONE RESPONSE]

1. Yes, Implemented the upgrade
2. No, Not implemented the upgrade
98. (Don't know)
99. (Refused)

[ASK VR3 IF VR2A=1 ("YES, IMPLEMENTED AT LEAST ONE UPGRADE")]

VR3. Which of the following recommendations have you implemented under the Home Energy Assessment program? [ASK FOR EACH ITEM IN VR1a thru p = 1

[1 = YES, IMPLEMENTED, 2 = NO, NOT IMPLEMENTED, 98 = DON'T KNOW / DON'T REMEMBER, 99 = REFUSED] [READ]

- a. High efficiency air to air (or air source) heat pump with electric backup
- b. High efficiency air to air (or air source) heat pump with NON electric backup
- c. High efficiency ground source (or geothermal) heat pump
- d. Electronic programmable thermostats
- e. Drain water heat recovery
- f. Solar domestic water heating system
- g. High efficiency ductless mini split heat pump
- h. Electric water heater tank insulation
- i. Electric water heater exposed pipe insulation
- j. Ceiling Insulation
- k. Exterior Wall Insulation
- l. Exposed Floor Insulation
- m. Basement Insulation
- n. Crawlspace Insulation
- o. Draft proofing
- p. Windows/Doors/Skylights

Spillover (SO Series)

SKIP PATTERN APPLIES TO ENTIRE SO SECTION: ASK IF VR2a=3 ("No, have not implemented any upgrades" OR IF VR2b=2 ("No, not implemented the upgrade") OR IF ANY POSED ITEM IN VR3a thru p=2 "No, not implemented"

You mentioned in a previous answer that there were some recommended upgrades that you decided not to install through the Home Energy Assessment program.

SO1. **Since the time that you participated** in the Home Energy Assessment program, have you implemented one or more of the recommended upgrades on your own?

- 1. (Yes)
- 2. (No)
- 98. (Don't know)
- 99. (Refused)

[IF SO1=1]

SO2. Which upgrades have you implemented on your own after participating in the Home Energy Assessment program? [READ, ACCEPT MULTIPLE]

IF VR2a=1 (Yes, implemented at least one upgrade): LIST OF EACH ITEM IN VR1a thru s=1 ("Yes, recommended") AND VR3a thru s=2("No, not implemented")]

OR

IF VR2a=3 (No, have not implemented any upgrades): LIST OF EACH ITEM IN VR1a thru s=1 ("Yes, recommended")

OR

IF VR2b=2 (No, not implemented the upgrade): LIST OF ITEM IN VR1a thru s=1("Yes, recommended")

- 96. Other energy-efficient measures? [Please specify_____]
- 98. (Don't know)
- 99. (Refused)

[IF SO1=1]

SO3. Have you received financing or rebates from other Efficiency Nova Scotia programs for the energy efficiency upgrades you implemented on your own after participating in the Home Energy Assessment program?

- 1. Yes [Go to FR1]
- 2. No
- 98. (Don't know) [Go to FR1]
- 99. (Refused) [Go to FR1]

[IF SO3 = 2]

SO4. How influential was your experience with the program on your decision to implement some or all of the measures that you installed on your own after participating in the Home Energy Assessment program? Please give your answer on a scale of 0 to 10, where 0 indicates that the Home Energy Assessment program "had no influence at all on your decision to implement additional energy efficiency upgrades" and 10 indicates that the program was "extremely

influential in your decision to implement additional energy efficiency upgrades.” [RECORD RESPONSE 0-10, 98 = Don’t know, 99 = REFUSED] [DO NOT ACCEPT A RANGE]

Free-Ridership [FR Series]

Now I'm going to ask you to think of all the energy-efficient upgrades that were implemented to your home under the Home Energy Assessment program.

FR1. BEFORE participating in the Home Energy Assessment program, did you have plans to implement the specific energy-efficient upgrades that were implemented through the program?

- 1. Yes
- 2. No
- 98. (Don’t know)
- 99. (Refused)

[IF FR1=YES, THEN ASK:]

FR1a. I just want to make sure I understand - Before you decided to participate in the Home Energy Assessment program, you had already made the decision to implement the energy efficiency upgrades you implemented through the program?

- 1. Yes
- 2. No
- 98. (Don’t know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Home Energy Assessment program.

If you had not participated in the Home Energy Assessment program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely **Would Not** Have Taken the Action,” and a 10 indicating that you “Definitely **Would Have** Taken the Action.” **[AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: “AND NEXT, In the absence of the program, would you have . . . : DO NOT ACCEPT A RANGE – ASK FR2 SEQUENCE IN ORDER/DO NOT RANDOMIZE]**

FR2a. ... implemented exactly the same quantity of energy efficiency upgrades that you implemented through the Home Energy Assessment program?

___ Response ___ 98 Don’t Know ___ 99 Refused

FR2b. ... implemented standard equipment, material or product instead of energy-efficient equipment, material or product?

___ Response ___ 98 Don’t Know ___ 99 Refused

FR2c. ... implemented the exact same energy efficiency upgrades that you implemented through the Home Energy Assessment program, but at a later date?

___ Response ___ 98 Don't Know ___ 99 Refused

[IF FR2c > 5, THEN ASK:]

FR2d. **[DO NOT ASK FR2d IF DON'T KNOW OR REFUSED IN Q.FR2c]** You indicated in your response to a previous question that if the Home Energy Assessment program had not been available there was an **[INSERT RESPONSE FROM FR2c]** in 10 likelihood that you would have implemented the exact same energy-efficient upgrades that you implemented through the program, but at a later date. Approximately how many months later would you have implemented these upgrades? **[DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

1. ___ months later
2. (Never)
3. (At the same time)
98. (Don't Know)
99. (Refused)

[IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2d ANSWER IN MONTHS, READ]:
Would it have been within...

1. Less than 6 months?
2. 6 months to less than 1 year later?
3. 1 to less than 2 years later?
4. 2 to less than 3 years later?
5. 3 to less than 4 years later?
6. 4 or more years later?
7. (Never)
98. (Don't Know)
99. (Refused)

FR3. Efficiency Nova Scotia gave you a rebate for the energy efficiency upgrades you implemented in your home. If you had not received the rebate from Efficiency Nova Scotia, would you have paid for the full cost of the energy efficiency upgrades you implemented? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely **Would Not** Have Paid" and a 10 indicating that you "Definitely **Would Have** Paid." **[PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

___ Response ___ 98 Don't Know ___ 99 Refused

FR4. Next, I'm going to ask you to rate the importance of the Home Energy Assessment program as well as other factors that might have influenced your decision to implement the energy

efficiency upgrades you implemented through the program? Using a scale from 0 to 10 where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to implement the energy efficiency upgrades you implemented through the program. **DO NOT ACCEPT A RANGE**

Factor (READ AND RANDOMIZE)	Responses
a. The program incentive	___ Response ___ 98 Don't Know ___ 99 Refused
b. Information or advice provided by the program	___ Response ___ 98 Don't Know ___ 99 Refused
c. Information or advice from the energy audit	___ Response ___ 98 Don't Know ___ 99 Refused
d. The EnerGuide Label and designation itself	___ Response ___ 98 Don't Know ___ 99 Refused
e. Previous experience with the Home Energy Assessment or EnerGuide for Existing Houses program, or a similar program either from Efficiency Nova Scotia or Nova Scotia Power	___ Response ___ 98 Don't Know ___ 99 Refused

Demographic Characteristics [D Series]

[ASK ALL RESPONDENTS]

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

D1. What type of residence do you live in? [READ RESPONSES 1-7, SELECT ONE RESPONSE]

1. Detached single-family home
2. Semi-detached house
3. Mobile home or house trailer
4. Townhouse or duplex which share adjacent walls
5. Row house (Single story apartment building)
6. Apartment building that have fewer than five stories
7. Apartment building that have five or more stories
96. (Other [SPECIFY: _____])
98. (Don't know)
99. (Refused)

D2. How many bedrooms are in your home? [98=DK; Enter zero for a studio apartment with no bedrooms]

D5. Is your home occupied year round, or is it a seasonal home?

1. Year round residence
2. Seasonal / vacation home
96. (Other Specify _____)
98. (Don't Know)
99. (Refused)

- D6. Including yourself, how many people live in this residence on a full-time basis?
Number of people: _____
- D7. In what age category do you fall? Are you... [READ]
1. 18 to 24
 2. 25 to 34
 3. 35 to 44
 4. 45 to 54
 5. 55 to 64
 6. 65 or over
 99. (Refused)
- D8. What is the highest grade of schooling completed by the head of your household? [DO NOT READ]
1. (Less than high school graduation certificate)
 2. (High school graduation certificate and/or some post-secondary)
 3. (Trades certificate or diploma)
 4. (College certificate or diploma)
 5. (University certificate or diploma)
 98. (Don't know)
 99. (Refused)
- D9. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category. [READ LIST; SELECT ONE RESPONSE]
1. Less than \$15,000
 2. \$15,000 - \$24,999
 3. \$25,000 - \$34,999
 4. \$35,000 - \$49,999
 5. \$50,000 - \$69,999
 6. \$70,000 - \$79,999
 7. \$80,000 or more
 98. (Don't know)
 99. (Refused)
- D10. [DO NOT READ] Gender:
1. Male
 2. Female

END: Those are all the questions I have for you. Thank and terminate.

APPENDIX II

PARTICIPANT SURVEY RESULTS

The participant survey results are presented in the following tables.

CS1. How did you first learn about this program?

Sources of Awareness*	2012	2013	2014
<i>Sample Size</i>	<i>80</i>	<i>101</i>	<i>100</i>
Word of mouth	40%	33%	43%
Media advertising	-	-	19%
The Internet	15%	6%	9%
ENSC website	1%	6%	4%
Home show	-	6%	4%
Facebook or other social media	5%	7%	2%
Third party contractor or service provider	6%	5%	2%
Contacted directly by ENSC	-	-	1%
Television	11%	11%	-
Newspaper ad or story	15%	10%	-
Previous/past participants	5%	8%	-
Radio	6%	3%	-
TeamBuy	4%	3%	-
Nova Scotia Power bill insert	-	3%	-
Homeowner Upgrade Report with Nova Scotia Power bill	-	2%	-
Building supply dealer/store	5%	2%	-
ACAP Cape Breton (DA)	1%	1%	-
Clean Nova Scotia (DA)	-	1%	-
Trinity Inspection Services (DA)	3%	-	-
Others	10%	9%	10%
Don't know	8%	3%	13%
*Multiple responses			

VR2a/VR2b. Through the Home Energy Assessment program, have you implemented at least one, all or none of the energy efficiency recommendations, meaning that you received a rebate or incentive for installing the upgrades?

Recommended Energy Efficiency Measures Implemented	2012	2013	2014
<i>Sample Size*</i>	<i>79</i>	<i>101</i>	<i>100</i>
Implemented at least one upgrade	65%	77%	64%
Implemented all of the upgrades	32%	19%	34%
Did not implement any upgrades	-	2%	1%
Don't know	4%	2%	1%
*Base: Respondents who indicated they were given recommendations for at least one of the eligible measures			

VR1. I am going to read you a list of upgrades that may have been recommended by the Energy Advisor for your home. For each one, can you please tell me if that upgrade was recommended for your home?

VR3. Which of the following recommendations have you implemented under the Home Energy Assessment program?

Measures	2012		2013		2014	
	Recom- mended	Imple- mented	Recom- mended	Imple- mented	Recom- mended	Imple- mented
<i>Sample Size</i>	80	80	101	101	100	100
Draft proofing	76%	45%	87%	62%	89%	80%
Windows/Doors/Skylights	70%	30%	86%	62%	71%	63%
Electric water heater tank insulation	69%*	39%*	61%*	29%*	67%	57%
Ceiling insulation	60%	24%	73%	38%	65%	50%
Basement insulation	56%	16%	73%	36%	64%	52%
Electronic programmable thermostats	59%	21%	52%	28%	60%	36%
Electric water heater exposed pipe insulation	68%*	41%*	52%*	33%*	58%	51%
Exterior wall insulation	53%	20%	64%	35%	52%	37%
High-efficiency air to air (or air source) heat pumps with electric backup	49%	4%	28%	5%	46%	13%
Exposed floor insulation	36%	9%	35%	9%	39%	25%
Crawlspace insulation	39%	10%	38%	17%	33%	24%
High-efficiency ductless mini-split heat pumps	31%	11%	26%	4%	31%	14%
Solar domestic water heating (DHW) systems	21%	4%	15%	-	11%	-
Drain water heat recovery	19%	1%	13%	2%	8%	3%
High-efficiency air to air (or air source) heat pumps with non-electric backup	15%	-	13%	2%	8%	2%
High-efficiency ground source (or geothermal) heat pumps	15%	3%	12%	1%	7%	2%

VR1/V3. Measure uptake calculated as the percentage of measures implemented by measures recommended.

Proposed Energy Efficiency Measure Uptake	2012	2013	2014
	Measure Uptake	Measure Uptake	Measure Uptake
<i>Sample Size</i>	80	101	100
Draft proofing	59%	71%	90%
Windows/Doors/Skylights	43%	72%	89%
Electric water heater tank insulation	57%	48%	85%
Ceiling insulation	40%	52%	77%
Basement insulation	29%	49%	81%
Electronic programmable thermostats	36%	54%	60%
Electric water heater exposed pipe insulation	60%	64%	88%
Exterior wall insulation	38%	55%	71%
High-efficiency air to air (or air source) heat pumps with electric backup	8%	18%	28%
Exposed floor insulation	25%	26%	64%
Crawlspace insulation	26%	45%	73%
High-efficiency ductless mini-split heat pumps	35%	15%	45%
Solar domestic water heating systems	19%	-	-
Drain water heat recovery	5%	15%	38%
High-efficiency air to air (or air source) heat pumps with non-electric backup	-	15%	25%
High-efficiency ground source (or geothermal) heat pumps	20%	8%	29%

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the Home Energy Assessment program?

Contact with ENSC	2012*	2013	2014
<i>Sample Size</i>	133	100	100
Yes	60%	80%	80%
No	30%	15%	14%
Don't know	10%	5%	6%
*Source: 2012 C-Sat Residential Study			

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with...

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

Satisfaction with Overall Performance	2012***		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Mean (1=Not at all satisfied, 10=Completely satisfied)**						
Responsiveness of employees to requests and enquiries in a timely manner	79	8.6	78	9.1	78	9.0
Length of time prior to your first appointment	n/a	n/a	78	9.1	77	8.9
ENSC's overall performance in working with you	80	8.5	80	9.0	79	8.7
Value of HEA relative to the time and cost involved	80	8.3	77	8.7	78	8.2
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of 'Refused' and 'Don't know' ***Source: 2012 C-Sat Residential Study						

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

Contact with ENSC Contact Centre	2012*	2013	2014
Sample Size	80	80	80
Yes	89%	80%	86%
No	10%	6%	6%
Don't know	1%	14%	8%
*Source: 2012 C-Sat Residential Study			

CS7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects?

Satisfaction with Overall Performance	2012***		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Service attitude	71	99%	64	98%	68	94%
Ability to provide advice	69	96%	63	98%	64	92%
Overall level of service provided	71	99%	64	97%	68	91%
Knowledge of programs available	68	97%	63	92%	65	97%
*Base: Number of respondents who had contact with ENSC contact center representatives ** Percentage completely satisfied/mostly satisfied. "Don't know/Refused" removed from calculations ***Source : 2012 C-Sat Residential Study						

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others?

Would Recommend HEA to a Family Member or Friend	2012**	2013	2014
Sample Size*	132	100	100
Definitely	80%	83%	67%
Probably	17%	15%	27%
Probably not	2%	1%	5%
Definitely not	1%	1%	1%
* "Don't know/refused" have been removed from calculation **Source: 2012 C-Sat Residential Study			

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified?

Would Participate in Other ENSC Programs	2012*	2013	2014
Sample Size	132	100	99
Definitely	70%	63%	60%
Probably	27%	35%	30%
Probably not	2%	1%	9%
Definitely not	2%	1%	1%
*Source: 2012 C-Sat Residential Study			

S10. Thinking of when your post-retrofit assessment was conducted by the energy advisor, how long, in days, was it before you received your rebate?

Length of Time to Receive Rebate	2014
<i>Sample Size</i>	60
7-9 days	2%
10-19 days	10%
20-29 days	15%
30-49 days	33%
50 days or more	40%
Mean*	45.0
**"Don't know/refused" have been removed from calculation	

FR4. Next, I'm going to ask you to rate the importance of the Home Energy Assessment program as well as other factors that might have influenced your decision to implement the energy efficiency upgrades you implemented through the program? Using a scale from 0 to 10 where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to implement the energy efficiency upgrades you implemented through the program.

Importance of HEA in Influencing Decisions	2012		2013		2014	
	<i>Sample Size*</i>	Mean Score	<i>Sample Size*</i>	Mean Score	<i>Sample Size*</i>	Mean Score
Average rating: 10= "Extremely important", 0= "Not important at all"						
Information or advice from the energy audit	80	8.5	99	8.3	100	8.0
Information or advice provided through the program	80	8.5	99	8.3	100	7.8
Program incentives	80	8.6	94	7.8	99	7.0
EnerGuide label and designation themselves	77	7.7	93	7.3	97	6.7
Previous experience with the EEH program or a similar program from either ENSC or Nova Scotia Power	66	4.4	90	4.5	92	5.2
* "Don't know/Refused" excluded from calculations						

D1. What type of residence do you live in?

Type of Residence	2012	2013	2014
<i>Sample Size</i>	80	101	100
Single-family detached	88%	97%	91%
Semi-detached	8%	-	4%
Townhouse or duplex	-	3%	2%
Mobile home or house trailer	3%	-	1%
Others	-	-	1%
Don't know/Refused	2%	-	1%

D2. How many bedrooms are in your home?

Numbers of Bedrooms	2012	2013	2014
<i>Sample Size</i>	80	101	100
1	3%	-	-
2	15%	15%	16%
3	43%	55%	44%
4 or more	39%	30%	40%
Don't know	1%	-	-

D5. Is your home occupied year round, or is it a seasonal home?

Type of Home	2012	2013	2014
<i>Sample Size</i>	80	101	100
Year Round	98%	99%	97%
Seasonal	1%	1%	3%
Refused	1%	-	-

D6. Including yourself, how many people live in this residence on a full-time basis?

Full-time Residents	2012	2013**	2014
Sample Size	80	201	100
0***	-	-	2%
1	8%	13%	11%
2	45%	51%	48%
3	23%	13%	22%
4	16%	18%	9%
5 or more	8%	3%	8%
Don't know	1%	-	-
Average*	2.8	2.5	2.5
*Don't know/Refused excluded from calculation **Source: 2013 annual and 2013 quarterly surveys ***Responses of '0' were for two respondents who were from seasonal homes			

D7. In what age category do you fall? Are you...

Respondent Age	2012	2013*	2014
Sample Size	80	201	100
18 to 24	-	-	1%
25 to 34	18%	16%	11%
35 to 44	14%	16%	16%
45 to 54	23%	19%	18%
55 to 64	30%	34%	33%
65 or older	15%	14%	20%
Refused	1%	-	1%
*Source: 2013 annual and 2013 quarterly surveys			

D8. What is the highest grade of schooling completed by the head of your household?

Education	2012	2013*	2014
<i>Sample Size</i>	80	201	100
Less than high school	3%	5%	2%
High school graduate	15%	19%	23%
Trade certificate	4%	5%	11%
College diploma	20%	19%	11%
University diploma	55%	49%	52%
Others	1%	-	-
Don't know/Refused	3%	1%	1%
*Source: 2013 annual and 2013 quarterly surveys			

D9. Which of the following income categories best describes your total annual household income before taxes in 2013?

	2012	2013*	2014
<i>Sample Size</i>	80	201	100
Less than \$15,000	-	1%	-
\$15,000 to \$24,999	6%	2%	2%
\$25,000 to \$34,999	3%	7%	9%
\$35,000 to \$49,999	18%	12%	9%
\$50,000 to \$69,999	18%	17%	15%
\$70,000 to \$79,999	3%	11%	13%
\$80,000 or more	35%	36%	33%
Refused / Don't know	19%	13%	19%
*Source: 2013 annual and 2013 quarterly surveys			

D10. Gender:

Gender	2012	2013*	2014
<i>Sample Size</i>	80	201	100
Male	64%	48%	67%
Female	36%	52%	33%
*Source: 2013 annual and 2013 quarterly surveys			

APPENDIX III

ALGORITHM FOR FREE-RIDERSHIP CALCULATION

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

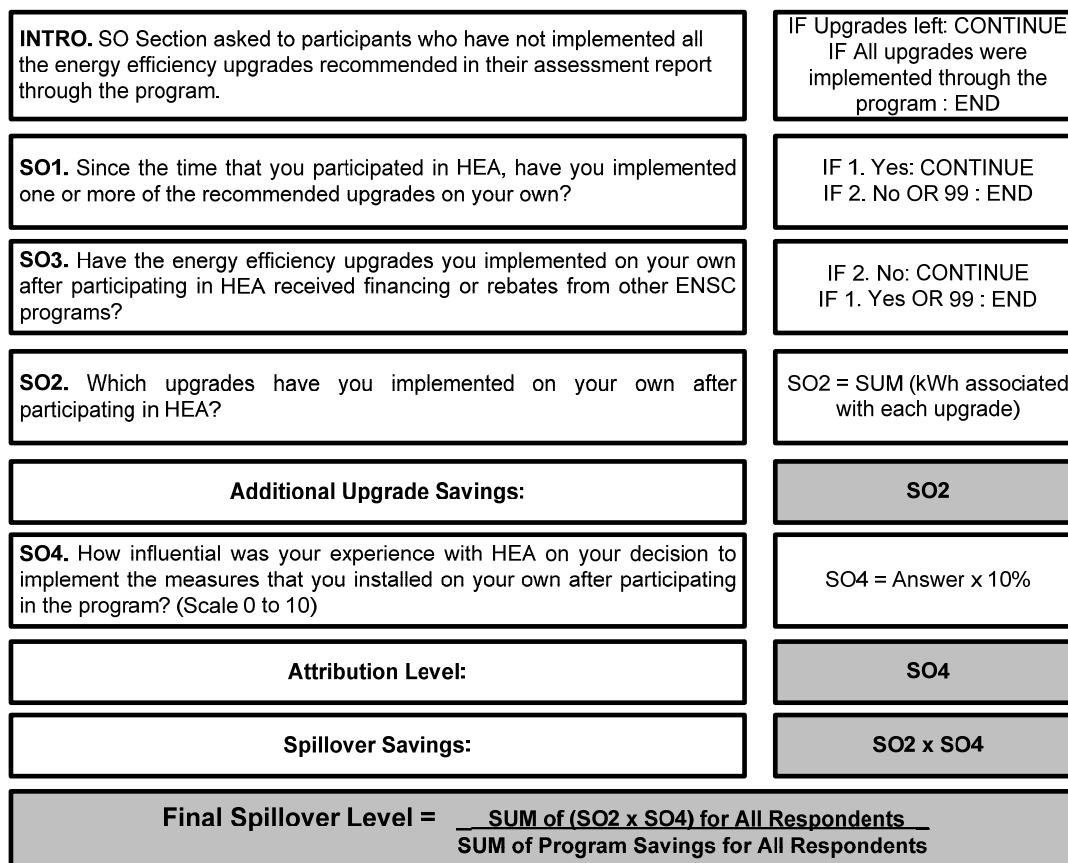
FR2a. If you had not participated in HEA, what is the likelihood that you would have implemented exactly the same quantity of energy efficiency upgrades that you implemented through the program? (Scale 0 to 10)	FR2a = Answer x 10%
FR2b. If you had not participated in HEA, what is the likelihood that you would have implemented standard equipment, material or product instead of energy-efficient equipment, material or product? (Scale 0 to 10)	FR2b = (10 – Answer) x 10%
PA1 Score:	MEAN VALUE OF: (FR2a ; FR2b)
FR1. Before participating in HEA, did you have plans to implement the specific energy efficiency upgrades that were implemented through the program?	IF 1. Yes: Use FR1a IF 2. No OR 99: FR1 = 0%
FR1a. I just to make sure - Before you decided to participate in HEA, you had already made the decision to implement the energy efficiency upgrades that you implemented through the program?	IF 1. Yes: FR1 = 100% IF 2. No OR 99: FR1 = 0%
FR3. If you had not received the rebate from ENSC, would you have paid for the full cost of the energy efficiency upgrades you implemented? (Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0%: FR3 / 2 IF FR1 = 100%: FR3
FR4. Level of influence (Scale 0 to 10) Factors a, b, c and e = Program factors Factors d = Non Program factors	FR4_P = SUM (a; b; c; e) FR4_NP = FR4d
PA3 Score:	100% - [FR4_P/(FR4_P+FR4_NP)]
FR2c. If you had not participated in HEA, what is the likelihood that you would have implemented the exactly same energy efficiency upgrades that you implemented through program but at a later date ? (Scale 0 to 10)	IF FR2c > 5: ASK FR2d Otherwise: PA4 = EMPTY
FR2d. Approximately how many months later would you have implemented these upgrades? 1. The last 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later? 7. (Never) 99. (Don't know / Refused)	IF 1. : FR2d = 100% IF 2. : FR2d = 50% IF 3. : FR2d = 25% IF 4. : FR2d = 0% IF 5. : FR2d = 0% IF 6. : FR2d = 0% IF 7. : FR2d = 0% IF 99. : FR2d = 0%
PA4 Score:	FR2d
Final Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)
Inconsistency Test #1	IF ABS(FR2a – FR2b) ≥ 30%: PA1 = MIN OF (FR2a ; FR2b)
Inconsistency Test #2	IF FR3 ≥ 70% AND IF (FR2a OR FR2b < 70%: PA2 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)

APPENDIX IV INTERNAL SPILLOVER METHODOLOGY

Internal spillover was measured using a participant survey. Participants were asked whether following their participation in HEA, they implemented any additional energy efficiency measures that were recommended in their assessment report, without benefitting from any rebates offered by ENSC programs. If a participant did admit to having implemented additional recommended measures, they were asked a set of questions designed to identify the additional energy efficiency measures implemented and to quantify their associated savings (type of measure, quantity, efficiency level, etc.). Subsequently, another question was asked to quantify the level of influence the program had on the participant's decision to whether implement these additional measures. The value established regarding this level of influence was used to determine the portion of the additional savings attributable to the program.

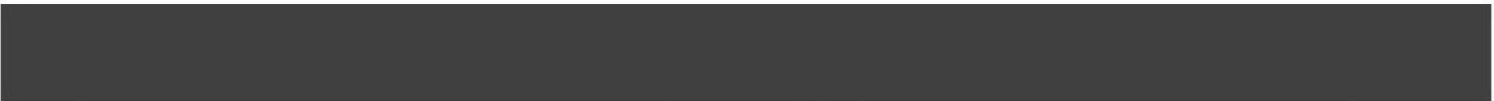
Then, the level of internal spillover was established by dividing the total quantity of the additional savings attributable to the program by the total quantity of savings achieved by the program for all the survey respondents.

The figure below illustrates the methodology used to calculate the internal spillover level.





ECONOLER



GREEN HEAT

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

CATI	Computer-Assisted Telephone Interviewing
CRA	Corporate Research Associates
DMS	Data Management System
DSM	Demand-side Management
DSMDS	Demand-side Management Data System
EFLH	Equivalent Full Load Hours
ENSC	Efficiency Nova Scotia Corporation
ESA	Energy Solutions Advisor
HSPF	Heating Seasonal Performance Factor
NTGR	Net-to-Gross Ratio
OPA	Ontario Power Authority
PM	Program Manager
PUC	Pennsylvania Public Utility Commission
SEER	Seasonal Energy Efficiency Ratio

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.

Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VII
1 PROGRAM DESCRIPTION.....	1
2 METHODOLOGY	2
2.1 Presentation of the Team	2
2.2 Evaluation Activities.....	2
2.2.1 Interview with Program Manager	3
2.2.2 On-site Visits	3
2.2.3 Survey	3
2.2.4 Unitary Savings Review	4
3 PROCESS EVALUATION	5
3.1 Participation in Green Heat.....	5
3.2 Follow-up on 2012 and 2013 Evaluation Report Recommendations	5
3.3 Program Documentation and Design.....	7
3.4 Tracking System.....	8
3.5 On-site Visits	10
4 MARKET EVALUATION	11
4.1 Participant Perspectives	11
4.1.1 Green Heat Awareness.....	11
4.1.2 Motivations and Barriers to Participation	12
4.1.3 Green Heat Influence.....	14
4.1.4 Satisfaction with Green Heat.....	14
4.1.5 Participant Recommendations for Improvements.....	16
5 IMPACT EVALUATION	17
5.1 Gross Savings	17
5.1.1 Unitary Savings Values Review	17
5.1.2 Revised Gross Savings.....	23
5.2 Net-to-Gross Ratio.....	24
5.2.1 Free-ridership	24
5.2.2 NTGR Calculation.....	24
5.3 Net Savings.....	25
CONCLUSION.....	27
APPENDIX I 2014 RECOMMENDATIONS.....	28
APPENDIX II PARTICIPANT SURVEY QUESTIONNAIRE	29
APPENDIX III PARTICIPANT SURVEY RESULTS.....	41
APPENDIX IV ALGORITHM FOR FREE-RIDERSHIP CALCULATION	55
APPENDIX V ON-SITE VISIT SAMPLING METHODOLOGY AND PROTOCOL.....	56

LIST OF TABLES

Table 1: Distortion Effects and Net-to-Gross Ratio.....	ix
Table 2: Comparison of Tracked and Evaluated Savings at the Generator	ix
Table 3: Survey Sample Size and Margin of Error.....	4
Table 4: Implementation Status of Recommendations in 2012 and 2013 Executive Summaries	6
Table 5: Sources of Awareness	11
Table 6: Reasons for Participating	12
Table 7: Specific Challenges Faced	13
Table 8: Importance of Green Heat in Influencing Decision.....	14
Table 9: Satisfaction with Overall Experience	14
Table 10: Satisfaction with ENSC	15
Table 11: Recommendations to Improve Green Heat	16
Table 12: Tracked Unitary Savings Values Based on Literature Review	17
Table 13: Revised Unitary Savings Values Based on Literature Review	21
Table 14: Revised Unitary Savings Values for Participants With Air Source Heat Pump Prior to Conversion.....	22
Table 15: Adjustment Ratio for Heat Pump as Initial Heating System	22
Table 16: Evaluation Results – Revised Gross Energy and Peak Demand Savings.....	23
Table 17: Evaluation Results – Revised Net Energy and Peak Demand Savings.....	25
Table 18: Comparison of Tracked and Evaluated Savings at the Generator	26

LIST OF FIGURES

Figure 1: Methodological Model	2
Figure 2: Participation in Green Heat, 2011-2014	5

EXECUTIVE SUMMARY

This report presents the results of the 2014 evaluation of Green Heat, which is a component of the Existing Residential program. The 2014 evaluation was based on an interview with the Program Manager (PM), five on-site visits, a telephone survey of 53 participants and a unitary savings review.

Program Component Overview

Efficiency Nova Scotia Corporation's (ENSC) Green Heat encourages homeowners to reduce electricity use in homes for space-heating or to supplement it with another energy source. Green Heat focuses on heating systems that use fuel derived from renewable resources.

Participants can choose between a rebate option and a zero-interest-financing option when taking part in Green Heat to install eligible equipment. Incentives are available for measures involving central heating systems, as well as for measures that supplement electrical-heating with an area heater. More precisely, the following categories of heating system are covered by the rebate option:

- › Wood and pellet stoves
- › Wood and pellet boilers and furnaces
- › Advanced pellet boilers and furnaces
- › Geothermal heat pumps
- › Central ducted heat pumps
- › Air-to-water heat pumps

Green Heat aimed to achieve net electricity savings of 1.3 GWh and peak demand savings of 0.4 MW for 2014.

Key Findings

The evaluation of Green Heat demonstrated that the program had a total of 235 participants in 2014, a level similar to 2013 (226 participants), but slightly lower than 2012 (282 participants). In terms of net energy savings, Green Heat generated 1.472 GWh in 2014, compared to 1.524 GWh in 2013 and 1.549 GWh in 2012, respectively.

Participant Satisfaction

Satisfaction with Green Heat was very high among participants in 2014. Indeed, nearly all the respondents indicated their satisfaction with Green Heat overall, as well as with its various aspects, such as the equipment installed, the initial confirmation of eligibility and the program application, forms and associated paperwork. Participants also indicated high levels of satisfaction with various factors related to ENSC. Specifically, participants were highly satisfied with ENSC's overall performance, the

responsiveness of ENSC employees to requests and enquiries in a timely manner, the speed of the application approval process and the value of Green Heat relative to the time and cost involved.

Consequently, when asked about ways to improve Green Heat, few participants provided recommendations. Fewer than two in 10 would like to see the rebate amount increased, while a similar proportion mentioned that Green Heat should be advertised in a better way. On another positive note, all the participants are likely to recommend Green Heat to their family or friends, and all would participate in other ENSC programs.

Challenges and Barriers

In 2014, the proportion of Green Heat participants experiencing challenges or barriers in installing their new equipment or new energy source was the same as that in 2013. Two in 10 participants claimed having encountered challenges or barriers. These challenges and barriers mainly included: problems with installation work, energy-efficient equipment not meeting payback requirements and the process requiring too much work. That said, nine in 10 participants found the Green Heat participation process easy to follow, indicating that this aspect of the program is acceptable to most participants.

Having the equipment installed before the deadline was identified as the main challenge or barrier in the 2013 evaluation. To comply with a bank regulation, the timeline for installing the new equipment had been changed from four months to two months in 2013 for participants in the rebate component. In 2014, this deadline was changed to six months, and survey results showed positive feedback from participants with this extended timeline.

On-site Visits

For all the on-site visits carried out as part of the 2014 Green Heat evaluation, it was shown that participants were offsetting electrical consumption. However, differences have been found between the information provided in the tracking report and that obtained through the visits about the type of heating system replaced. For three of the five sites visited, the primary heating source listed in the tracking system did not match the type of system validated on site.

Energy Savings

To calculate the net savings of Green Heat in 2014, the Evaluator reviewed the gross savings values estimated by ENSC by making a literature review mainly regarding the central ducted, geothermal and air-to-water heat pumps, because tracked unitary savings associated with these technologies are not based on billing analyses or calibrated simulations. Moreover, the free-ridership measured in the participant survey was also taken into consideration. Through this approach, a free-ridership level of 36 percent was established in 2014. The free-ridership level was established at 34 percent in 2013 and 32 percent in 2012.

Table 1: Distortion Effects and Net-to-Gross Ratio

	2014
Free-ridership Level	36%
Net-to-Gross Ratio	0.64

The evaluation revealed that Green Heat generated net energy savings of 1.472 GWh and peak demand savings of 0.594 MW at the generator in 2014.

Table 2: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	NTGR	Net Savings
Energy Savings			
Tracked Savings from ENSC	2.393 GWh	0.66	1.580 GWh
Evaluation Results	2.299 GWh	0.64	1.472 GWh
Peak Demand Savings			
Tracked Savings from ENSC	1.067 MW	0.66	0.705 MW
Evaluation Results	0.928 MW	0.64	0.594 MW

The net energy savings calculated through this evaluation are seven percent lower than those calculated based on the data in the tracking report. There are three factors that explain this difference: (1) the net-to-gross ratio (NTGR) calculated through this evaluation is slightly lower than the NTGR established in the 2013 evaluation; (2) the reduction in unitary savings for geothermal heat pumps; and (3) the adjustments made to deal with the cases in which heat pumps were used as the primary heating system before the conversion.

The net peak demand savings calculated through the evaluation are 16 percent lower than those calculated based on the data from the tracking report. This difference in net peak demand savings is bigger than that in the net energy savings. This can be explained by the heat pump unitary savings revision which resulted in a slight increase of unitary energy savings and a decrease in unitary peak demand savings.

Recommendations

Overall, the Econoler team believes that Green Heat is operating in a satisfactory manner. In addition to the general recommendations presented for all the ENSC program components in the overall evaluation executive summary of the 2014 demand-side management (DSM) programs, throughout this report, the Econoler team makes specific recommendations aimed at optimizing Green Heat's performance. Based on the evaluation results, the most important recommendations are summarized as follows:

- 2014 GH-R1. Consider using an initial system efficiency other than 100 percent when the air source heat pump or the geothermal heat pump is used as the initial primary heating system.** Some projects were found to have an existing ducted or ductless air source heat pump or a geothermal heat pump as the existing primary source of heat. Unitary savings are based on a switch from an electrical heating system with an assumed efficiency of 100 percent (like baseboard heaters). It is recommended that ENSC consider using lower unitary savings when the initial primary heating system is a heat pump, and remove the eligibility criterion that requires these participants to have a total electricity consumption greater than 21,000 kWh/year before the installation of the new system.
- 2014 GH-R2. Improve the pre-screening process to ensure the use of exact information regarding the initial heating system type.** For a significant number of on-site visits, the information collected about the primary heating system type was different than the information given in the tracking report. In one case, the visit showed that a geothermal system was initially used while the tracking report listed an electrical baseboard. In another case, an electrical furnace was listed as the primary heating system before the conversion while the visit showed that an air-source heat pump had actually been used. As these differences can have a significant impact on the eligibility and the energy savings, ENSC should take actions and measure to ensure the use of exact information regarding the primary heating system.

1 PROGRAM DESCRIPTION

Green Heat targets existing homes in Nova Scotia that primarily use electricity for heating. The goal of Green Heat is to provide financial incentives to homeowners to encourage them to reduce electricity use in homes for space heating or to supplement it with another energy source. Green Heat focuses on heating systems that use fuel derived from renewable resources.

Participants can choose between a rebate and a zero-interest financing option when taking part in Green Heat and installing eligible equipment. Incentives are available for installing central heating systems and supplementing electrical heat with an area heater. More precisely, the following categories of heating system equipment are rebated:

- › Wood and pellet stoves
- › Wood and pellet boilers and furnaces
- › Advanced pellet boilers and furnaces
- › Geothermal heat pumps
- › Central ducted heat pumps
- › Air-to-water heat pumps

To participate in Green Heat, homeowners can apply to Efficiency Nova Scotia Corporation (ENSC) directly by filling out a pre-approval application form. Then, the Program Manager (PM) gets in touch with them to verify their eligibility. Eligibility considerations are mainly related to the heating source (electricity) and electrical energy consumption and can vary depending on the type of equipment installed. When approved, applicants for the rebate option have up to six months to install equipment and submit their rebate application forms to ENSC. Participants who opt for the financing option have up to two months to install equipment and send their financing application forms to ENSC.

ENSC manages and administers Green Heat internally. Green Heat is funded through electricity ratepayer funds. The 2014 marketing strategy was the same as the 2013 marketing strategy, with a continued focus on communicating more closely with retailers and heating equipment distributors and attending trade shows with heating contractors.

Green Heat aimed to achieve net electricity savings of 1.3 GWh and peak demand savings of 0.4 MW for 2014. Electrical energy savings generated by Green Heat are accounted for under the Existing Residential program.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and the activities carried out for the Green Heat evaluation.

2.1 Presentation of the Team

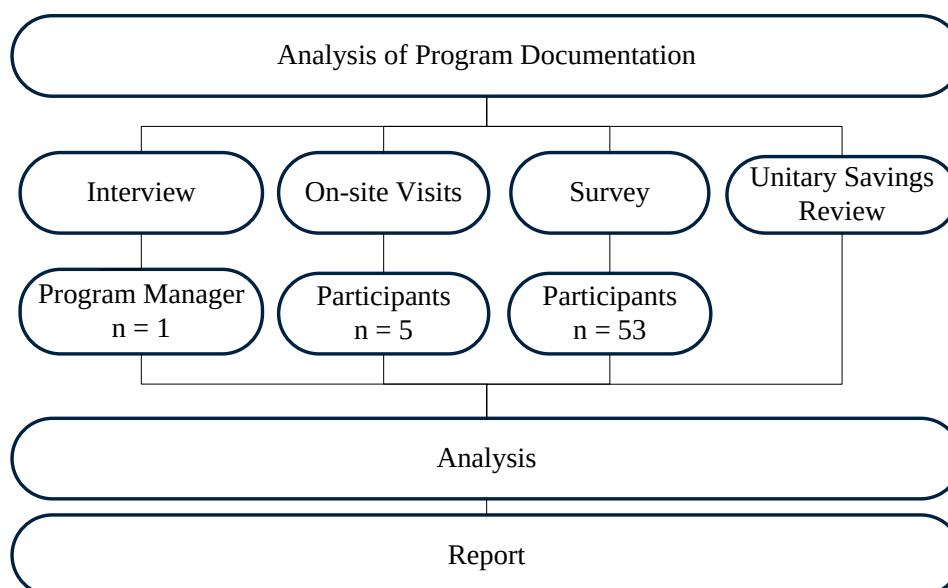
To carry out the 2014 evaluation, Econoler collaborated with two partner entities: Corporate Research Associates (CRA) and Equilibrium Engineering. Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all the deliverables.
- › CRA performed the participant survey and analyzed and reported on the data collected from this activity.
- › Equilibrium Engineering conducted the on-site visits, reviewed the tracking sheet and assisted Econoler with certain parts of the impact evaluation. Equilibrium Engineering was also in charge of analyzing and reporting on the information collected from these different activities.

2.2 Evaluation Activities

Figure 1 illustrates the research strategy and data collection activities used for the 2014 evaluation.

Figure 1: Methodological Model



Each step of this methodological model is further detailed in the following sub-sections.

2.2.1 Interview with Program Manager

The Econoler team conducted one interview with the PM in September 2014. This interview was intended, among other things, to follow up on the 2012 and 2013 evaluation recommendations regarding process issues and understand the main changes that occurred in program delivery in 2014. Based on the information obtained from this interview, a list of questions and topics to include in the data collection tools was prepared.

2.2.2 On-site Visits

In October 2014, five on-site visits were conducted by Equilibrium Engineering to some participants' homes, including one visit for the air-source heat pump, one for the geothermal heat pump, one for the pellet stove and two visits for the wood stove. These visits were used to validate the new equipment installed, collect information on the previous space heating and hot water systems, and gather data on the usage of the different energy sources available in these homes. A copy of the on-site visit sampling methodology and the protocol used to collect information is included in Appendix V.

2.2.3 Survey

In October and November 2014, CRA staff in Halifax conducted a telephone survey with a total of 53 Green Heat participants, using computer-assisted telephone interviewing (CATI) technology. The average length of the survey was 14 minutes.

The participant survey was meant to collect feedback on the following aspects of Green Heat:

- › Free-ridership
- › Program awareness
- › Participant motivations and barriers
- › Satisfaction with the program
- › Recommendations for improvements

The questionnaire and the complete survey results are presented in Appendix II and Appendix III respectively. Table 3 shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 telephone surveys.

Table 3: Survey Sample Size and Margin of Error

Survey	Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
2014 Participants	235 ¹	53	±9.9% ²
2013 Participants	226	70	±8.2%
2012 Participants	282	75	±8.2%

The margin of error is used to determine the level of precision³ of the measurement, and its associated confidence level indicates the probability for a measure to fall within this margin of error. As part of this evaluation, the confidence level and the margin of error only take random sampling errors into account; they do not reflect non-sampling errors or biases, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

2.2.4 Unitary Savings Review

To review the unitary savings values used in the tracking sheet, the Econoler team validated the parameters currently used in the tracked savings calculations by conducting a literature review of similar technical reference manuals and public evaluation reports by other jurisdictions and choosing the most recent and accurate data sources. When no reliable or representative sources were found in the literature, engineering calculations were made to estimate the savings.

¹ The population of Green Heat participants for the 2014 survey was 100 at the time the survey was being conducted (after removing the duplicates).

² Due to the small population size, a census was undertaken rather than a sampling approach. Drawing a random sample of 53 completed projects from a population of 235 would yield a margin of error as noted in the table.

³ Precision refers to how close the measured values are to each other. However, it does not take into consideration how close the measured value is to the true value, which refers to accuracy.

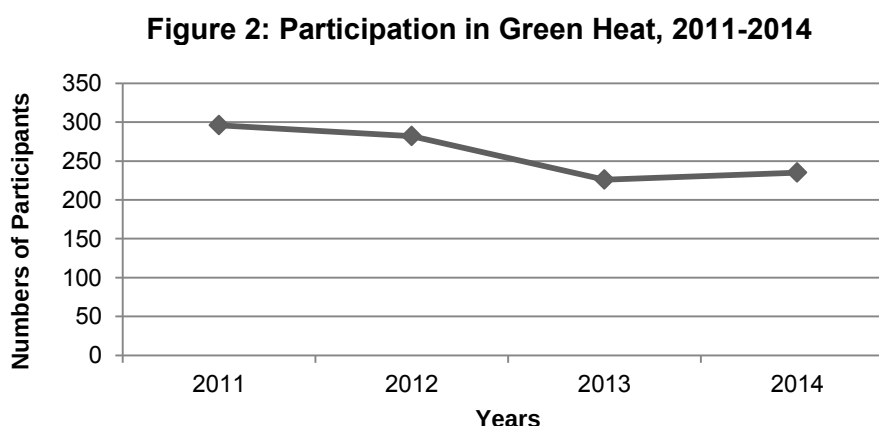
3 PROCESS EVALUATION

This section presents the findings of the 2014 Green Heat process evaluation, which has been carried out on the basis of the information gathered from the Green Heat documentation and tracking system, as well as an interview with the PM and on-site visits.

3.1 Participation in Green Heat

Figure 2 illustrates a slight decline in participation in Green Heat since its beginning in 2011. A total of 235 participants participated in Green Heat in 2014, which is similar to 2013 (226 participants), but slightly lower than in 2012 (282 participants) and 2011 (296 participants).

It should be noted that in late 2012, a decision was made to modify this program component and focus on heating systems that use fuel derived from renewable resources. Rebates for customers who wished to switch to natural gas were therefore removed from Green Heat. This could have impacted the number of participants in Green Heat.



3.2 Follow-up on 2012 and 2013 Evaluation Report Recommendations

This section reports on the progress in acting on the recommendations made by the Evaluator in the 2012 and 2013 evaluation reports. The Evaluator follows up on recommendations from both 2012 and 2013 because only a partial process evaluation was conducted in 2013, which did not include a review of the implementation status of the 2012 recommendations.

To better monitor the progress in implementing the recommendations, the PM has been using a monitoring tool, namely a table that documents all the recommendations made and the corresponding implementation status. This tool is an excellent initiative which serves to enhance the program memory principle.

The Evaluator analyzed the content of the file to determine whether ENSC followed up on the recommendations. Table 4 gives a brief summary of the implementation status of each recommendation presented in the executive summary section of the 2012 and 2013 evaluation reports.

Table 4: Implementation Status of Recommendations in 2012 and 2013 Executive Summaries

Recommendation	Status
2012 Recommendations	
2012 GH-R1. Continue marketing efforts and outreach activities	Implemented
2012 GH-R2. Consider reintroducing a rebate on ductless mini-split heat pumps for quality purposes	Will not be implemented
2012 GH-R3. Consider conducting calibrated simulations with real participants who installed a wood or pellet stove	Implemented
2013 Recommendations	
2013 GH-R1. Review information provided to participants to determine whether enhancements or clarifications are required	Implemented
2013 GH-R2. Consider extending the deadline for participants to complete the installation	Implemented
2013 GH-R3. Consider requiring additional submittal information and photo documentation of the old primary heating system	Implemented

The sections below describe the actions taken by ENSC to implement these recommendations.

2012 Executive Summary Recommendations

The Evaluator noticed that two of the three recommendations made in 2012 were implemented by ENSC. The implementation of these recommendations allowed for overall program improvement. One of them was to continue marketing efforts and outreach activities as they contribute to lowering the free-ridership level by influencing decision-making among homeowners who have not yet decided whether to replace their equipment (2012 GH-R1). To act on this recommendation, in 2013, ENSC provided many retailers with retailer packages and worked with one retailer to produce co-branded marketing flyers. Further, ENSC attended a heating systems trade show to promote Green Heat among retailers and distributors.

The other recommendation implemented in 2013 was to conduct calibrated simulations with real participants who each installed a wood or pellet stove (2012 GH-R3). The simulation results allowed for a more precise calculation of the savings for the two most popular types of equipment covered by Green Heat.

The 2012 evaluation report recommended considering introducing a rebate on ductless mini-split heat pumps as part of Green Heat after the removal of this equipment from Home Energy Assessment (HEA) (2012 GH-R2), but ENSC has decided not to implement it. The 2012 interviews with distributors

indicated that they would like ENSC to once again provide a rebate on ductless mini-split heat pumps to encourage the installation of quality ductless mini-split heat pumps that achieve a specific minimum level of efficiency. ENSC reviewed the possibility for reintroducing this rebated equipment as part of Green Heat. The decision not to act on this recommendation was based on the concern that free-ridership for this equipment would be too high to justify rebates.

2013 Executive Summary Recommendations

All the three recommendations made in the executive summary section of the 2013 evaluation report were implemented by ENSC. The 2013 participant survey results indicated that there might have been an issue with the information provided to participants regarding Green Heat. Therefore, Econoler recommended reviewing information provided to participants to determine whether corrections, clarifications, or improvements are required (2013 GH-R1). Since then, the program pre-approval forms have been remodelled with two possible incentive paths: one for financing and another for rebate. This has also been integrated in the program website.

During the 2013 evaluation, the Evaluator also noticed that the main challenge or barrier faced by participants was to have the equipment installed before the deadline. Econoler recommended considering extending the installation period to allow the participants to complete the installation (2013 GH-R2). ENSC addressed this issue by extending the installation period from two months to six months for the rebate path. The installation period remains two months for the financing path, since this is a requirement from the financing institution.

As for the recommendation aimed at collecting additional information for ongoing evaluation (2013 GH-R3), some additional information has been added in the pre-approval form, such as the square footage of the house, the built year, the number of house occupants, etc. The requirement to attach a photo taken prior to installation has not been met because it was not considered an effective control measure for the level of effort required; instead, some clients have been randomly selected to receive a pre-installation visit to confirm the baseline.

3.3 Program Documentation and Design

As part of the evaluation, the Evaluator analyzed the program documentation and worked together with the PM to improve and revise the program manual, the evaluation plan and the logic model, where applicable. More specifically, this revision work allowed defining relevant objectives and barriers for Green Heat that can also be easily assessed. It also clarified the role of retailers as program partners.

As an improvement to Green Heat, ENSC has developed a project workflow checklist outlining the steps to be followed by the PM. Since every step in processing each new application must be properly completed before moving onto the following step, incorporating this workflow into the Data Management System (DMS) has provided an excellent tool for ensuring that the administrative procedures for application processing are followed without having to depend on direct oversight. This

tool can also prevent the occurrence of missing information in the database, which can undermine evaluation accuracy.

3.4 Tracking System

In 2014, ENSC began to track Green Heat data using the demand-side management data system (DSMDS) and generate tracking reports (extracted directly from the DSMDS) for evaluation purposes. The DSMDS and the tracking reports have replaced the 2013 Green Heat tracking sheet, which was an Excel-based tool that documented relevant project details. The 2014 tracking report is an output from the DSMDS in the form of an Excel workbook, which contains four tabs: 1) Overall Summary; 2) Rate Code Allocation; 3) Project Details; and 4) Installed Systems. The following sections describe the information contained in each of the individual tabs.

Overall Summary

The first tab in the tracking report contains a summary table of Green Heat projects implemented in each month. For each month in the sheet, there are values to indicate the number of measures installed, the incentive amount paid, the tracked gross energy and peak demand savings, and the tracked net savings. The summary information in this tab was used by the Evaluator to verify the reported gross savings recorded in the project details tab, but was not used as part of the sampling process.

Rate Code Allocation

Similar to the overall summary tab, the rate code allocation tab records incentive amounts, broken down by month and by rate code. The rate code allocation tab was not used by the Evaluator, but provides a quick reference to where and when funding is being allocated, which makes it useful for tracking the Green Heat budget.

Project Details

The project details tab contains the most information, and is similar in scope to the 2013 tracking sheet used by Green Heat. Information contained in this tab includes project ID, utility account number, rate code, project status, participant contact information, primary sources for heating before conversion, domestic hot water energy source, incentive amount, tracked energy and peak demand savings of each project, and details about the type and quantity of equipment installed. The information in this tab was used by the Evaluator to calculate the gross and net savings, develop the sampling plans for data collection activities and adjust the on-site visit protocol for 2014.

Installed Systems

The final tab in the tracking report contains a summary table of the equipment installed to date. The quantity of each equipment type was recorded and categorized in two groups, namely those that received financing and those that received a rebate.

The information contained in the DSMDS and the tracking report is generally complete and well organized. All fields necessary for program administration and evaluation were present in the tracking report, and all the projects were assigned a unique identification number that allows for easy lookup in the DSMDS.

The most important element in the evaluation process of the tracking system was the Evaluator's review of the Project Details tab of the tracking report. The information contained within this tab includes the tracked values for gross energy and peak demand savings, as well as net energy savings. Econoler made a detailed review of the dataset and found that all the entries matched the specified unitary savings values defined in the Green Heat evaluation plan.

Twenty-two projects were found to have an existing ducted or ductless air source heat pump as the existing primary source of heat. The possible issue with these projects is that the unitary savings are based on a switch from an electrical heating system with an assumed efficiency of 100 percent (like baseboard heaters). In these 22 identified cases, the unitary savings would be significantly lower, because the baseline operating efficiency would be higher than the assumed 100 percent. As this issue can create an inflated tracked savings value, it will be reviewed and adjusted in the gross savings calculations.

In 2013, the Evaluator mentioned that ENSC should collect the utility account number and the rate code for every participant. The tracking report of this year contains information about the rate code for all the participants. This has been a significant improvement since this information was missing for 30 percent of the participants last year. However, the utility account number is still missing for 9 percent of the participants this year.

Another issue identified during the tracking review was the discovery of several projects, for which no primary source of heating was identified (1.7%), and a handful more with no primary heating type identified (3.0%). The Evaluator also noticed that information about whether or not electrical heating was kept as backup was not recorded in the tracking sheet. Although this information was not required to evaluate energy savings, such information is easy to record and can be used to determine the most common practices.

Overall, the information provided by ENSC in the tracking report contains enough information to allow for analyzing the current status of all the projects and preparing a sampling plan. The Evaluator considers the Green Heat tracking report to be consistent and complete. However, the Evaluator suggests again that the utility account number and backup heating source should be collected for all the participants. The Evaluator also suggests that ENSC keep track of whether electrical heating is kept as backup or not. This information could be useful in the future to validate most common practices.

3.5 On-site Visits

Five on-site visits were carried out as part of 2014 Green Heat evaluation. These visits included an assessment of two wood stoves, one pellet stove, one central air source heat pump and one geothermal heat pump. The purpose of the visits was to validate that the rebated equipment was installed and in use, and to verify that the information provided about the old heating systems was accurate.

The five visits confirmed that the equipment for which a rebate was claimed through Green Heat were installed, and currently used as the primary heating source. All of the sites visited still had an electrical backup source with the anticipated usage ranging from zero to twenty percent. As the percent usage of the backup is based on the participants' declaration there is a possibility that the expected backup usage provided is not representative of the reality for wood and pellet stoves. The backup usage is expected to be higher with these types of equipment as they cannot run unattended all day, and will not service all areas of the homes when they are not used with a central distribution system.

An important issue was found about the type of equipment in place before the new system was installed. For three of the five sites visited, the primary heating source listed in the tracking system was incorrect. For two of these participants, the difference is expected to have a significant impact on actual savings generated by the measure. In one case, the tracking system lists electrical baseboard as the primary heating system while during the visit, it was found that an old geothermal system was in place before the conversion. In the second case, the tracking system lists an electric furnace as primary heating system while the visit showed that initial system was a failed central air source heat pump. In addition, no data related to the heating capacity of the new equipment or the number of full time occupants was found in the tracking sheet. Although these items do not have a direct impact on tracked savings values they do point to a need for improving record keeping.

Overall the results of the on-site visits confirmed that all participants were offsetting electrical consumption, and showed that the information provided in the tracking system was sufficient to carry out on-site validations. Some discrepancies concerning the replaced heating system were found between the visits and the tracking system. Further improvements to the pre-screening process could thus improve the quality of the tracked savings.

4 MARKET EVALUATION

This section presents the findings of the 2014 Green Heat market evaluation from the participant perspectives.

4.1 Participant Perspectives

A participant survey was conducted as part of the Green Heat evaluation. In addition to the questions designed for impact evaluation purposes, survey participants were asked questions regarding program awareness, barriers and satisfaction.

4.1.1 Green Heat Awareness

Participants found out about Green Heat in a number of ways, mainly through word of mouth, media advertising, in stores or on the ENSC website. Table 5 summarizes all the different sources of awareness.

Table 5: Sources of Awareness

Sources of Awareness	2012**	2013	2014
<i>Sample Size*</i>	34	70	53
Word of mouth	24%	21%	19%
Media advertising	26%	20%	15%
The store where new equipment was purchased	21%	7%	15%
On the ENSC website	9%	20%	13%
Through a third-party contractor or service provider	15%	20%	9%
Contacted directly by ENSC	3%	1%	9%
On the Internet in general	15%	9%	8%
Facebook or other social media	3%	4%	4%
At home show	6%	4%	2%
Others	6%	10%	6%
Don't know/Cannot recall	-	-	6%
*Multiple responses **Source: 2012 C-Sat Residential Study			

4.1.2 Motivations and Barriers to Participation

The main reason for participating in Green Heat was to save on energy costs (with 68% having given this response as their most important motivation). Comfort is mentioned by one in 10, as wanting a back-up heating source. Other motivations included wanting a wood stove to make a home more energy efficient, because the system needed replacing, or to help the environment (see Table 6).

Table 6: Reasons for Participating

Reasons for Participating	2012		2013		2014	
	Most Important Motivation	Second Most Important Motivation*	Most Important Motivation	Second Most Important Motivation*	Most Important Motivation	Second Most Important Motivation*
<i>Sample Size</i>	75	75	70	70	53	53
Save on energy costs/bills	81%	15%	73%	16%	68%	19%
For better comfort	8%	12%	3%	11%	8%	8%
To have a backup heating source	4%	8%	1%	6%	8%	8%
Wanted wood stove/Like wood heat	-	7%	3%	4%	6%	6%
To make home more energy efficient	1%	1%	3%	16%	4%	6%
To help the environment	1%	3%	1%	7%	2%	4%
Needed to replace system/Heating system wasn't working properly	-	-	10%	-	2%	-
Rebate/Financing	-	-	1%	4%	-	6%
Others	4%	5%	4%	10%	4%	9%
Nothing/No other reasons	-	43%	-	37%	-	40%
Don't know	-	8%	-	3%	-	-
*Multiple responses						

A small number of participants (4%) reported having concerns prior to taking part in Green Heat, which is consistent with the results from 2013 (3%). Concerns were that the financing would not come through or that the new heating system would be inefficient.

Two in 10 participants felt there were challenges or barriers when installing equipment or new energy sources rebated through Green Heat (19%), which is consistent with the results from 2013 (19%). As shown in Table 7, specific challenges included issues with installations, energy efficient equipment not meeting payback requirements or the process requiring too much work.

Table 7: Specific Challenges Faced

Specific Challenges Faced in Installing New Equipment*	2013 (#)	2014 (#)
<i>Sample Size**</i>	13	10
Problems with installation	-	3
Energy-efficient equipment does not meet payback requirements	1	2
Paperwork/process required too much work	1	2
Having equipment installed before deadline	4	1
Choosing the right equipment/unit	2	1
Finding a qualified contractor	1	1
Approval takes too long	-	1
Cost of equipment/unit	4	-
Hard to find good wood to burn	3	-
Others	2	1
*Multiple responses **Base: Respondents who said they had concerns		

4.1.3 Green Heat Influence

Survey respondents were asked questions about the influence of Green Heat on their decision to replace their heating system with another heating source. Similar to previous years, the rebate or financing was the most important factor in influencing their decision. Information or advice about Green Heat was considered modestly important, while less importance was placed on previous experience with an ENSC or NSP program.

Table 8: Importance of Green Heat in Influencing Decision

Importance of Green Heat in Influencing Decision to Replace Heating System with Another Heating Source	2012		2013		2014	
	Sample Size*	Important	Sample Size*	Important	Sample Size*	Important
Mean (0 = Not at all important, 10 = Extremely important)*						
Program rebate or financing	75	7.8	68	7.5	53	7.6
Information on the program provided by the salesperson	72	6.1	67	6.6	51	5.7
Previous experience with similar program either from ENSC or NSP	72	4.2	57	4.2	49	3.9
*Excludes responses of 'Refused' and 'Don't know'						

4.1.4 Satisfaction with Green Heat

Nearly all respondents were satisfied with Green Heat overall. Of note, none offered a “not satisfied” rating, as shown in Table 9. In addition, the majority found it easy to participate in Green Heat (89%). Among the small number of respondents who found the Green Heat application difficult (n=6), reasons included a lack of information about Green Heat or the participation process, too much paperwork or poor communication.

Table 9: Satisfaction with Overall Experience

Satisfaction with Overall Experience	2012	2013	2014
Sample Size*	75	70	53
5 – Very satisfied	77%	77%	80%
4	15%	20%	18%
3	7%	1%	2%
2	1%	1%	-
1 – Not at all satisfied	-	-	-
*Don't know removed from calculations			

Respondents were highly satisfied with various aspects of Green Heat. Nearly all were satisfied with the systems installed in their home (98%), the interaction and communication with ENSC staff (96%),

the initial confirmation of eligibility (96%) and the program application, forms and associated paperwork (92%). The average time to receive the rebate was six weeks, with some waiting 12 weeks or more. Given the high satisfaction ratings with this aspect of Green Heat (88%), however, it is evident that this length of time is acceptable for most participants. There were somewhat lower satisfaction ratings for the rebate or incentive amount, but this finding remains high with eight in 10 participants satisfied in this regard (79%).

As indicated in Table 10, there were high levels of satisfaction with various factors related to ENSC, which is consistent with findings from previous years. Specifically, participants were highly satisfied with the responsiveness of ENSC employees to requests and enquiries in a timely manner, with the overall performance of ENSC, with the speed of the application approval process and with the value of Green Heat relative to the time and cost involved. Of note, all participants are likely to recommend Green Heat to family or friends (100%), and all would participate in other programs (100%).

Table 10: Satisfaction with ENSC

Satisfaction with Overall Performance	2012***		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Mean (1 = Not at all satisfied, 10 = completely satisfied)**						
Responsiveness of employees to requests and enquiries in a timely manner	31	9.5	65	9.3	49	9.2
ENSC's overall performance in working with you	31	9.5	65	9.2	49	9.2
Speed with which the application was approved	31	9.5	65	9.1	49	9.0
Value of the program relative to the time and cost involved	31	9.2	65	8.9	48	8.4
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of 'Refused' and 'Don't know' ***Source: 2012 C-Sat Residential Study						

The majority of participants had contact with ENSC contact centre staff (76%), called Energy Solutions Advisors (ESAs). There were high levels of satisfaction with various factors related to ESAs, with all participants who had contact with ENSC contact center staff reporting satisfaction (100%). Furthermore, the majority of participants reported they were *completely satisfied* with the ESAs' knowledge of programs available, service attitude and ability to provide advice.

4.1.5 Participant Recommendations for Improvements

Respondents were asked whether they had any recommendations to improve Green Heat. Less than two in 10 would like to see the rebate amount increased, while a similar number mentioned that Green Heat should be advertised in a better way. Table 11 summarizes all the recommendations provided by respondents.

Table 11: Recommendations to Improve Green Heat

Recommendations to Improve Green Heat	2012	2013	2014
<i>Sample Size*</i>	75	70	53
Increase rebate amount	13%	21%	15%
Advertise the program more or in a better way	8%	6%	13%
Offer additional equipment eligible for rebates/financing	5%	9%	8%
Offer more information on the equipment recommended	5%	3%	6%
Lower the minimum amount of electricity usage required for participating	-	1%	4%
Speed up the process	-	1%	4%
Simplify program application, forms and associated paperwork	7%	-	4%
Improve communication	9%	6%	2%
Increase the time given to complete the upgrades	-	3%	2%
Allow for repeat participation in the program	-	1%	2%
Information on qualified contractors	-	1%	2%
More knowledgeable people	-	3%	-
Provide financing options	-	1%	-
Others	11%	6%	6%
No recommendations	53%	51%	49%
*Multiple responses			

5 IMPACT EVALUATION

The objective of the 2014 Green Heat impact evaluation is to determine the gross and net energy savings. Both electrical energy and peak demand savings were estimated by analyzing two main parameters: the unitary savings values used for each type of equipment installed and the free-ridership level of the program.

5.1 Gross Savings

The tracking report provided for 2014 shows a total of 235 participants (193 from the rebate option and 42 from the financing option), who had installed a total of 235 units. The following sections present the unitary savings values tracked by ENSC for each type of equipment and the revision conducted by the Evaluator during this evaluation.

5.1.1 Unitary Savings Values Review

Tracked Savings

Table 12 displays a detailed list of the eligible equipment and current unitary savings values (energy and peak demand) tracked by ENSC. These values come from the 2013 evaluation report.

Table 12: Tracked Unitary Savings Values Based on Literature Review

Category of Equipment	Tracked Energy Savings Value (kWh/year)	Tracked Peak Demand Savings Value (kW)
Wood Stoves	10,443	4.00
Pellet Stoves	8,959	4.00
Wood Furnace or Boiler	13,804	7.66
Pellet Furnace or Boiler	13,765	7.75
Combination Advanced Pellet-Boiler/Furnace	22,206	10.34
Geothermal Heat Pump	14,330	7.84
Central Ducted Heat Pump	7,076	4.00
Air to Water Heat Pump	7,076	4.00

The current tracked savings values for wood and pellet stoves come from calibrated HOT2000 energy models, which were carried out by Econoler as part of the 2013 evaluation for six past participants, who each had a wood or pellet stove installed through the program. The unitary savings values shown in Table 12 have been calculated by using the difference between the pre-installation simulations calibrated to reflect the historical electrical consumption profile of the participants, and the post-installation simulations (i.e., with pellet or wood stove offset).

The tracked unitary savings values for wood and pellet boilers/furnaces are based on an analysis carried out by Dunskey Energy Consulting⁴ and a set of gross savings values established by Navigant Consulting⁵.

The energy and peak demand savings estimates provided by Navigant Consulting were calculated using whole building simulation modelling with the eQuest software, as well as engineering estimates from various sources. Where appropriate, savings values provided by Navigant Consulting were adjusted by Dunskey Energy Consulting using HOT2000 simulations.

As part of the 2012 evaluation of Green Heat, the Evaluator made an adjustment to the unitary savings values to reflect the real annual electrical heating consumption of the participating homes before they had their space heating units replaced. To do so, a billing analysis was performed with 235 participants and revealed that the average annual electrical heating consumption of the participants amounted to 14,600 kWh. This parameter was used to adjust the unitary savings values of wood and pellet boilers/furnaces.

The unitary savings value used for the combination pellet boilers and furnaces is higher than the baseline consumption of 14,600 kWh obtained from the billing analysis conducted in the 2012 evaluation. The reason is that combination pellet boiler and furnaces unitary savings value includes additional offset savings for domestic hot water, and is not based solely on displaced space heating energy. Therefore, for this type of equipment, the unitary savings value has been determined only on the basis of the analyses carried out by Dunskey Energy Consulting and Navigant Consulting.

For geothermal heat pumps, the tracked unitary savings value come from a Hydro-Québec residential geothermal evaluation report⁶, which is based on a billing analysis conducted on post-implementation and engineering calculations. Savings from both heating and cooling were included in this evaluation. The unitary savings value obtained from this study were used because of the similarities between the region studied and Nova Scotia, and the fact that no detailed metering studies have been carried out in the province.

⁴ Dunskey Energy Consulting, *Residential Fuel Substitution Pilot Program*, Submitted to Efficiency Nova Scotia Corporation, December 16, 2010.

⁵ Navigant Consulting, *2011 to 2019 Fuel Substitution Potential Analysis*, Submitted to Nova Scotia Power Inc., February 24, 2010.

⁶ Hydro-Québec, *Rapport d'évaluation : Programme : Géothermie – Marché résidentiel 2007 to 2009*, March 25, 2011.

The unitary savings value for central ducted air source heat pumps has been determined on the basis of the 2011 Ontario Power Authority (OPA) Quasi-Prescriptive Measures and Assumptions Report⁷, which used a regression analysis to estimate the consumption of air source heat pumps based on the region and the rated efficiency of the heat pump.

For air-to-water heat pumps, ENSC uses the same unitary savings values as those for ducted central air source heat pumps because both types of equipment are central pumps and typically require a backup energy source during the coldest months of the year. Therefore, since there have been no available metering studies, or acceptable calculation methodologies for the technology, it was assumed that the central air source system savings values are close enough to represent a reasonable reduction in electrical consumption.

Revised Savings

The Evaluator reviewed the unitary savings values used for all the types of Green Heat equipment by performing a literature review. The research mainly focused on identifying more recent technical reference guides, and recently completed metered studies in similar climate zones. A specific focus was placed on central ducted, geothermal, and air-to-water heat pumps because the savings associated with these three technologies are not determined based on any billing analyses or calibrated simulations proper to Green Heat participants.

The OPA released the Prescriptive Measures and Assumptions List 2014⁸, which contains energy and peak demand savings for a variety of energy efficiency measures, including a unitary savings value for air source heat pumps. The unitary savings value listed was determined based on the scenario of replacing an existing air source heat pump with a new more efficient unit, therefore underestimating the savings expected when replacing electric resistance heat. The authors were contacted to request more detailed information about the calculation methodology to help adjust the assumed base case. However, they were unable to fulfill this request. Without access to the calculation methodology, it was impossible to accurately update the unitary savings values with the OPA reference document.

Another document for a similar purpose, the 2015 Technical Resource Manual⁹ released by the Pennsylvania Public Utility Commission (PUC) includes energy and peak demand savings calculations for many energy efficiency measures. The formulas in this document use Equivalent Full Load Hours (EFLH), allowing for adaptations to specific climate conditions. In previous years, the EFLH values were set at 2,200 hours for heating. However, with Nova Scotia in AHRI Climate Zone V, its heating EFLH value is set at 2,750 hours¹⁰.

⁷ Ontario Power Authority (OPA), *2011 Quasi-Prescriptive Measures and Assumptions, Release Version 1*, December 2010, pages 221 to 224.

⁸ Ontario Power Authority (OPA), *OPA Prescriptive Measures and Assumptions List*, January 2014.

⁹ Pennsylvania Public Utility Commission (PUC), *Technical Reference Manual*, June 2014.

¹⁰ ANSI/AHRI, *Standard 201/204 with Addenda 1 and 2 (formerly ARI Standard 210/240), Table 19 "Representative Cooling and Heating Load Hours for Each Generalized Climatic Region"* (page 116), March 2012.

Using the formulas from the 2015 PUC Technical Resource Manual, calculations were made to determine the suitability of the resultant unitary savings values. Both unitary energy savings and peak electrical reduction savings calculations were made for ducted air source heat pumps and geothermal heat pumps. The calculations made resulted in an adjustment of both the central air source and geothermal heat pump systems, as shown in Table 13 below.

To make the calculations, the Evaluator made several adjustments to the input variables. The first adjustment required was the calculation of the average heating load using the adopted baseline consumption of 14,600 kWh/year and the AHRI EFLHs (2,750 hours per year). The result of the calculation indicated that an average heating load of 18,000 Btu/hour was a reasonable value to use when making the revised savings calculations. Additionally, the Evaluator modified the peak reduction calculations by using the Heating Seasonal Performance Factors (HSPF) values instead of the Seasonal Energy Efficiency Ratio (SEER) values. This decision was made based on the fact that Nova Scotia's peak electrical loads occur during winter months, and not during the summer.

The revised unitary savings values have resulted in an increase in unitary savings for the central air source heat pumps (8,320 kWh/year), and a reduction in the geothermal unitary savings (10,411 kWh/year). Based on the assumed baseline space heating energy required for an average house, the results appear to be within an acceptable range. Therefore, the Evaluator proposes that ENSC adopt these revised unitary savings values for 2014 and future program years.

Air-to-water heat pumps were included as a measure in several TRMs as a domestic water heating system. However, none of the studies evaluated them as an integrated domestic hot water and space heating system. Based on the results of this review, the Evaluator recommends that ENSC use the updated tracked unitary savings value for central air source heat pumps. If air-to-water heat pumps account for a larger portion of Green Heat savings, ENSC should consider carrying out a calibrated model simulation of installed units or a metering study to measure and verify consumption and peak demand savings.

The literature review did not show conclusive results regarding wood stoves and pellet stoves because no detailed metering studies on similar climates were identified. Additionally, since the tracked unitary savings values for these two types of equipment were updated in the 2013 evaluation using calibrated simulations, the Evaluator recommends that ENSC continue using the current tracked savings values.

Similar to the results of the literature review for wood and pellet stoves, the Evaluator did not find any updated studies for wood and pellet furnaces/boilers. Since the current tracked unitary savings are based on simulations carried out by Dunskey Energy Consulting and Navigant Consulting, as well as a billing analysis conducted by Econoler in 2012, the Evaluator recommends keeping the current figures. Given the small number of projects installing these technologies through the program, it is hard to justify the need for conducting a metering study or a more thorough analysis.

Table 13 lists the unitary savings values revised by the Evaluator. The items in bold have been modified based on the tracked unitary savings values listed above in Table 12, while those not in bold were not modified as part of the 2014 evaluation.

Table 13: Revised Unitary Savings Values Based on Literature Review

Category of Equipment	Revised Unitary Savings Value (kWh/year)	Revised Unitary Peak Demand Savings Value (kW)
Wood Stoves	10,443	4.00
Pellet Stoves	8,959	4.00
Wood Furnace or Boiler	13,804	7.66
Pellet Furnace or Boiler	13,765	7.75
Combination Advanced Pellet-Boiler/Furnace	22,206	10.34
Geothermal Heat Pump	10,411	3.96
Central Ducted Heat Pump	8,820	3.03
Air to Water Heat Pump	8,820	3.03

The revised unitary savings values presented in Table 13 are all based on a switch from an electrical heating system with an assumed efficiency of 100 percent, such as baseboard heaters. Since the tracking system revealed that some participants had air source heat pumps prior to the conversion, an adjustment has thus been calculated to consider the efficiency of air source heat pumps, which is higher than 100 percent. Since the exact information about the age and the technical specifications of the participants' existing heat pump models was not available, the Evaluator selected an HSPF value found in the available literature. According to a document published by EnerGuide¹¹ 10 years ago, the HSPF for heat source heat pumps used in Nova Scotia region ranged between 6.7 and 7.4.

Given the typical lifespan of an air source heat pump ranging between 15 and 20 years¹² and the deterioration of the system over time, the Evaluator considered the value of 6.7 to be representative of the HSPF of an average air source heat pump replaced through Green Heat. Assuming that the portion of space heating savings remains the same, the Evaluator revised unitary savings in cases where a heat pump is the existing heating system.

In cases where the initial heat pump is replaced with a new heat pump, the Evaluator used the formulas from the 2015 PUC Technical Resource Manual, and an initial HSPF of 6.7 (instead of 3.412, which corresponds to an efficiency of 100 percent). The Evaluator also assumed an initial HSPF of 6.7 instead of 3.412 in cases where the new system is a pellet stove, a wood stove, a wood furnace or

¹¹ EnerGuide, Natural Resources Canada's Office of Energy Efficiency, *Heating and Cooling With a Heat Pump*, December 2004.

¹² Natural Resources Canada, <http://www.nrcan.gc.ca/energy/publications/efficiency/heating-heat-pump/6831>, last modified April 15, 2014.

boiler, and a pellet furnace or boiler. For the advanced pellet-boiler/furnace combination measure, unitary savings were revised for the portion associated with space heating only. This portion was assumed to be equivalent to pellet furnace or boiler unitary savings. No change was made to the remaining portion, which is associated with domestic hot water heating. This revision resulted in revised unitary savings values presented in Table 14 below.

**Table 14: Revised Unitary Savings Values for Participants
With Air Source Heat Pump Prior to Conversion**

Equipment Category	Revised Unitary Savings Value When Heat Pump is Installed Prior to Conversion (kWh/year)	Revised Unitary Peak Demand Savings Value When Heat Pump is Installed Prior to Conversion (kW)
Wood Stoves	5,318	2.04
Pellet Stoves	4,562	2.04
Wood Furnace or Boiler	7,030	3.90
Pellet Furnace or Boiler	7,010	3.95
Advanced Pellet-Boiler/Furnace Combination	15,451	6.54
Geothermal Heat Pump	3,291	1.37
Central Ducted Heat Pump	1,201	0.44
Air to Water Heat Pump	1,201	0.44

2014 Green Heat participants with an initially installed heat pump converted their system to a new air source heat pump, a geothermal heat pump or a pellet stove. The following table presents the adjustment ratios calculated for these three types of systems for this year's evaluation. None of the participants who installed a wood stove, a wood furnace or a pellet furnace initially used a heat pump as their primary heating system. The adjustment ratio is thus equal to 1 for these types of systems.

Table 15: Adjustment Ratio for Heat Pump as Initial Heating System

New Equipment	Adjustment Ratio for Energy Savings	Adjustment Ratio for Peak Demand Savings
Pellet Stoves	0.973	0.973
Geothermal Heat Pump	0.886	0.891
Central Ducted Heat Pump	0.729	0.732

Prior to this evaluation, ENSC considered the same savings for participants who initially had electrical baseboards or furnaces as for those who initially had a heat pump as their primary heating system. Those who had a heat pump were not eligible unless the total electricity consumption in their homes was greater than 21,000 kWh/year before the installation of the new system. The Evaluator

recommends removing this eligibility criterion. Instead, ENSC should use revised unitary savings values provided in Table 14 when a heat pump is installed prior to conversion.

5.1.2 Revised Gross Savings

The annual gross savings for each category of equipment installed through Green Heat are presented in Table 16. These were calculated using the unitary savings values revised in this report.

Overall, the revised total gross energy and revised peak demand savings amount to 2.090 GWh and 0.844 MW at the meter respectively. Table 16 shows the revised total gross savings at the generator level calculated using the Nova Scotia Power residential line loss factor of 1.100 between the meter and the generator. The total gross energy and peak demand savings at the generator are therefore estimated at 2.299 GWh and 0.928 MW respectively.

Table 16: Evaluation Results – Revised Gross Energy and Peak Demand Savings

Category of Product	Wood Stove	Pellet Stove	Wood Furnace or Boiler	Pellet Furnace or Boiler	Central Ducted Heat Pump	Geoth. Heat Pump	Total
Energy Savings							
Number of Units	84	92	1	1	51	6	235
Unitary Savings (kWh)	10,443	8,959	13,804	13,765	8,820	10,411	-
Adjustment for Heat Pump as Initial Primary Heating System	1.000	0.973	1.000	1.000	0.729	0.886	-
Total Gross Energy Savings – at Meter (GWh)	0.877	0.802	0.014	0.014	0.328	0.055	2.090
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Gross Energy Savings – at Generator (GWh)	0.965	0.882	0.015	0.015	0.361	0.061	2.299
Peak Demand Savings							
Unitary Peak Demand Savings (kW)	4.00	4.00	7.66	7.75	3.03	3.96	-
Adjustment for Heat Pump as Initial Primary Heating System	1.000	0.973	1.000	1.000	0.732	0.891	-
Total Gross Peak Demand Savings – at Meter (MW)	0.336	0.358	0.008	0.008	0.113	0.021	0.844
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Gross Peak Demand Savings – at Generator (MW)	0.370	0.394	0.008	0.009	0.124	0.023	0.928

5.2 Net-to-Gross Ratio

To measure the influence of Green Heat on participants' decision whether or not to install eligible heating systems, a self-report survey was conducted using a set of questions. Based on an analysis of the responses to this survey, an appropriate net-to-gross ratio (NTGR) was determined.

This section presents the methodology used to transform responses to the survey questions into an NTGR. The survey questions assessed only one kind of distortion effect: free-ridership.

5.2.1 Free-ridership

In the case of Green Heat, free-ridership can occur when participants would have still installed the heating system in the absence of the program. The free-ridership level was measured through the participant survey, using the same algorithm as that for the 2011, 2012 and 2013 evaluations. The algorithm for the free-ridership calculation is presented in Appendix IV.

The 2014 survey results revealed an overall free-ridership level of 36 percent for Green Heat. This free-ridership level is similar to that established as part of last three years' evaluations (34% in 2013, 32% in 2012 and 42% in 2011). This result shows that Green Heat influenced the decisions to install 64 percent of the heating systems installed in 2014.

5.2.2 NTGR Calculation

The NTGR has been calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership}).$$

Using the free-ridership level established for Green Heat, the NTGR value has been established at 0.64.

5.3 Net Savings

The net peak demand and energy savings for Green Heat have been calculated by applying the NTGR value just described and the following equation.

$$\text{Net Savings} = \text{Gross Evaluation Savings} \times \text{NTGR}$$

The total net energy savings are 1.338 GWh at the meter and 1.472 GWh at the generator while the total net peak demand savings are 0.540 MW at the meter and 0.594 MW at the generator. Detailed results are presented in Table 17.

Table 17: Evaluation Results – Revised Net Energy and Peak Demand Savings

Category of Product	Wood Stove	Pellet Stove	Wood Furnace or Boiler	Pellet Furnace or Boiler	Central Ducted Heat Pump	Geoth. Heat Pump	Total
Energy Savings							
Total Gross Energy Savings – at Meter (GWh)	0.877	0.802	0.014	0.014	0.328	0.055	2.090
NTGR	0.640	0.640	0.640	0.640	0.640	0.640	0.640
Total Net Energy Savings – at Meter (GWh)	0.561	0.513	0.009	0.009	0.210	0.035	1.338
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Net Energy Savings – at Generator (GWh)	0.618	0.565	0.010	0.010	0.231	0.039	1.472
Peak Demand Savings							
Total Gross Peak Demand Savings – at Meter (MW)	0.336	0.358	0.008	0.008	0.113	0.021	0.844
NTGR	0.640	0.640	0.640	0.640	0.640	0.640	0.640
Total Net Peak Demand Savings – at Meter (MW)	0.215	0.229	0.005	0.005	0.072	0.014	0.540
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Net Peak Demand Savings – at Generator (MW)	0.237	0.252	0.005	0.005	0.080	0.015	0.594

Table 18 compares the energy and peak demand savings established through this evaluation and those calculated in the tracking report.

Table 18: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	NTGR	Net Savings
Energy Savings			
Tracked Savings from ENSC	2.393 GWh	0.66	1.580 GWh
Evaluation Results	2.299 GWh	0.64	1.472 GWh
Peak Demand Savings			
Tracked Savings from ENSC	1.067 MW	0.66	0.705 MW
Evaluation Results	0.928 MW	0.64	0.594 MW

The net energy savings calculated through the evaluation are seven percent lower than those calculated based on the data from the tracking report. The NTGR calculated through this evaluation is slightly lower than that established in the 2013 evaluation; this difference can be explained by two factors: (1) the reduction in unitary savings for geothermal heat pumps and (2) the adjustments made to deal with cases in which heat pumps were used as the primary heating systems before the conversion.

The net peak demand savings calculated through the evaluation are 16 percent lower than those calculated based on the data from the tracking report. The difference in net peak demand savings is bigger than that in net energy savings. This can be explained by the heat pump unitary savings revision which resulted in a slight increase of unitary energy savings and a decrease in unitary peak demand savings.

CONCLUSION

The 2014 evaluation of Green Heat demonstrated that most of the recommendations made specifically for Green Heat in the last evaluations were implemented. The Evaluator commends ENSC on the efforts it made to improve and optimize Green Heat. Among the improvements, the Evaluator noticed efforts made to continue marketing and outreach activities, conduct calibrated simulations with real participants who installed wood or pellet stoves and review information provided to participants to determine potential improvements or clarifications. Furthermore, ENSC extended the deadline for participants to complete the installation of their equipment. In 2013, having the equipment installed before the deadline was identified by participants as the main challenge or barrier. The timeline for installing the new equipment was changed from four months to two months in 2013 to align with the financing deadline. To follow up on the Evaluator's recommendation, this deadline was extended to six months, and survey results showed positive feedback from participants with this extended deadline.

On-site visits conducted as part of the 2014 evaluation confirmed that the equipment for which a rebate was claimed through Green Heat was installed, and currently used as the primary heating source. These visits also allowed identifying the discrepancies between the information in the tracking system and that collected on site concerning the replaced heating system. Although the information provided by ENSC in the tracking report contains enough information to allow carrying out the evaluation, it is recommended that further improvements be made to the accuracy of the data collected.

Survey results showed that participants' satisfaction with Green Heat was very high in 2014. Indeed, nearly all the respondents indicated that they were satisfied with Green Heat overall and its various aspects, such as the equipment installed, the initial confirmation of eligibility and the program application, forms and associated paperwork. Participants also expressed high levels of satisfaction with various factors related to ENSC.

Participation in Green Heat has had a slight decline since its beginning in 2011: a total of 235 participants participated in Green Heat in 2014, compared to 226 participants in 2013, 282 in 2012 and 296 in 2011. This decrease in Green Heat participation could be perhaps best explained by the decision made in 2012 for Green Heat to focus on heating systems that use fuel derived from renewable resources. Because of this decision, rebates for customers who wished to switch to natural gas were removed.

The evaluation revealed that Green Heat generated net energy savings of 1.472 GWh and peak demand savings of 0.594 MW at the generator in 2014, which is a decrease compared to previous years (1.524 GWh and 0.665 MW in 2013, 1.549 GWh and 0.857 in 2012, and 1.570 GWh and 0.785 MW in 2011). To calculate Green Heat's 2014 net savings, the Evaluator reviewed the gross savings used in the tracking sheet by comparing them with the same type of values found in a literature review. Moreover, the Evaluator took into consideration the free-ridership measured in the participant survey.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix summarizes all the recommendations made by the Evaluator throughout this report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Consider using an initial system efficiency other than 100 percent when the air source heat pump or the geothermal heat pump is used as the initial primary heating system. Some projects were found to have an existing ducted or ductless air source heat pump or a geothermal heat pump as the existing primary source of heat. Unitary savings are based on a switch from an electrical heating system with an assumed efficiency of 100 percent (like baseboard heaters). It is recommended that ENSC consider using lower unitary savings when the initial primary heating system is a heat pump, and remove the eligibility criterion that requires these participants to have a total electricity consumption greater than 21,000 kWh/year before the installation of the new system.
	2 Improve the pre-screening process to ensure the use of exact information regarding the initial heating system type. For a significant number of on-site visits, the information collected about the primary heating system type was different than the information given in the tracking report. In one case, the visit showed that a geothermal system was initially used while the tracking report listed an electrical baseboard. In another case, an electrical furnace was listed as the primary heating system before the conversion while the visit showed that an air-source heat pump had actually been used. As these differences can have a significant impact on the eligibility and the energy savings, ENSC should take actions and measure to ensure the use of exact information regarding the primary heating system.
Unitary Savings Values Review	3 The Evaluator recommends that ENSC use the updated tracked unitary savings value for central air source heat pumps. If air-to-water heat pumps account for a larger portion of Green Heat savings, ENSC should consider carrying out a calibrated model simulation of installed units or a metering study to measure and verify consumption and peak demand savings.
	4 The literature review did not show conclusive results regarding wood stoves and pellet stoves because no detailed metering studies on similar climates were identified. Additionally, since the tracked unitary savings values for these two types of equipment were updated in the 2013 evaluation using calibrated simulations, the Evaluator recommends that ENSC continue using the current tracked savings values.
	5 Similar to the results of the literature review for wood and pellet stoves, the Evaluator did not find any updated studies for wood and pellet furnaces/boilers. Since the current tracked unitary savings are based on simulations carried out by Dunskey Energy Consulting and Navigant Consulting, as well as a billing analysis conducted by Econoler in 2012, the Evaluator recommends keeping the current figures. Given the small number of projects installing these technologies through the program, it is hard to justify the need for conducting a metering study or a more thorough analysis.

APPENDIX II

PARTICIPANT SURVEY QUESTIONNAIRE

Could I speak with [INSERT NAME]?

- 6 Yes [GO TO INTRODUCTION]
- 7 No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

Hello, my name is _____ from CRA (Corporate Research Associates), a Halifax-based survey research company. I am calling on behalf of the Green Heat Program from Efficiency Nova Scotia Corporation (ENSC).

We are calling customers who used the Green Heat program to substitute their electric space heating with another heating source such as a wood or pellet stove, or a heat pump in 2014. The program provides a rebate or financing for converting your heating source. Are you the person in your household who was most involved and familiar with deciding about the program?

[IF NO, ASK TO SPEAK TO THE APPROPRIATE PERSON: "May I please speak to the person who knows the most about the heating system in your house?"]

[IF APPROPRIATE PERSON] We are trying to get feedback from customers about the Green Heat Program to make the program better. Your responses will be kept strictly confidential—that is, your name will not be associated with any of your responses. This survey will take about 10 minutes of your time.

V1. Our records indicate that your household participated in the Green Heat Program. Is this correct?

- 1. Yes [CONTINUE]
- 2. No, does not recall participating [PROBE: "Are you sure? According to our records, you would have received **[A REBATE/FINANCING]** from Efficiency Nova Scotia for switching from electricity to a new energy source such as a wood or pellet stove, or heat pump"] [IF PERSIST AS NO, THANK, TERMINATE AND RECORD]
- 9. Don't know/Refused [PROBE: "Are you the person who knows the most about the heating system in your house or your household participation in the Green Heat Program?"] [IF NO, ASK TO SPEAK TO THE APROPRIATE PERSON AND RESTART AT INTRODUCTION. IF PERSISTS AS NO, THANK, TERMINATE AND RECORD.]

Awareness and Participation [P Series]

P2. Now I'm going to ask you to think back to when you decided to supplement your electric space heating or completely replace it with another heating source and participate in the Green Heat Program. What was the SINGLE most important reason you were interested in switching heating system or substituting heating source? [DO NOT READ – CODE ONE ONLY]

1. (To save on energy/to save on energy costs)
2. (For better comfort)
3. (To make home more energy efficient)
4. (To help the environment)
5. (To have a backup heating source)
96. (Other) [SPECIFY_____])
98. (Don't know) [GO TO P4]
99. (Refused) [GO TO P4]

P3. Were there any other reasons? [SAME LIST AS IN P2] [DO NOT READ. ACCEPT MULTIPLE RESPONSES]

97. None/no other reasons

P4. And who would you say had the most influence on you about purchasing the equipment bought through the Green Heat Program? [ACCEPT ONE RESPONSE ONLY]

1. (An installer)
2. (Co-worker, family, friend or word of mouth)
3. (The store where you purchased your new equipment)
4. (Program documentation/Print brochure)
5. (Efficiency Nova Scotia Advisor)
96. (Other [SPECIFY_____])
98. (Don't know)
99. (Refused)

P5. Before participating, did you have any concerns about taking part in the program? [ACCEPT ONE RESPONSE ONLY]

1. (Yes)
2. (No)
98. (Don't know)
99. (Refused)

P6. [IF P5 = 1] What were those concerns? PROBE: Anything else? [DO NOT READ. ACCEPT ALL RESPONSES]

1. (That the new heating system would be inefficient)
2. (That improvements would cost a lot)
3. (Rebates would be too low / insufficient)
4. (The financing would not come through)
5. (Wouldn't like what I installed)
6. (The process would take too long)
7. (My insurance would increase)
96. (Other) [SPECIFY _____]
98. (Don't know)
99. (Refused)

Satisfaction [S Series]

CS1. How did you first learn about this program? [DON'T READ - ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]

1. Media advertising
2. Contacted directly by Efficiency Nova Scotia
3. Through a third party contractor or service provider
4. Efficiency Nova Scotia website
5. Facebook or other social media
97. (Other [SPECIFY _____])
98. (Don't know)
99. (Refused)

S1. Using a scale from 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how would you rate your satisfaction with the Green Heat Program OVERALL? [DO NOT ACCEPT A RANGE - RECORD NUMBER, 98 = Don't know/Don't recall, 99 = Refused]

S2. [IF S1 = 1, 2 OR 3] You indicated that you were not satisfied with the program overall. What was the SINGLE most important reason you were not satisfied with the program overall? [PROBE FOR SPECIFIC REASON. DO NOT READ. ACCEPT ONE RESPONSE]

1. (Too difficult to complete the pre-approval application form)
2. (Too long to get the pre-approval)
3. (Program too hard to understand – too many conditions)
4. (The rebate amount is too small)

5. (The rebate/financing application form is too complicated to complete)
 6. (There are too many documents to submit along with the rebate/financing application form)
 7. (It is too long to receive the rebate amount))
 8. (There are too many verifications from Efficiency Nova Scotia)
 96. (Other, [specify: _____])
 98. (Don't know)
 99. (Refused)
- S3. [IF S1 = 1, 2 OR 3] Were there any other reasons you were not satisfied? [PROBE FOR SPECIFIC REASONS. ACCEPT MULTIPLE; SAME LIST AS S2]
- 97 No other reasons
- S4. Now I'm going to ask you to think about each aspect of the Green Heat Program. On a scale of 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how satisfied were you with each aspect of the Green Heat Program? If you did not have experience with one of the aspects please tell me. [DO NOT RANDOMIZE] [97 = Not Applicable, 98 = Don't know/Don't recall, 99 = Refused]
- a) Program application, forms and associated paperwork
 - b) Interaction and communication with Efficiency Nova Scotia staff
 - c) Initial confirmation of eligibility
 - d) Rebate amounts
 - e) Time required to receive rebate/financing
 - f) The system installed in your home
- S5. Using a 5-point scale, where '1' is very difficult and '5' is very easy, how would you rate the process to participate in the program? [1-5 scale, 98 = Don't know/Don't recall, 99 = Refused]
- S6. [IF S5 = 1, 2 OR 3] What was difficult about participating in the program? [MULTIPLE RESPONSE – RECORD VERBATIM] Probe: Anything else?
- (Record answer)
97. (Don't know)
 98. (Refused)

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the Green Heat program? [DO NOT READ RESPONSES – CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[IF YES IN CS2, CONTINUE. OTHERWISE, SKIP TO CS27]

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where "1" is not at all satisfied and "10" is completely satisfied, how satisfied were you with [READ AND ROTATE. CODE ONE RESPONSE FOR EACH STATEMENT]

- b. The responsiveness of employees to your requests and enquiries in a timely manner
 - e. The speed with which the application was approved
 - g. The value of the program relative to the time and cost involved
- ___ Response ___ 98 Don't Know ___ 99 Refused

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you? PROBE TO AVOID ACCEPTING A RANGE

___ Response ___ 98 Don't Know ___ 99 Refused

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? [DO NOT READ RESPONSES – CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO CS27]

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? [CODE ONE ONLY]

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's ...: [READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]

- a. Service attitude
- b. Knowledge of programs available
- c. Ability to provide advice

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied

- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others? [CODE ONE ONLY]

- 1. Definitely
- 2. Probably
- 3. Probably not
- 4. Definitely not

- 97. (Not eligible to any other programs)
- 98. (Don't know)
- 99. (Refused)

V37. [IF CS27 = 3 or 4] Why would you not recommend Efficiency Nova Scotia programs? [DO NOT READ – MULTIPLE RESPONSES]

- 1. (Is not worth the expenses)
- 2. (No family members or friends that could be eligible)
- 3. (Concern that actual bill savings would be less than estimated)
- 4. (Lack of information to make an informed decision)
- 5. (Rebate amount is too small)
- 6. (Energy efficient equipment does not meet payback requirements)
- 96. (Other [Specify: _____])
- 98. (Don't know/Don't recall)
- 99. (Refused)

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
98. (Don't know)
99. (Refused)

S10. [ASK ONLY IF "REBATE" IN SAMPLE AND IF THERE IS A DATE UNDER "DATE CHEQUE MAILED"] Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in weeks, was it before you received your rebate? [RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

Free-Ridership [FR Series]

FR1. Moving along to another topic ... Had you **already** considered replacing or substituting your space heating with another heating source **before** you heard about the Green Heat Program?

1. Yes
2. No
98. (Don't know)
99. (Refused)

[IF FR1=YES]

FR1a. I just want to make sure I understand, before you decided to participate in the Green Heat Program, had you already made the decision to replace or substitute your space heating with another heating source?

1. Yes
2. No
98. (Don't know)
99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Green Heat Program.

If you had not participated in the Green Heat Program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely **Would Not** Have Taken the Action," and a 10 indicating that you "Definitely **Would Have** Taken the Action." [AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND

AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING:
 “AND NEXT, in the absence of the Program, would you have . . . : DO NOT ACCEPT A RANGE –
 ASK FR2 SEQUENCE IN ORDER/DO NOT RANDOMIZE]

FR2a. ... replaced or substituted your space heating system with one that did not use electricity?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2b. ... replaced or substituted your old space heating system with another one that uses electricity?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2c. ... replaced or substituted your space heating system with one that did not use electricity, *but at a later date?*

___ Response ___ 98 Don't Know ___ 99 Refused

[IF FR2c > 5, THEN ASK]

FR2cc. DO NOT ASK FR2cc IF DON'T KNOW OR REFUSED IN Q.FR2c You indicated in your response to a previous question that if the Green Heat Program had not been available there was an [FR2c] in 10 likelihood that you would have replaced or substituted your space heating system with one that did not use electricity, but at a later date. Approximately how many months later would you have replaced or substituted your your space heating system? [DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

1. _____ months later
2. (Never)
3. (At the same time)
97. (Don't Know)
98. (Refused)

FR2ccc. [IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2cc ANSWER IN MONTHS, READ]:

Would it have been within ...

1. Less than 6 months?
2. Within 6 months to less than 1 year later?
3. 1 to less than 2 years later?
4. 2 to less than 3 years later?
5. 3 to less than 4 years later?
6. 4 or more years later?
7. (Never)
98. (Don't Know)
99. (Refused)

FR3. [IF REBATE] Efficiency Nova Scotia paid you \$[INCENTIVE] for your new space heating system. If you had not received the rebate from Efficiency Nova Scotia, would you have made the same purchase?

[IF FINANCING] Efficiency Nova Scotia provided you with a \$[ACTUAL LOAN AMOUNT] loan for your new space heating system. If you had not received the financing from Efficiency Nova Scotia, would you have made the same purchase? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely **Would Not Have**” and a 10 indicating that you “Definitely **Would Have**.” [PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

FR4. Next, I'm going to ask you to rate the importance of factors that might have influenced your decision to replace or substitute your space heating system to another heating source. Using a scale from 0 to 10, where 0 means “Not at all important” and 10 means “Extremely important”, please rate the importance of each of the following in your decision to replace your heating system to another heating source.

Factor (READ AND RANDOMIZE)	Responses – DO NOT ACCEPT A RANGE
a. The program rebate or financing	___ Response ___ 98 Don't Know ___ 99 Refused
b. Information on the program provided by a salesperson	___ Response ___ 98 Don't Know ___ 99 Refused
d. Previous experience with a similar program either from Efficiency Nova Scotia or Nova Scotia Power	___ Response ___ 98 Don't Know ___ 99 Refused

Barriers to Action [B Series]

B1. Were there any challenges or barriers that you faced in implementing the new equipment or the new energy source rebated by the Green Heat Program?

1. Yes
2. No
98. (Don't know)
99. (Refused)

B2. [If B1 = 1 'Yes'] What were those challenges or barriers? PROBE: Anything else? [DO NOT READ. ACCEPT ALL RESPONSES]

1. (Lack of information about the program to make an informed decision)
2. (Rebate was too little)
3. (Paperwork/process required too much work)
4. (Approval takes too long)

- 5. (Lack of financing)
- 6. (Energy efficient equipment does not meet payback requirements)
- 7. (Lack of technical knowledge)
- 8. (Finding a qualified contractor)
- 9. (Having equipment installed before deadline)
- 10. (Cost of equipment/unit)
- 96. (Other barrier [Specify: _____])
- 98. (Don't know)
- 99. (Refused)

Recommendations for Program Improvements [R Series]

R1. Do you have any recommendations for improving the Green Heat Program? PROBE: Anything else? [DO NOT READ. ACCEPT MULTIPLE]

- 1. (Offer more products/measures eligible for rebates/financing)
- 2. (Offer more information on the products/measures recommended)
- 3. (Simplify program application, forms and associated paperwork)
- 4. (Increase the rebate amount)
- 5. (Increase the time given to complete the upgrades)
- 6. (Improve communication)
- 7. (Advertise the program more or in a better way)
- 8. (No recommendation)
- 96. (Other [SPECIFY _____])
- 98. (Don't know)
- 99. (Refused)

R2. [IF R1=1] Which additional products or measures would you like to be eligible in the Green Heat Program? [RECORD VERBATIM. ACCEPT MULTIPLE]

- 96. (Record answer)
- 97. (Don't know)
- 98. (Refused)

Demographics [D Series]

[ASK ALL RESPONDENTS]

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

- D1. What type of residence do you live in? [READ RESPONSES 1-5, then 96; SELECT ONE RESPONSE]
1. Detached single-family home
 2. Semi-detached house
 3. Mobile home or house trailer
 4. Townhouse or duplex which share adjacent walls
 5. Row house
 96. Other [SPECIFY: _____]
 98. (Don't know)
 99. (Refused)
- D2. How many bedrooms are in your home? [98=DK; Enter zero for a studio apartment with no bedrooms]
- D6. Including yourself, how many people live in this residence on a full-time basis?
Number of people: _____
[NOTE: DON'T ALLOW ZERO FOR A RESPONSE]
- D7. What is your age group? Are you... [READ]
1. 18 to 24
 2. 25 to 34
 3. 35 to 44
 4. 45 to 54
 5. 55 to 64
 6. 65 or over
 9. (Refused)
- D8. What is the highest level of education you have completed? [DO NOT READ]
1. (Less than high school graduation certificate)
 2. (High school graduation certificate and/or some post-secondary)
 3. (Trades certificate or diploma)
 4. (College certificate or diploma)
 5. (University certificate or diploma)
 99. (Refused)

D9. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category. [READ LIST; SELECT ONE RESPONSE]

1. Less than \$15,000
2. \$15,000 - \$24,999
3. \$25,000 - \$34,999
4. \$35,000 - \$49,999
5. \$50,000 - \$69,999
6. \$70,000 - \$79,999
7. \$80,000 or more
99. (Refused)

D10. [DO NOT READ] Gender:

1. Male
2. Female

END: Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

APPENDIX III

PARTICIPANT SURVEY RESULTS

The participant survey results are presented in the following tables.

CS1. How did you first learn about this program?

Sources of Awareness	2012**	2013	2014
<i>Sample Size*</i>	34	70	53
Word of mouth	24%	21%	19%
Media advertising	26%	20%	15%
The store where new equipment was purchased	21%	7%	15%
On the ENSC website	9%	20%	13%
Through a third-party contractor or service provider	15%	20%	9%
Contacted directly by ENSC	3%	1%	9%
On the Internet in general	15%	9%	8%
Facebook or other social media	3%	4%	4%
At home show	6%	4%	2%
Others	6%	10%	6%
Don't know/Cannot recall	-	-	6%
*Multiple responses **Source: 2012 C-Sat Residential Study			

P2. What was the SINGLE most important reason you were interested in switching heating system or substituting heating source?

P3. Were there any other reasons?

Reasons for Participating	2012		2013		2014	
	Most Important Motivation	Second Most Important Motivation*	Most Important Motivation	Second Most Important Motivation*	Most Important Motivation	Second Most Important Motivation*
<i>Sample Size</i>	75	75	70	70	53	53
Save on energy costs/bills	81%	15%	73%	16%	68%	19%
For better comfort	8%	12%	3%	11%	8%	8%
To have a backup heating source	4%	8%	1%	6%	8%	8%
Wanted wood stove/Like wood heat	-	7%	3%	4%	6%	6%
To make home more energy efficient	1%	1%	3%	16%	4%	6%
To help the environment	1%	3%	1%	7%	2%	4%
Needed to replace system/Heating system wasn't working properly	-	-	10%	-	2%	-
Rebate/Financing	-	-	1%	4%	-	6%
Others	4%	5%	4%	10%	4%	9%
Nothing/No other reasons	-	43%	-	37%	-	40%
Don't know	-	8%	-	3%	-	-
*Multiple responses						

P4. And who would you say had the most influence on you about purchasing the equipment bought through the Green Heat Program?

Who Influenced Purchase of Equipment Through Green Heat	2012	2013	2014
<i>Sample Size*</i>	75	70	53
Participant made decision	29%	21%	26%
Co-worker, family, friend or word of mouth	20%	29%	23%
The store where you purchased your new equipment	13%	16%	8%
ENSC advisor	-	6%	4%
Program documentation/Print brochure	-	4%	2%
Information online	3%	3%	2%
Installer	7%	1%	2%
Media advertising	-	3%	-
Others	11%	6%	6%
Don't know/Refused	17%	11%	28%
*Multiple responses			

P5. Before participating, did you have any concerns about taking part in the program?

Concerns with Green Heat Prior to Taking Part	2012	2013	2014
<i>Sample Size</i>	75	70	53
Yes	11%	3%	4%
No	89%	97%	96%

P6. What were those concerns?

Specific Concerns with Green Heat*	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size**</i>	8	2	2
Rebates/financing would be too low or insufficient/Financing wouldn't come through	1	1	1
New heating system would be inefficient	-	-	1
Upgrades would not be inspected if equipment bought elsewhere	-	1	-
Too much hassle/bureaucracy	-	1	-
Worried I would not be eligible/qualify	3	-	-
Improvement would cost a lot	3	-	-
New heating system would be inefficient	3	-	-
Process would take too long	1	-	-
*Multiple responses **Base: Respondents who said they had concerns			

B1. Were there any challenges or barriers that you faced in implementing the new equipment or new energy source rebated by the Green Heat Program?

Challenges or Barriers Faced in Installing the New Equipment or New Energy Source	2012	2013	2014
<i>Sample Size</i>	75	70	53
Yes	13%	19%	19%
No	87%	81%	81%

B2. What were those challenges or barriers?

Specific Challenges Face in Installing New Equipment*	2013 (#)	2014 (#)
<i>Sample Size**</i>	13	10
Problems with installation	-	3
Energy-efficient equipment does not meet payback requirements	1	2
Paperwork/process required too much work	1	2
Having equipment installed before deadline	4	1
Choosing the right equipment/unit	2	1
Finding a qualified contractor	1	1
Approval takes too long	-	1
Cost of equipment/unit	4	-
Hard to find good wood to burn	3	-
Others	2	1
*Multiple responses **Base: Respondents who said they had concerns		

FR4. Using a scale from 0 to 10, where 0 means “Not at all important” and 10 means “Extremely important”, please rate the importance of each of the following in your decision to replace your heating system to another heating source.

Importance of Green Heat in Influencing Decision to Replace Heating System with Another Heating Source	2012		2013		2014	
	<i>Sample Size*</i>	Important *	<i>Sample Size*</i>	Important *	<i>Sample Size*</i>	Important *
Mean (0=Not at all important, 10=Extremely important)*						
Program rebate or financing	75	7.8	68	7.5	53	7.6
Information on the program provided by the salesperson**	72	6.1	67	6.6	51	5.7
Previous experience with similar program either from ENSC or NSP	72	4.2	57	4.2	49	3.9
*Mean excludes responses of 'Refused' and 'Don't know'						

S1. Using a scale from 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how would you rate your satisfaction with the Green Heat Program overall?

Satisfaction with Overall Experience	2012	2013	2014
<i>Sample Size*</i>	75	70	53
5 – Very satisfied	77%	77%	80%
4	15%	20%	18%
3	7%	1%	2%
2	1%	1%	-
1 – Not at all satisfied	-	-	-
*Don't know removed from calculations			

S2. You indicated that you were not satisfied with the program overall. What was the SINGLE most important reason you were not satisfied with the program overall? S3. Were there any other reasons you were not satisfied?

Reasons Less Satisfied with Green Heat	2013		2014	
	Most Important Reason (#)	Second Most Important Reason (#)	Most Important Reason (#)	Second Most Important Reason (#)
<i>Sample Size*</i>	2	2	1	1
Lack of time to do the repairs suggested	-	-	1	-
Energy efficient equipment didn't qualify	-	-	-	1
Requirements to be eligible for rebate	1	-	-	-
Too many documents to submit along with the rebate application form	1	-	-	-
Program geared more towards inspectors/sellers	-	1	-	-
Others	-	-	-	-
None/No other reasons	-	-	-	-
Don't know	-	1	-	-
*Base: Respondents who were less satisfied with Green Heat				

S4. On a scale of 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how satisfied were you with each aspect of the Green Heat Program?

Aspect of Green Heat	2012		2013		2014	
	Sample Size*	Satisfied **	Sample Size*	Satisfied **	Sample Size*	Satisfied **
The system installed in your home***	73	95%	68	96%	52	98%
Interaction and communication with ENSC staff	74	96%	69	99%	53	96%
Initial confirmation of eligibility	73	93%	70	94%	52	96%
Program application, forms and associated paperwork	74	96%	70	96%	53	92%
Time required to receive rebate or incentive	72	94%	69	93%	49	88%
Rebate or incentive amounts	73	85%	70	70%	52	79%
*Don't know removed from calculations						
**Percentage of respondents who gave a rating of 5 or 4 on a scale where 5 = 'Very satisfied' and 1 = 'Not at all satisfied'						

S5. Using a 5-point scale, where '1' is very difficult and '5' is very easy, how would you rate the process to participate in the program?

Program Participation Process	2012	2013	2014
Sample Size*	75	70	52
5 – Very easy	64%	57%	60%
4	27%	33%	29%
3	7%	9%	12%
2	1%	1%	-
1 – Very difficult	1%	-	-
*Don't know removed from calculations			

S6. What was difficult about participating in the program?

Causes for Green Heat Application Difficulty*	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size**</i>	7	7	6
Lack of information about program/participation process	-	5	3
Paperwork/process was time consuming/required too much work	2	3	2
Poor communication	2	-	1
Couldn't do any upgrades until approved	-	1	-
Lack of awareness of program	2	-	-
Installation	2	-	-
Delay to receive the rebate	1	-	-
*Multiple responses **Base: Respondents who had difficulty with participation (a rating of 1, 2 or 3 on a scale where 5 = 'Very easy' and 1 = 'Very difficult')			

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the Green Heat program?

Contact with ENSC	2012*	2013	2014
<i>Sample Size</i>	34	70	53
Yes	91%	93%	92%
No	6%	6%	8%
Don't know	3%	1%	-
*Source: 2012 C-Sat Residential Study			

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where "1" is not at all satisfied and "10" is completely satisfied, how satisfied were you with...

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

Satisfaction with Overall Performance	2012***		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Mean (1=Not at all satisfied, 10=completely satisfied)**						
Responsiveness of employees to requests and enquiries in a timely manner	31	9.5	65	9.3	49	9.2
ENSC's overall performance in working with you	31	9.5	65	9.2	49	9.2
Speed with which the application was approved	31	9.5	65	9.1	49	9.0
Value of the program relative to the time and cost involved	31	9.2	65	8.9	48	8.4
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of 'Refused' and 'Don't know' ***Source: 2012 C-Sat Residential Study						

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

Contact with ENSC Contact Centre Staff	2012*	2013	2014
Sample Size	31	65	49
Yes	84%	78%	76%
No	13%	20%	12%
Don't know	3%	2%	12%
*Source: 2012 C-Sat Residential Study			

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's ...

Satisfaction with Overall Performance	2012***		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Overall level of service provided by ENSC contact centre staff	26	100%	51	99%	37	100%
Knowledge of programs available	26	100%	49	98%	35	100%
Service attitude	26	100%	51	96%	37	100%
Ability to provide advice	25	100%	51	94%	37	100%
*Base: Number of respondents who had contact with ENSC staff **Percentage of respondents who gave a rating of 5 or 4 on a scale where 5 = 'Very satisfied' and 1 = 'Not at all satisfied'; Don't know removed from calculations ***Source: 2012 C-Sat Residential Study						

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others?

Would Recommend Green Heat to a Family Member or Friend	2012**	2013	2014
Sample Size*	34	70	53
Definitely	94%	90%	94%
Probably	6%	9%	6%
Probably not	-	1%	-
Definitely not	-	-	-
*Don't know/refused have been removed from calculation **Source: 2012 C-Sat Residential Study			

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs?

Would Participate in Other ENSC Programs	2012**	2013	2014
Sample Size*	34	70	52
Definitely	82%	79%	87%
Probably	18%	20%	13%
Probably not	-	1%	-
Definitely not	-	-	-
*Don't know/refused have been removed from calculation **Source: 2012 C-Sat Residential Study			

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in weeks, was it before you received your rebate?

Length of Time to Receive Rebate	2014
<i>Sample Size*</i>	33
2-3 weeks	27%
4-5 weeks	27%
6-11 weeks	33%
12+ weeks	12%
Average	6.0 weeks
*Don't know/refused have been removed	

R1. Do you have any recommendations for improving the Green Heat Program? PROBE: Anything else?

Recommendations to Improve Green Heat	2012	2013	2014
<i>Sample Size*</i>	75	70	53
Increase rebate amount	13%	21%	15%
Advertise the program more or in a better way	8%	6%	13%
Offer additional equipment eligible for rebates/financing	5%	9%	8%
Offer more information on the equipment recommended	5%	3%	6%
Lower the minimum amount of electricity usage required for participating	-	1%	4%
Speed up the process	-	1%	4%
Simplify program application, forms and associated paperwork	7%	-	4%
Improve communication	9%	6%	2%
Increase the time given to complete the upgrades	-	3%	2%
Allow for repeat participation in the program	-	1%	2%
Information on qualified contractors	-	1%	2%
More knowledgeable people	-	3%	-
Provide financing options	-	1%	-
Others	11%	6%	6%
No recommendations	53%	51%	49%
*Multiple responses			

R2. Which additional products or measures would you like to be eligible in the Green Heat Program?

Additional Products would like Eligible through Green Heat	2014 (#)	2014 (#)
<i>Sample Size**</i>	4	4
Heat Pump	-	2
Solar Power	3	-
Don't know	1	2

D1. What type of residence do you live in?

Type of Residence	2012	2013	2014
<i>Sample Size</i>	75	70	53
Detached single-family home	91%	93%	94%
Semi-detached house	1%	3%	4%
Mobile home or house trailer	5%	4%	2%
Townhouse or duplex which share adjacent walls	3%	-	-

D2. How many bedrooms are in your home?

Number of Bedrooms	2012	2013	2014
<i>Sample Size</i>	75	70	53
1	-	-	2%
2	15%	13%	11%
3	48%	53%	49%
4+	37%	34%	38%

D3. Including yourself, how many people live in this residence on a full-time basis?

Number of people in household	2012	2013	2014
<i>Sample Size</i>	75	70	53
1	12%	9%	11%
2	41%	39%	45%
3	20%	26%	17%
4+	27%	27%	26%

D7. What is your age group?

Age	2012	2013	2014
<i>Sample Size</i>	75	70	53
18-24	-	1%	4%
25-34	15%	19%	11%
35-44	27%	17%	21%
45-54	24%	30%	26%
55-64	24%	26%	17%
65+	11%	6%	19%
Refused	-	-	2%

D8. What is the highest level of education you have completed?

Education	2012	2013	2014
<i>Sample Size</i>	75	70	53
Less than high school graduation certificate	4%	-	4%
High school graduation certificate and/or some post-secondary	15%	23%	17%
Trade certificate	7%	4%	6%
College certificate or diploma	15%	21%	13%
University certificate or diploma	57%	50%	58%
Refused	3%	1%	2%

D9. Which of the following income categories best describes your total annual household income before taxes in 2013?

Income	2012	2013	2014
<i>Sample Size</i>	75	70	53
Less than \$15,000	-	-	-
\$15,000-\$24,999	7%	1%	2%
\$25,000-\$34,999	9%	6%	2%
\$35,000-\$49,999	12%	20%	9%
\$50,000-\$69,999	13%	17%	25%
\$70,000-\$79,999	7%	16%	11%
\$80,000 or more	39%	31%	42%
Refused	13%	7%	10%

D10. Gender?

Gender	2012	2013	2014
<i>Sample Size</i>	75	70	53
Male	55%	56%	62%
Female	45%	44%	38%

APPENDIX IV

ALGORITHM FOR FREE-RIDERSHIP CALCULATION

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

FR2a. If you had not participated in Green Heat, what is the likelihood that you would have replaced or substituted your space heating system with one that did not use electricity? (Scale 0 to 10)	FR2a = Answer x 10%
FR2b. If you had not participated in Green Heat, would you have replaced or substituted your old space heating system with another one that uses electricity? (Scale 0 to 10)	FR2b = (10 – Answer) x 10%
PA1 Score:	MEAN VALUE OF: (FR2a ; FR2b)
FR1. Had you already considered replacing or substituting your space heating system with another heating source before you heard about Green Heat?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%
FR1a. I just want to make sure - Before you decided to participate in Green Heat, had you already made the decision to replace or substitute your space heating system with another heating source?	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%
FR3. If you had not received the rebate/financing from ENSC, would you have made the same purchase of a new space heating system ? (Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3
FR4. Level of influence (Scale 0 to 10) Factors a, b, d = Program factors	FR4_P = MAX(a; b; d)
PA3 Score:	(10 - FR4_P) x 10%)
FR2c. In the absence of Green Heat, what is the likelihood that you would have replaced or substituted your space heating system with one that did not use electricity but at a later date ? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2ccc Otherwise: PA4 = EMPTY
FR2ccc. Approximately how many months later would you have made the replacement or the substitution? 1. Less than 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later? 7. (Never) 9. (Don't know / Refused)	IF 1. : FR2ccc = 100% IF 2. : FR2ccc = 50% IF 3. : FR2ccc = 25% IF 4. : FR2ccc = 0% IF 5. : FR2ccc = 0% IF 6. : FR2ccc = 0% IF 7. : FR2ccc = 0% IF 9. : FR2ccc = 0%
PA4 Score:	FR2ccc
Final Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)
Inconsistency Test #1	IF ABS(FR2a – FR2b) ≥ 30%: PA1 = MIN OF (FR2a ; FR2b)
Inconsistency Test #2	IF FR3 ≥ 70% AND IF (FR2a OR FR2b < 70%: PA2 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)

APPENDIX V

ON-SITE VISIT SAMPLING METHODOLOGY AND PROTOCOL

Sampling Methodology

In preparation for five on-site visits, the Evaluator prepared a sampling plan for the 138 projects listed in the tracking report. The primary criterion for the development of the sampling plan was the gross savings reported for each of the equipment categories. The square root of the tracked gross savings was calculated for each group and totalled. Equipment categories were ranked from highest to lowest based on their percentage of the summed total, and then multiplied against the sample population size (n=5). The results are presented in the table below.

Table 19: Sample Distribution Results¹³

Row Labels	Count of Measure	Sum of Gross (kWh)	√ of Savings	% of √ Savings	Portion of Sample (n=5)	Final Count
ASHP	34	240,584	490.5	23.1%	1.2	1
Geothermal	4	57,320	239.4	11.3%	0.6	1
Pellet Stove	47	421,073	648.9	30.6%	1.5	1
Wood Stove	53	550,019	741.6	35.0%	1.7	2
Grand Total	138	1,268,996	2,120.4	100.0%		5

A secondary screening of the data was carried out on all four equipment categories, and the results supported the sample outcome. The smallest category was geothermal with 11.3 percent of the proportional savings. As geothermal also represents the largest unitary savings value of the four groups, it was considered a suitable fit for the sample. Similarly, the wood stove sample of two was further qualified using the variable nature of the device. Since a wood stove cannot be automated to run without occupants in the home, there is a high chance that the unitary savings could be impacted, and should therefore warrant a larger sample size.

As the savings by category were calculated using fixed unitary value, the importance of individual projects within a category had no impact on the sample selection process. Sites were selected randomly from each equipment category and were limited to locations that fell within a 200 km radius of the Halifax Regional Municipality (HRM).

On-site Visit Protocol

Similar to the other program evaluations, the Evaluator prepared a standardized site visit protocol to aid in collecting relevant information. Validation of unitary savings is limited primarily to confirming that operable new equipment has displaced some of the electrical heating system. Therefore, the site visit

¹³ As of October 7, 2014.

protocol was developed around confirming tracked information and identifying potential patterns that may negatively impact the tracked savings. Additional information collected with the protocol includes building type, full-time occupants and information about the location of the equipment that is used to quantify the percentage of the total heating load it represents.

For each site, the type and characteristics of the space and/or DHW heating systems were also reviewed and recorded prior to the visit. This information allows the evaluator to assess the accuracy of the tracked information stored in the DSMDS and collect nameplate information from the installed equipment. Upon completion of the site visits, the collected information will be used to validate the applications received by ENSC and identify possible process improvement opportunities.

Green Heat On-Site Protocol

General Information											
#	Project ID	Type of Installation	Site Visit Date	Contact Name	Contact Phone #	Address	City	Person Met During The Visit	House Type	Number of Full Time Occupants From Tracking Sheet	Number of Full Time Occupants (Onsite Validation)

Primary Heating System - Before Conversion						
Primary Heating Source - From Tracking Sheet	Primary Heating Source - Validation Onsite	Primary Heating Capacity - Validation Onsite	% of Total Heating From Primary Source - Participant Declaration	Primary Heating Efficiency/AFUE - Validation Onsite	Is Equipment Still In Place?	Notes

Secondary Heating System - Before Conversion						
Secondary Heating Source - From Tracking Sheet	Secondary Heating Source - Validation Onsite	Secondary Heat Capacity - Validation Onsite	% total heating from Secondary Source	Secondary Heating Efficiency/AFUE - Validation Onsite	Is Equipment Still In Place?	Notes

New Heating System - After Conversion					
Installation Date - Validation Onsite	New Heating Source - From tracking sheet	New Heating Source - Validation Onsite	New Heat Capacity - From Tracking Sheet	New Heat Capacity Validation Onsite	% Total Heating From New Source

New Heating Source AFUE - Validation Onsite	Model Name & Number of New Heating System	Is the equipment ENERGY STAR? (Yes or No)	Is Electric Back-Up Still in Use?	If Still in Use, What is the Antipicated % of Usage?	Picture Taken of Name Plate? (Yes/No)

Water Heating System						
System Replaced During the Fuel Substitution (YES/NO)? - From Tracking Sheet	System replaced during the fuel substitution (YES/NO)? - Validation onsite	DHW Source - From Tracking Sheet	DHW Source - Validation Onsite	Energy Factor of New Water Heating System From Tracking Sheet	Energy Factor of DHW Source - Validation Onsite/Online	Model Name/Number for DHW System - From Tracking Sheet

Model name/Number for DHW System - Validation Onsite	Picture of Name Plate Taken? (Yes/No)	Is the equipment ENERGY STAR® certified (YES/NO)?	NOTES



ECONOLER

LOW INCOME HOMEOWNER

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ECONOLER

ABBREVIATIONS

ARet	Appliance Retirement
DA	Delivery Agent
ENSC	Efficiency Nova Scotia Corporation
HEA	Home Energy Assessment
LIH	Low Income Homeowner
NRCan	Natural Resources Canada
NTGR	Net-to-Gross Ratio
PRISM	Princeton Scorekeeping Method
RDI	Residential Direct Install

DEFINITIONS

Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Billing calibration	An activity that consists in adjusting the expected energy savings based on the relative difference between the results of the building energy simulations and the actual energy consumption of the building.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
EnerGuide rating	An EnerGuide rating shows a standard measure of the home's energy performance. It shows exactly how energy efficient the home is.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	V
Program Component Overview.....	V
Key Findings.....	V
1 PROGRAM DESCRIPTION	1
2 VALIDATED SAVINGS.....	2
2.1 Gross Savings	2
2.1.1 Building Envelope Measures Using Savings per EnerGuide Point Increase.....	2
2.1.2 Building Envelope Measures Using Modelled Energy Consumptions.....	5
2.1.3 Prescriptive Measures' Savings	6
2.1.4 Peak Demand Savings.....	8
2.1.5 Validated Gross Savings	9
2.2 Interactive Effects	10
2.3 Net-to-Gross Ratio	10
2.4 Net Savings.....	10

LIST OF TABLES

Table 1: Validated Savings at the Generator	v
Table 2: Calculation of Average Savings per EnerGuide Point Based on HOT2000 Data	4
Table 3: Weighted Unitary Savings Value of the New Freezers Installed	8
Table 4: Validated Gross Energy and Peak Demand Savings	9
Table 5: Validated Net Energy and Peak Demand Savings	11
Table 6: Validated Savings at the Generator	11

LIST OF FIGURES

Figure 1: Linear Regression Analysis between the Incremental EnerGuide Rating and Space-heating Savings	4

EXECUTIVE SUMMARY

In 2014, evaluation of the Low Income Homeowner (LIH) program involved not only substantiating the savings tracked by Efficiency Nova Scotia Corporation (ENSC) with the parameters established in the 2013 evaluation, but also reassessing specific key parameters. This report presents LIH's validated gross and net savings for the year of 2014.

Program Component Overview

LIH aims to facilitate the implementation of cost-effective building envelope measures in homes owned by low-income customers across Nova Scotia by providing upgrades at no cost to homeowners.

LIH mainly includes building envelope measures, such as draft-proofing, as well as insulation for basements, crawl spaces, exposed floors, walls and attics, if required. Ventilation fans in bathrooms and moisture reduction measures (such as covering dirt floors in basements) are implemented on a case-by-case basis. LIH also replaces old dehumidifiers, refrigerators and freezers with ENERGY STAR® qualified models. The majority of the new refrigerator and freezer models installed were ENERGY STAR® qualified, but non-ENERGY STAR® models were installed in a few select instances when models of the same size were not available from manufacturers.

Key Findings

LIH had a total of 961 participants in 2014, compared with 739 in 2013 and 811 in 2012. LIH generated 2.311 GWh in net savings at the generator and 0.539 MW in peak demand savings in 2014, compared with 1.678 GWh and 0.398 MW respectively in 2013.

The increase in net savings has resulted from a higher level of participation and an increase to the EnerGuide point value. The Evaluator reviewed the gross savings by examining the following three elements: the savings associated with the EnerGuide point, the savings associated with the modelled energy consumption and the savings generated by the implementation of a number of prescriptive measures.

Due to the objectives of LIH (installation of building envelope measures and replacement of appliances at no cost for homeowners) and the target customers, the distortion and interactive effects of the program component were assumed to be negligible. Consequently, the net-to-gross ratio (NTGR) for LIH was assumed to be 1; as a result, the gross savings were equal to the net savings.

Table 1: Validated Savings at the Generator

	Initial Gross Savings	NTGR	Net Savings
Energy Savings	2.311 GWh	1.00	2.311 GWh
Peak Demand Savings	0.539 MW	1.00	0.539 MW

1 PROGRAM DESCRIPTION

Low Income Homeowner (LIH) undertaken by Efficiency Nova Scotia Corporation (ENSC) aims to facilitate the implementation of cost-effective building envelope measures in homes owned by low-income customers across Nova Scotia. All the measures are provided to such homeowners at no cost.

LIH mainly includes building envelope measures, such as draft-proofing, as well as insulation for basements, crawl spaces, exposed floors, walls and attics, if required. Ventilation fans in bathrooms and moisture reduction measures (such as covering dirt floors in basements) are implemented on a case-by-case basis.

Building envelope measures implemented in electrically heated homes are funded by electricity ratepayers and in non-electrically heated homes, by provincial funds. If a home has both electrical and non-electrical heating, the funds provided by electricity ratepayers are proportional to the estimated use of electrical space-heating. If the home has multiple fuel sources, the delivery agent (DA) consults with the homeowner during the initial assessment of the home to estimate the percentage of heating supplied by each fuel source. Starting in 2015, LIH will be available to electrically heated homes through a different not-for-profit organization, Clean Foundation, while ENSC will continue to offer the service to non-electrically heated homes.

Through LIH, old models of dehumidifiers, refrigerators and freezers are also replaced by ENERGY STAR® qualified models. ENSC continued to promote the replacement of old refrigerators with more efficient models through LIH. The majority of the new models installed were ENERGY STAR® qualified, but non-ENERGY STAR® models were also installed in a few select instances during 2014 when replacements of the same size were not available from manufacturers. These measures are funded by electricity ratepayers. In homes with potential moisture issues, a new dehumidifier could be provided even if there was not any before in the home. New dehumidifiers are treated as part of the building envelope upgrade and are funded according to the proportion of electricity use in comparison to non-electricity use for space-heating.

Homeowners who take part in LIH are also eligible for ENSC's Residential Direct Install (RDI), a program component in which low-cost energy-efficient products (i.e., lighting and water conservation products) are installed at no cost to participants. Homeowners can also choose to participate in RDI first and then continue with LIH if they meet the eligibility criteria.

LIH aimed to achieve net electricity savings of 1.9 GWh and peak demand savings of 0.4 MW for 2014. Electrical energy savings generated by LIH are accounted for under the Existing Residential program.

2 VALIDATED SAVINGS

In 2014, a full-scale evaluation of LIH was not carried out. The evaluation of LIH involved not only substantiating the savings tracked by ENSC who used the parameters established in the 2013 evaluation, but also reassessing the following specific key parameters: (1) EnerGuide point value, (2) modelled energy consumption, and (3) unitary savings. This section presents the validation of results regarding the gross and net savings for LIH.

2.1 Gross Savings

The final tracking sheet provided by ENSC for 2014 contained a total of 961 participants, which represents an increase compared to 2013 (739 participants) and 2012 (811 participants). In 2014, the Evaluator reviewed the following parameters to assess building envelope gross savings:

- › The energy savings value per EnerGuide point increased for the 109 participants, for whom modeled energy consumptions were not available;
- › The calculations using the modeled energy consumptions that resulted from the HOT2000 simulations made.

For the prescriptive measures, the Evaluator updated some unitary savings values by applying the results obtained from the Appliance Retirement (ARet) evaluation.

Finally, to calculate gross peak demand savings for both building envelope and prescriptive measures, the demand-to-energy ratio was applied as a key parameter.

The methodology for evaluating these elements is described in the following sections.

2.1.1 Building Envelope Measures Using Savings per EnerGuide Point Increase

In 2014, ENSC calculated the building envelope measures' savings for 109 LIH participants by applying an incremental savings coefficient per increased EnerGuide point (also referred to as "savings per EnerGuide point"). This method was used to calculate the building envelope measures' savings for 31 participants who had not yet completed the E assessment and for 78 participants for whom the modelled energy consumption was unknown.

The tracked savings per EnerGuide point currently used by ENSC is 783 kWh, based on the 2013 LIH evaluation.

In short, the savings calculation per EnerGuide point for building envelope measures was based on the following equation:

$$\text{Building Envelope Measure Gross Savings (kWh)} = \text{\% Electric Heating}_{D \text{ Assessment}} \times [ER_{E \text{ Assessment}} - ER_{D \text{ Assessment}}] \times 783 \text{ (kWh)}$$

Where:

ER corresponds to the EnerGuide Rating, all fuel types combined.

A predicted EnerGuide rating was used for participants for whom the E assessment had not yet been completed. This EnerGuide rating projection was made during the initial assessment, based on the assumption that all the measures recommended in the initial assessment were implemented by the DA. Since this was not representative of what actually happened, ENSC applied a realization rate of 95.5 percent to make a realistic estimate of the EnerGuide rating for the envelope measures. After analyzing the projected EnerGuide rating and the real E assessment rating of all the other participants in the database, the Evaluator considered the realization rate of 95.5 percent to be acceptable and used it to establish the revised savings.

Since there were a significant number of participants for whom the calculation method with EnerGuide point value was used, the Evaluator reviewed this method as part of the 2014 evaluation.

Data Processing

With regards to data, the Evaluator used the initial and final EnerGuide ratings and the modeled consumption values provided for 2013 LIH participants. More specifically, the Evaluator kept only those participants who met the following criteria:

- › Participants had modeled energy consumption data.
- › Participants with 100 percent electrical space heating; households must be electrically heated only to obtain a reduction in electricity consumption and allow for a comparison with electricity billings.
- › Participants had both initial and final EnerGuide ratings available and the ratings were consistent; projects with an EnerGuide rating that decreased or remained unchanged after project implementation were withdrawn from the analysis.

The required information was available for a total of 88 LIH participants. After processing the data, the Evaluator compared these participants and the overall population of participants to ensure that the analysis of savings per EnerGuide point was conducted with a representative sample.

EnerGuide Rating

The data regarding the 88 participants selected by the Evaluator was used to analyze the average space heating energy savings per EnerGuide point by comparing D and E simulation results. Since the majority of EnerGuide rating savings came from space heating load decrease, the Evaluator

decided to calculate the savings per EnerGuide point only from the space heating reduction observed in the simulations for before and after the retrofit. This approach was more precise, since it removed possible mistakes entered for the base load and domestic water heating energy consumption in the HOT2000 simulations.

To avoid giving more weight to any of the participants, the Evaluator calculated the average savings per EnerGuide point of each participant before adding up all the values. In the end, the Evaluator established the overall average of all the sampled participants' unitary savings value per EnerGuide point, as shown in the following table.

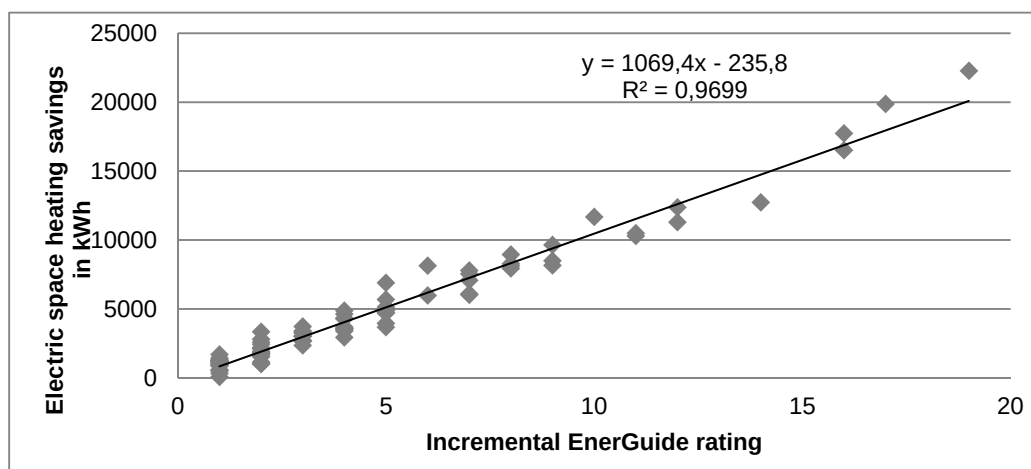
Table 2: Calculation of Average Savings per EnerGuide Point Based on HOT2000 Data

Description	Values and Units
Range of EnerGuide point increase per participant	From 1 to 19
Range of space-heating savings per participant	From 73 to 22,279 kWh/year
Range of space-heating savings per EnerGuide point per participant	From 73 to 1,695 kWh/year
Overall average savings per EnerGuide point for all sampled participants	1,001 kWh/year

As shown in the table above, the Evaluator estimated the overall value of savings per EnerGuide point at 1,001 kWh/year, using the data from all the sampled participants.

To improve accuracy of the previous analysis, the Evaluator conducted a linear regression analysis based on the data about space-heating savings between the D and E assessments of all the sampled participants as a function of the respective incremental EnerGuide rating of each participant. The following figure highlights the results from this regression analysis and the linear equation for estimating the simulated space-heating savings of a residential building in relation to its EnerGuide rating improvement.

Figure 1: Linear Regression Analysis between the Incremental EnerGuide Rating and Space-heating Savings



This linear regression was established using 88 points (one point per participant). The coefficient of determination R^2 (0.97) shows that this regression is statistically acceptable (over 0.75) and is therefore likely to be representative of the population. The estimated coefficient (1,069) is relevant and there is a significant relationship between the energy consumption (y) and EnerGuide rating increase of the corresponding house (x). Since the R^2 statistical parameter confirms that the linear regression coefficient is acceptable and that the number of participants considered is high enough, the Evaluator decided to use the linear regression value of 1,069 kWh per EnerGuide point.

Calibration

As part of the 2012 evaluation of Home Energy Assessment (HEA) and LIH, a billing analysis was performed with 416 participants¹ to evaluate the accuracy of the modeled heating consumption obtained from the HOT2000 simulations. The regression model used for the billing analysis follows the Princeton Scorekeeping Method (PRISM). The average deviation observed between the modeled energy consumption from HOT2000 simulations and the participants' actual consumption (electrical billing data) was an overestimation of 18 percent. This value was already used by ENSC to calculate the building envelope savings in the tracking sheet.

For the 2014 evaluation, the Evaluator's use of the 18-percent overestimation established in the 2012 evaluation report is still valid, given that the analysis was recently done with a large sample. A new billing calibration should be conducted only if a new version of the HOT2000 software is released.

Therefore, the calibration adjustment of 18 percent has resulted in a final EnerGuide point savings value of **877 kWh**.

2.1.2 Building Envelope Measures Using Modelled Energy Consumptions

For the 394 participants with modeled energy consumption data available, building envelope measures' savings were calculated using the new method implemented in 2013. Instead of calculating the savings based on the EnerGuide ratings and a unitary savings value per EnerGuide point increase, this method is directly based on the D and E modeled heating energy consumption data resulting from the HOT2000 simulations and the percentage of electrical heating estimated during the D assessment. When fuel-switching occurs, the energy savings are credited to the "former" fuel (D assessment).

The overestimation of 18 percent obtained from the billing analysis conducted in 2012 is still used in this method.

¹ 94 from LIHS and 322 from HEA.

In short, ENSC calculated the building envelope measures' savings in the tracking sheet using the following equation:

$$\frac{\text{Building Envelope Measure Gross Savings (kWh)} = \frac{\% \text{Electric Heating}_{D \text{ Audit}} \times [SHEC (MJ)_{D \text{ Audit}} - SHEC (MJ)_{E \text{ Audit}}] \times (1 - 18\%)}{3.6 \text{ MJ/kWh}}$$

Where:

SHEC corresponds to the total space-heating energy consumption, all fuel types combined.

As mentioned previously, the 18-percent overestimation established in the 2012 evaluation report is still valid for use by the Evaluator for 2014.

2.1.3 Prescriptive Measures' Savings

In addition to the savings calculated for building envelope measures, ENSC calculated the unitary savings values for a set of prescriptive measures not taken into account by HOT2000 simulations.

Refrigerator Replacements

Tracked Savings

ENSC promoted the replacement of old refrigerators with more efficient models through LIH. For this appliance replacement measure, ENSC uses a unitary savings value of 986 kWh per year. This figure is based on the average consumption of old appliances retired and that of ENERGY STAR® refrigerators from the ARet 2013 Evaluation Report². Since LIH's guidelines for DAs indicate that eligible refrigerators must be those manufactured in 1990 or before, the unitary savings value is based on the 20- to 29-year-old category presented in ARet. Old refrigerators of an average size of 15 ft³ consume on average 1,394 kWh per year. Given that new ENERGY STAR® refrigerators on average consumes 408 kWh per year, replacing an old refrigerator with a new ENERGY STAR® model will result in unitary savings of 986 kWh per year.

Revised Savings

The Evaluator updated the unitary savings by using the average consumption value of old appliances replaced and the average consumption value of ENERGY STAR® refrigerators from the ARet³ 2014 Evaluation Report. Since the LIH guidelines indicate that eligible refrigerators must be those manufactured in 1990 or before, the Evaluator based its calculations on the older than 25-year-old category assessed in the ARet evaluation. Based on the updated parameters from the 2014 ARet evaluation, old refrigerators of an average size of 16 ft³ consume on average 1,369 kWh per year. For this year's evaluation, the same occupant adjustment factor was used (1.12) and no part-use factor

² ARet - Appliance Retirement 2013 - DSM Evaluation report, Econoler.

³ ARet - Appliance Retirement 2014 - DSM Evaluation report, Econoler.

was considered since the Evaluator believes that it was unlikely for the average low-income household to have two refrigerators.

Given that new ENERGY STAR® refrigerators on average consume 408 kWh per year, replacing an old refrigerator with a new ENERGY STAR® model will result in unitary savings of 961 kWh per year.

Freezer Replacements

Tracked Savings

ENSC promotes the replacement of old freezers with more efficient models Through LIH. For this measure, ENSC uses a unitary savings value of 540 kWh per year, based on the 2013 LIH evaluation report. This figure is based on the average consumption of old appliances retired through ARet in 2013 and the average consumption of ENERGY STAR® refrigerators obtained from the Natural Resources Canada (NRCan) EnerGuide Appliance Directory.

Since the LIH guidelines indicate that freezers eligible for a replacement must be those manufactured in 1990 or before, the Evaluator calculated its estimate of the average consumption of the old appliances replaced on the basis of the “20- to 29-year-old” category presented in the ARet; as a result, the average consumption was established at 1,090 kWh per year. As in ARet, an occupant adjustment factor of 1.12 was used and a part-use factor of 0.94 was considered since the Evaluator assumed that it was possible for a low-income household to have two freezers.

To estimate the average consumption of the new freezers installed, data from the NRCan EnerGuide Appliance Directory was used. The average consumption was established at 550 kWh per year, which corresponds to the average energy consumption of a new ENERGY STAR® freezer.

Therefore, this method has resulted in a unitary savings value of 540 kWh per year.

Revised Savings

In 2014, the majority of the new models installed were ENERGY STAR® models (98 %), but non-ENERGY STAR® models were also installed when ENERGY STAR® models of the same size were not available. In fact, Energy Star has recently increased its eligibility criteria, making it more difficult for freezers of small sizes (5-7 ft³) to reach the percentage of consumption reduction in comparison to the standard model. Since ENSC did not want to install freezers larger than what participants had before, they decided to install non-Energy Star freezers of the same size. These units often consume less energy than the Energy Star model of the next size up.

The Evaluator updated not only the unitary savings value used by ENSC to take into account the fact that non-Energy Star models are now installed under LIH, but also the updated metered consumption of old appliances assessed in the ARet 2014 Evaluation Report.

As with the 2013 evaluation, the Evaluator based its calculations of the old replaced freezers on the data regarding the “Greater than 25 Years Old” category included in ARet; as a result, the average

consumption value for an average size of 15 ft³ was established at 1,022 kWh per year and that for a small size of 5 ft³ was established at 341 kWh per year. The occupant adjustment factor of 1.12 established in the ARet evaluation was used and a part-use factor of 0.90 was also considered.

To evaluate the average consumption of new freezers installed, the Evaluator used two different sources: ARet 2014 for establishing the average consumption of the new ENERGY STAR[®] freezers (518 kWh/year) and the manufacturers' data for the average consumption of the non-ENERGY STAR[®] units installed (222 kWh/year). Then, the proportion of each type of freezers installed (Energy Star and non-Energy Star) was used to establish the average energy savings value of the new freezers installed under LIH.

Table 3: Weighted Unitary Savings Value of the New Freezers Installed

Type	Proportion in the Tracking Sheet	Average Savings
Energy Star Units	98 %	504 kWh/year
Non-energy Star Units	2 %	119 kWh/year
All Units	100 %	496 kWh/year

This resulted in a weighted unitary savings value for freezer replacement of 496 kWh per year.

Dehumidifiers

Tracked Savings

ENSC promotes the replacement of old dehumidifiers with more efficient models through LIH. In some instances, ENSC also installed dehumidifiers in households where no dehumidifier was in place before the project.

With regard to the replacement of existing dehumidifiers, ENSC used a unitary savings value of 633 kWh per year for each installed product based on the 2013 LIH evaluation report. This value was updated in 2013 since the Energy Factor under Test Conditions had been modified by the ENERGY STAR[®] program requirement⁴ for dehumidifiers. The Evaluator considers the unitary savings value still valid in 2014.

2.1.4 Peak Demand Savings

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.233 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by LIH in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

⁴ ENERGY STAR[®] Program Requirements for Dehumidifiers Eligibility Criteria V3.0, Partner Commitments, July 2012, available at: http://www.energystar.gov/ia/partners/product_specs/program_reqs/Dehumidifiers_Program_Requirements.pdf, (Last accessed January 27, 2015).

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

2.1.5 Validated Gross Savings

The annual gross savings for the building envelope measures and the prescriptive measures implemented in 2014 were validated by the Evaluator and are presented in the following table. Overall, the validated gross energy and peak demand savings amounted to 2.101 GWh and 0.490 MW respectively at the meter.

The gross savings at the generator have also been estimated using a line loss factor of 1.100 between the meter and the generator, as shown in the following table. This line loss factor value was provided by Nova Scotia Power for residential customers. As a result, the validated energy savings and peak demand savings have been established at 2.311 GWh and 0.539 MW, respectively.

Table 4: Validated Gross Energy and Peak Demand Savings

	Building Envelope Measures		Prescriptive Measures			
Product Category	Modelled Heating Consumption	Savings per EnerGuide Point Increase*	Refrigerator Replacement	Freezer Replacement	Dehumidifier Replacement	Total
Energy Savings						
Total Number of Units	-	448	135	323	245	1,158
Unitary Savings (kWh)	-	877	961	496	633	-
Total Gross Energy Savings – at the Meter (GWh)	1.263	0.393	0.130	0.160	0.155	2.101
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	-
Total Gross Energy Savings – at the Generator (GWh)	1.390	0.432	0.143	0.176	0.171	2.311
Peak Demand Savings						
Demand-to-Energy Ratio (MW/GWh)	0.233	0.233	0.233	0.233	0.233	-
Total Gross Peak Demand Savings – at the Meter (MW)	0.2943	0.0916	0.030	0.037	0.036	0.490
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	-
Total Gross Peak Demand Savings – at the Generator (MW)	0.324	0.101	0.033	0.041	0.040	0.539
*In the “Savings per EnerGuide Point” column, the number of units is in fact the sum of the differences in EnerGuide rating between the E assessment and the D assessment of participants for whom the Evaluator calculated savings per EnerGuide point.						

2.2 Interactive Effects

In a residence, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as space-heating and cooling equipment.

For LIH in 2014, it was assumed that no prescriptive measures caused significant interactive effects. Therefore, the interactive effects have been assumed to be negligible.

2.3 Net-to-Gross Ratio

LIH offers no-cost energy assessments and implementation of energy efficiency measures for low-income homeowners. Due to the specific characteristics of the measures proposed and the target customers, the distortion effects of the program are assumed to be insignificant. Consequently, the NTGR is considered to be 1 for LIH.

2.4 Net Savings

Net savings were estimated by applying the interactive effects and the NTGR to the gross energy savings, using the equation below.

$$\text{Net savings} = \text{Gross Evaluation Savings} \times (1 + \text{Interactive Effects Factor}) \times \text{NTGR}$$

As with previous years, the NTGR for LIH is assumed to be 1. Moreover, no Interactive effects factor was considered because measures that impacted the heating and cooling consumption (CFL, tank wrap and pipe insulation) were already transferred to RDI. So the equation below was used:

$$\text{Net savings} = \text{Gross Evaluation Savings}$$

Overall, the total net energy and peak demand savings for LIH amounted to 2.101 GWh and 0.490 MW respectively at the meter, and 2.311 GWh and 0.539 MW respectively at the generator. The detailed results are presented in the following table.

Table 5: Validated Net Energy and Peak Demand Savings

	Building Envelope Measures		Prescriptive Measures			
Product Category	Modelled Heating Consumption	Savings per EnerGuide Point Increase	Refrigerator Replacement	Freezer Replacement	Dehumidifier Replacement	Total
Energy Savings						
Total Gross Energy Savings – at the Meter (GWh)	1.263	0.393	0.130	0.160	0.155	2.101
Interactive Effects Factor	0%	0%	0%	0%	0%	-
NTGR	1.00	1.00	1.00	1.00	1.00	-
Total Net Energy Savings – at the Meter (GWh)	1.263	0.393	0.130	0.160	0.155	2.101
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	-
Total Net Energy Savings – at the Generator (GWh)	1.390	0.432	0.143	0.176	0.171	2.311
Peak Demand Savings						
Total Gross Peak Demand Savings – at the Meter (MW)	0.294	0.092	0.030	0.037	0.036	0.490
Interactive Effects Factor	0%	0%	0%	0%	0%	-
NTGR	1.00	1.00	1.00	1.00	1.00	-
Total Net Peak Demand Savings – at the Meter (MW)	0.294	0.092	0.030	0.037	0.036	0.490
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	-
Total Net Peak Demand Savings – at the Generator (MW)	0.324	0.101	0.033	0.041	0.040	0.539

The table below summarizes the validated energy and peak demand savings calculated in the 2014 tracking sheet.

Table 6: Validated Savings at the Generator

	Initial Gross Savings	NTGR	Net Savings
Energy Savings	2.311 GWh	1.00	2.311 GWh
Peak Demand Savings	0.539 MW	1.00	0.539 MW



ECONOLER



NEW HOME CONSTRUCTION

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

CATI	Computer-Assisted Telephone Interviewing
CRA	Corporate Research Associates
DSM	Demand-side Management
ENSC	Efficiency Nova Scotia Corporation
HEA	Home Energy Assessment
LIH	Low Income Homeowner
NBC	National Building Code
NTGR	Net-to-Gross Ratio
PRISM	Princeton Scorekeeping Method

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Billing calibration	An activity that consists in adjusting the expected energy savings based on the relative difference between the results of the building energy simulations and the actual energy consumption of the building.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
EnerGuide rating	An EnerGuide rating shows a standard measure of the home's energy performance. It shows exactly how energy-efficient the home is.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Market effects	The impact of the program on the market (such as increased product availability, practices, and prices) that extends beyond changing the program participants' behaviour. This includes spillover among non-participants.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.

Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VII
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	2
2.1 Presentation of the Team	2
2.2 Methodology Description	2
3 VALIDATED TRACKED SAVINGS	4
3.1 Gross Savings	4
3.1.1 Unitary Savings Value per EnerGuide Point Increase	4
3.1.2 Peak Demand Savings	7
3.1.3 Validated Gross Savings	8
3.2 Interactive Effects	8
3.3 Net-to-Gross Ratio	9
3.3.1 Free-ridership	9
3.3.2 Spillover (Market Effects)	9
3.3.3 NTGR Calculation	9
3.4 Net Savings	10
APPENDIX I PARTICIPANT SURVEY QUESTIONNAIRE	11
APPENDIX II PARTICIPANT SURVEY RESULTS	21
APPENDIX III BUILDER SURVEY QUESTIONNAIRE	30
APPENDIX IV BUILDER SURVEY RESULTS	46
APPENDIX V ALGORITHM FOR FREE-RIDERSHIP CALCULATION - PARTICIPANT	51
APPENDIX VI INTERNAL SPILLOVER METHODOLOGY	54

LIST OF TABLES

Table 1: Distortion Effects and Net-to-Gross Ratio	viii
Table 2: Validated Savings at the Generator	viii
Table 3: Participant Survey Sample Size and Margin of Error.....	3
Table 4: Calculation of Average Savings per EnerGuide Point from HOT2000 Data	6
Table 5: Validated Gross Energy and Demand Savings.....	8
Table 6: Validated Net Energy and Peak Demand Savings	10

LIST OF FIGURES

Figure 1: Linear Regression Analysis Between the Incremental EnerGuide Rating and Space Heating Savings	6

EXECUTIVE SUMMARY

The 2014 evaluation of New Home Construction, also known as Performance Plus in 2013, involved validating the tracked savings of Efficiency Nova Scotia Corporation (ENSC) as well as re-evaluating specific key parameters, namely the EnerGuide point value, free-ridership and spillover in the form of market effects. This report presents the validated gross and net savings for the year 2014.

Program Component Overview

New Home Construction is meant to encourage homeowners and builders to exceed building code requirements for energy efficiency in new homes, thus increasing the number of energy-efficient dwellings in the province. Incentives (reimbursement of the \$300 enrollment fee) are provided for homes that achieve or exceed ENERGY STAR certification (EnerGuide 85 or higher and Passive House certification also qualify). An additional incentive of \$1,500 is provided to homes that achieve or exceed ENERGY STAR certification and are expected to consume less than 19,000 kWh annually as shown by computer modeling. Projects who had registered under the former Performance Plus had to meet the former eligibility criteria.

Key Findings

Econoler reviewed the content of the 2014 tracking sheet. A total of 846 participants took part in New Home Construction in 2014 (including 709 participants registered under Performance Plus).

To calculate the gross savings of New Home Construction in 2014, the Evaluator reviewed the savings value per EnerGuide point increase using the heating consumption data from the 2014 evaluation of Home Energy Assessment (HEA). The savings value per EnerGuide point was estimated at 891 kWh in 2014, compared to 882 kWh in 2013. In the 2013 evaluation, the Evaluator took into account the studies conducted to validate the average baseline EnerGuide rating (78). Econoler considers this value to be acceptable for 2014.

In its net savings calculations, the Evaluator took into consideration the free-ridership level measured through the participant and builder surveys as well as the market effects obtained through the builder survey. The Econoler team found that the 2014 free-ridership level calculated among builders and homeowners were 32 percent and 38 percent respectively, compared to 27 percent and 45 percent during the 2013 evaluation. This increased free-ridership level among builders affected the overall program free-ridership level, whose calculation is based on the percentage of the weight carried by homeowners and builders in the decision making process. Overall, the 2014 free-ridership level for New Home Construction is established at 33 percent, compared to 32 percent in 2013.

The evaluation revealed market effects of 11 percent, compared to 13 percent and 8 percent assessed in 2012 and 2013 respectively.

These two distortion effects resulted in a net-to-gross ratio (NTGR) of 0.78, which was used to establish the program net savings.

Table 1: Distortion Effects and Net-to-Gross Ratio

Distortion Effects	2014
Free-Ridership Level	33%
Market Effects	11%
Net-to-Gross Ratio	0.78

The evaluation revealed that New Home Construction generated net energy savings of 4.572 GWh and peak demand savings of 1.175 MW in 2014, as shown in the table below.

Table 2: Validated Savings at the Generator

	Gross Savings	NTGR	Net Savings
Energy Savings	5.861 GWh	0.78	4.572 GWh
Peak Demand Savings	1.506 MW	0.78	1.175 MW

1 PROGRAM DESCRIPTION

Efficiency Nova Scotia Corporation's (ENSC) program component for new houses is called New Home Construction. New Home Construction is meant to encourage homeowners and builders to exceed building code requirements for energy efficiency in new homes, thus increasing the number of energy-efficient dwellings in the province.

New Home Construction is funded through demand-side management (DSM) and the Province of Nova Scotia. The funds received from electricity ratepayers go towards measures that reduce electricity consumption, whereas funds from the Province of Nova Scotia are directed to non-electrically heated homes.

Once a house is registered, an energy analysis tool developed by the federal government (HOT2000¹) is used to model the energy efficiency of the home based on the building code and house plans before it gets built in order to calculate and assign a preliminary EnerGuide rating. The simulation results are then provided to the builder or the homeowner in a report that includes energy efficiency recommendations to ensure the home reaches ENERGY STAR certification (at a minimum) and that the home consumes less than 19,000 kWh annually. A final inspection and a blower door test are completed once the home is built to verify the home's efficiency level.

The following incentives are offered under New Home Construction:

- › A refund of the assessment costs (\$300) is provided for homes that achieve or exceed ENERGY STAR certification (EnerGuide 85 or higher and Passive House certification also qualify).
- › An additional incentive of \$1,500 is given to homes that achieve or exceed ENERGY STAR certification and that are expected to consume less than 19,000 kWh as shown by computer modelling using HOT2000.

Before New Home Construction, ENSC administered the Performance Plus program component for new homes. The rationale behind Performance Plus was essentially the same as for New Home Construction, with one difference being that incentives under Performance Plus were based on the final EnerGuide rating reached by the home. Due to a reduction in funding from the Province of Nova Scotia, Performance Plus ended on January 1, 2014, although it will continue offering incentives for houses that registered before January 1, 2014.

New Home Construction aimed to achieve net electricity savings of 5.9 GWh and peak demand savings of 1.5 MW for 2014. Electrical energy savings generated by New Home Construction are accounted for under the New Residential program.

¹ This software was developed by the Housing, Buildings, Communities and Simulation (HBCS) group of CanmetENERGY, a division of NRCan. For additional information : <http://198.103.48.154/eng/software_tools/hot2000.html>, (Last accessed January 15, 2015).

2 METHODOLOGY

This section presents the Econoler team and the methodology used to evaluate New Home Construction.

2.1 Presentation of the Team

To carry out the 2014 evaluation, Econoler collaborated with Corporate Research Associates (CRA). Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all the deliverables.
- › CRA performed the telephone surveys with participants and builders.

2.2 Methodology Description

In 2014, the evaluation of New Home Construction involved validating ENSC's tracked savings, which were established using the 2013 evaluation results, and re-evaluating the following specific key parameters: (1) EnerGuide point value, (2) free-ridership, and (3) spillover in the form of market effects. The resulting total gross and net energy and peak demand savings were then compiled.

To update the EnerGuide point value, Econoler used the heating consumption data from the 2014 evaluation of Home Energy Assessment (HEA). To revise the free-ridership and spillover levels, two telephone surveys were conducted: one participant survey and one builder survey. Both surveys were conducted by CRA staff in Halifax. The interviews were conducted in October and November 2014 using computer-assisted telephone interviewing (CATI) technology.

Participant Survey

The participant survey was conducted with a total of 48 homeowner participants. The average length of the survey was 12 minutes.

The main purpose of the participant survey was to revise the free-ridership level. Even though a process evaluation was not required for New Home Construction in 2014, the Evaluator made sure to optimize the survey planned for this evaluation and include questions on the level of satisfaction with Performance Plus or New Home Construction—depending on which program component they took part in—and ENSC.

The survey questionnaire and results are presented in Appendices I and II respectively. The table below shows the population and sample sizes as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 participant surveys.

Table 3: Participant Survey Sample Size and Margin of Error

Survey	Population	Sample Size (n)	Margin of Error at 90% Confidence Level
2014 Participants	846 ²	48	±11.5%
2013 Participants	1,176	70	±9.5%
2012 Participants	1,024	70	±9.5%

Builder Survey

The builder survey was conducted with a total of 28 builders across Nova Scotia. The average length of the builder survey was 9.5 minutes. Of the 28 builders, 26 were participating builders and two were non-participating builders. Builders were asked different series of questions depending on whether they were participants or non-participants.

The purpose of the builder survey was to revise free-ridership (among participant builders), and internal spillover in the form of market effects (among non-participant builders). The survey questionnaire also included questions regarding the builders' satisfaction with Performance Plus or New Home Construction—depending on which program component they took part in—and ENSC.

The survey questionnaire and results are presented in Appendices III and IV respectively. Considering a total of 26 participant builders, the corresponding margin of error at a 90 percent confidence level is ±14.0 percent.³

The margin of error is used to determine the level of precision⁴ of the measurement, and its associated confidence level indicates the probability that a measure will fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or bias, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

² The population for the 2014 participant survey was 121 participants at the time of the survey. The final 2014 participant population only refers to participants who generated electric savings.

³ The population for the 2014 participant builder survey was 101.

⁴ Precision refers to how close the measured values are to each other. It does not, however, take into consideration how close the measured value is to the true value, which refers to accuracy.

3 VALIDATED TRACKED SAVINGS

This section presents the gross and net savings for New Home Construction in 2014.

3.1 Gross Savings

The final tracking sheet provided by ENSC for 2014 contained a total of 846 participants. To establish the gross energy savings associated with each of these participants, the Evaluator used an average savings per EnerGuide point increase based on HEA participant data. For the gross peak demand savings calculation, the demand-to-energy ratio was used.

The methodology for evaluating these elements is described in the following sections.

3.1.1 Unitary Savings Value per EnerGuide Point Increase

The next sections present the three key features used to calculate gross energy savings under New Home Construction, namely the EnerGuide baseline, the savings per EnerGuide point calculated with HEA participants and the 2012 billing calibration results.

New House EnerGuide Baseline

The average baseline EnerGuide rating was adjusted to 78 from 80 in the 2011 evaluation. A literature review was conducted in 2013 since the residential new house market in Canada has significantly evolved in recent years, and Nova Scotia is no exception. In Nova Scotia, the National Building Code (NBC) Revision of 2012 (Part 9) was adopted in July 2013 and came into effect on December 31, 2013.⁵ The requirements of the NBC Revision of 2012 in effect in Nova Scotia correspond to an average EnerGuide Rating of 78 when modelled in HOT2000 version 10. The Evaluator therefore considered that an EnerGuide baseline of 78 was still relevant in 2013. The Evaluator still considers this value to be appropriate in the current market.

Savings per EnerGuide Point

In 2014, ENSC calculated energy savings linked to building envelope measures using an incremental savings coefficient per increase of EnerGuide point (also referred to as “savings per EnerGuide point”).

In the 2014 tracking sheet, each EnerGuide point over the baseline rating of 78 accounted for 882 kWh of annual savings for gross impact calculations. The 882 kWh savings figure comes from the 2013 evaluation report, which was based on the average savings per EnerGuide point for 2013 HEA (1,075 kWh) and an overestimation of 18 percent. The savings per EnerGuide point are applied only

⁵ Nova Scotia, Building Code Legislation, “*Nova Scotia Building Code Regulations – Users Version, 2014*”, p88-89, available at <<http://novascotia.ca/lae/buildingcode/legislation.asp>>, (Last accessed January 15, 2015).

when the main heat source of the house is electricity, regardless of the electricity's share in delivering heating throughout the year. In return, ENSC did not claim electrical energy savings when the main heat source was not electricity (oil, natural gas, etc.), even though the backup heating system was electric.

In short, the savings calculation per EnerGuide point is based on the equation below:

$$\text{Gross Electric Savings (kWh)} = [ER_{\text{N Assessment}} - ER_{\text{Baseline}}] \times 882(\text{kWh})$$

Where

- › *ER corresponds to the EnerGuide Rating for participating households heated by electrical source only.*

The savings per EnerGuide point value was updated for this evaluation with HEA participants for the year 2014. The following sections describe the methodology followed by the Evaluator to define this new value.

Data Processing

The Evaluator used the pre-retrofit (D) and post-retrofit (E) EnerGuide ratings as well as the modelled consumption provided for the 2014 HEA participants.

The requested information was provided for a total of 450 HEA participants, which included participants who only used electric space heating and participants for whom both pre-retrofit and post-retrofit EnerGuide ratings were available and consistent. Projects with an EnerGuide rating that decreased or remained unchanged after project implementation were removed from the analysis. Participants with an increased EnerGuide rating higher than 50 were also withdrawn.

After processing the data, the Evaluator compared these participants and the participant population to ensure that the analysis of savings per EnerGuide point is conducted on a representative sample.

EnerGuide Rating

The 450 participants selected by the Evaluator were used to analyze the average space heating energy savings per EnerGuide point through the comparison of pre-retrofit (D) and post-retrofit (E) simulation results. Since the majority of EnerGuide rating savings came from space heating load decrease, the Evaluator decided to calculate the savings per EnerGuide point only from the space heating reduction observed between D and E simulations. This approach was more precise, since it removed possible mistakes entered into the HOT2000 simulations related to the base load and the domestic water heating energy consumption.

To avoid giving more weight to any of the participants, the Evaluator calculated the average savings per EnerGuide point of each participant before summing all values. At the end, the Evaluator computed the overall average of each participant's unitary savings value per EnerGuide point, as shown in the next table.

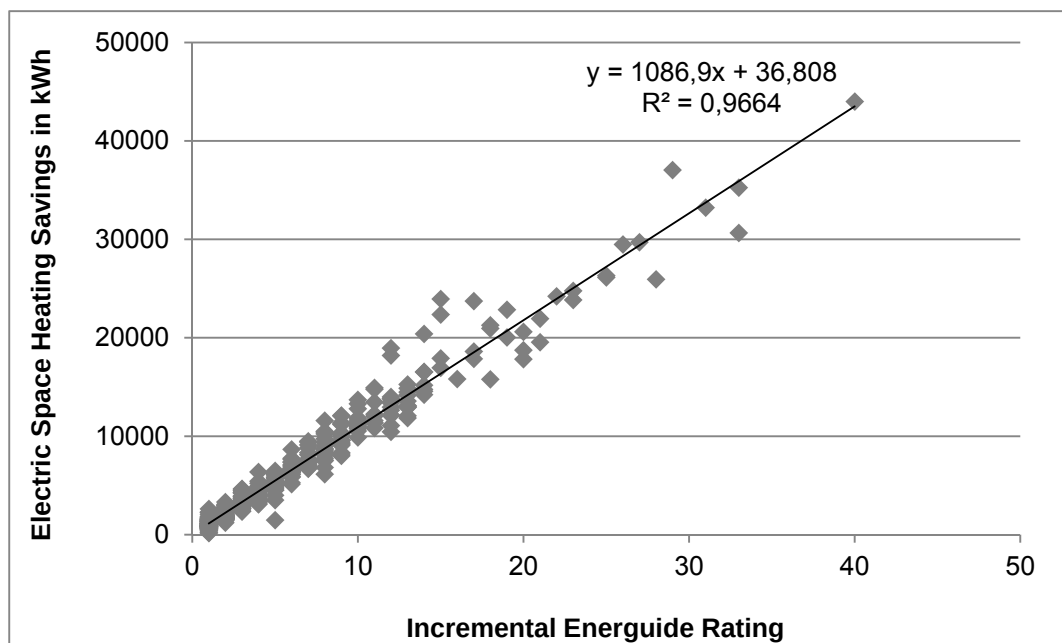
Table 4: Calculation of Average Savings per EnerGuide Point from HOT2000 Data

Description	Values and Units
Range of EnerGuide Point per Participant	From 1 to 40
Range of Space Heating Savings per Participant	From 151 to 44,002 kWh/year
Range of Space Heating Savings per EnerGuide Point, per Participant	From 151 to 2,607 kWh/year
Overall Average Savings per EnerGuide Point	1,085 kWh/year

As per the above table, the Evaluator estimates the overall value of savings per EnerGuide point at 1,085 kWh/year, using data from all sample participants.

For the sake of improving the precision of the previous analysis, the Econoler team conducted a linear regression analysis based on the space heating savings between the D and E assessments of all sample participants as a function of the respective incremental EnerGuide rating of each participant. The next figure features the results of this regression analysis along with the calculated linear equation used to estimate the simulated space heating savings of a residential building in relation to its EnerGuide rating improvement.

Figure 1: Linear Regression Analysis Between the Incremental EnerGuide Rating and Space Heating Savings



This linear regression was established using 450 points (one point per participant). The coefficient of determination R^2 (0.966) showed that this regression is statistically acceptable (over 0.75) and thereby likely representative of the population. The estimated coefficient (1,087) is relevant—there is a significant relationship between the energy consumption (y) and the EnerGuide rating increase of the corresponding house (x). Since the statistical parameter R^2 confirms that the linear regression coefficient is acceptable and that the number of participants considered is high, the Evaluator decided to use the linear regression value of 1,087 kWh per EnerGuide point. This is slightly higher than last year's result of 1,075 kWh/year.

Calibration

For the 2012 evaluation of the EnerGuide programs (HEA, Low Income Homeowner [LIH] and Performance Plus), a billing analysis was performed over 416 participants⁶ to evaluate the accuracy of the modelled heating consumptions obtained from the HOT2000 simulations. The regression model used for the billing analysis follows the Princeton Scorekeeping Method (PRISM). The average deviation observed between the modelled energy consumptions from HOT2000 simulations and the real participants' consumptions (electrical billing data) resulted in an 18 percent overestimation. This value is already used by ENSC to calculate building envelope savings in the tracking sheet.

For the 2014 evaluation, the Evaluator finds that the use of the 18 percent overestimation established in the 2012 evaluation report is still valid, as the analysis was carried out recently and with a large sample. A new billing calibration would be necessary if a new version of the HOT2000 software was released. Indeed, the Evaluator agrees with the following statement, taken from the 2012 Savings Verification Review:

*"The results of this empirical analysis of savings per EnerGuide point should be good for at least three years. However, looking forward, this type of empirical analysis should be repeated once the new software replacement for Hot2000 is adopted and in place for Efficiency Nova Scotia programs."*⁷

For 2014, the 18 percent calibration adjustment therefore results in a final EnerGuide point savings value of **891 kWh**, which is slightly higher than the 882 kWh value tracked by ENSC (based on the 2013 evaluation report).

3.1.2 Peak Demand Savings

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.257 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by New Home Construction in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

⁶ 94 from LIH and 322 from HEA.

⁷ Quote H. Gil Peach & Associates/Scan America, "Verification Review of Program Year 2012 Evaluation", July 31, 2013, page 6.

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

3.1.3 Validated Gross Savings

The annual gross savings tracked for the building envelope measures in 2014 were validated by the Evaluator and are presented in Table 5. Overall, the gross energy and peak demand savings amount to 5.328 GWh and 1.369 MW at the meter.

The gross savings at generator level are also calculated, using a line loss factor of 1.100 between the meter and the generator. This line loss factor value was provided by Nova Scotia Power for residential customers. As a result, the validated gross energy and peak demand savings at the generator are 5.861 GWh and 1.506 MW respectively.

Table 5: Validated Gross Energy and Demand Savings

Parameter	Value
Energy Savings	
Number of Units*	5,980
Unitary Savings (kWh)	891
Total Gross Energy Savings – at meter (GWh)	5.328
Line Loss Factor	1.100
Total Gross Energy Savings – at generator (GWh)	5.861
Peak Demand Savings	
Demand-to-Energy Ratio (MW/GWh)	0.257
Total Gross Peak Demand Savings – at meter (MW)	1.369
Line Loss Factor	1.100
Total Gross Peak Demand Savings – at generator (MW)	1.506
* The number of units is in fact the number of participants for whom an energy assessment was conducted and for whom the Evaluator calculated savings per EnerGuide point. The unitary savings value shown in this column is the savings per EnerGuide point figure calculated through HEA participants.	

3.2 Interactive Effects

No additional interactive effects are considered in the net savings calculation since they are already taken into account in the HOT2000 simulations.

3.3 Net-to-Gross Ratio

The net-to-gross ratio (NTGR) evaluation is based on a self-report approach which relies on a series of questions designed to measure the influence of New Home Construction on the decision of participants and builders to implement eligible energy efficiency measures.

This section presents the methodology used to transform responses to survey questions into an NTGR. It includes the assessment of two distortion effects: free-ridership and spillover in the form of market effects.

3.3.1 Free-ridership

In the case of New Home Construction, free-ridership can occur when participants or builders would have still implemented the energy efficiency measures in the absence of the program. The free-ridership level was measured through the survey conducted with participant homeowners and the survey conducted with participating builders. The algorithm behind the free-ridership calculation is presented in Appendix V. This algorithm was developed during the 2011 evaluation of the program.

The 2014 survey results revealed free-ridership levels of 38 percent among homeowners and 32 percent among participant builders. Using the percentage of the weight carried by homeowners (21%) and the builders (79%) to participate in New Home Construction, the overall free-ridership level was established at 33 percent in 2014. By comparison, the free-ridership level was 32 percent in 2013, 37 percent in 2012 and 32 percent in 2011.

3.3.2 Spillover (Market Effects)

The builder survey was used to assess spillover in the form of market effects, which can occur when a builder decides to implement energy efficiency measures in new construction projects without participating in the program.

The methodology used to calculate the market effects is presented in Appendix VI.

The 2014 survey results revealed market effects of 11 percent. The past evaluations revealed market effects of 8 percent in 2013, 13 percent in 2012 and 5 percent in 2011.

3.3.3 NTGR Calculation

The NTGR has been calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership} + \% \text{ spillover (market effects)})$$

The NTGR value for New Home Construction is estimated at 0.78.

3.4 Net Savings

The net savings were estimated using the NTGR presented above. The equation below was used to calculate the net savings.

$$\text{Net savings} = \text{Gross Evaluation Savings} \times \text{NTGR}$$

This equation was used for calculating both peak demand savings and energy savings.

The 2014 validated net energy savings for New Home Construction are estimated at 4.156 GWh at the meter and at 4.572 GWh at the generator while the net peak demand savings are estimated at 1.068 MW at the meter and at 1.175 MW at the generator. The detailed results are presented in the following table.

Table 6: Validated Net Energy and Peak Demand Savings

Parameter	Value
Energy Savings	
Total Gross Energy Savings – at meter (GWh)	5.328
NTGR	0.78
Total Net Energy Savings – at meter (GWh)	4.156
Line Loss Factor	1.100
Total Net Energy Savings – at generator (GWh)	4.572
Peak Demand Savings	
Total Gross Peak Demand Savings – at meter (MW)	1.369
NTGR	0.78
Total Net Peak Demand Savings – at meter (MW)	1.068
Line Loss Factor	1.100
Total Net Peak Demand Savings – at generator (MW)	1.175

APPENDIX I

PARTICIPANT SURVEY QUESTIONNAIRE

Hello may I please speak with [INSERT NAME]?

- 1 Yes [GO TO INTRODUCTION]
- 2 No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

Hello, my name is _____ and I am with CRA (Corporate Research Associates), a Halifax-based survey research company. We are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your household recently participated in Efficiency Nova Scotia Corporation's [Performance Plus/New Home Construction] program for new houses. [For PP: The Performance Plus program provides rebates for achieving certain EnerGuide ratings/For NHC: The New Home Construction program provides a rebate if Energy Star certification is achieved, and a home that consumes less than 19,000 kilowatt hours also receives an incentive.] We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about fifteen minutes. Is this a good time for you?

Verification and Recall (V Series)

- V1. We understand you participated in the [Performance Plus/New Home Construction] program for the house you built or are building at [ADDRESS FROM FILE]. Is that correct?
- 1 Yes [CONTINUE]
 - 2 No [PROMPT: "Are you sure? This program provides rebates for installing energy efficient upgrades in newly constructed houses and residential buildings. The home buyer can receive rebates. " RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO: "Is there someone else who would know about having participated in the [Performance Plus/New Home Construction] program?"]
- 1 Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
 98. Don't know [PROMPT: "This program provides rebates for installing energy efficient measures in newly constructed houses and residential buildings. The home buyer can receive rebates." RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS DON'T KNOW: "Is there someone else who would know about having participated in the [Performance Plus/New Home Construction] program?"]

- 1 Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
- 2 No [THANK & TERMINATE]
- 99. Refused [THANK AND TERMINATE]

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"]

[SCHEDULED, IF NECESSARY, FOR: _____]

V2. Are you in the business of building and/or selling homes?

- 1 Yes [THANK & TERMINATE]
- 2 No [CONTINUE]
- 98. (Don't know) [THANK & TERMINATE]
- 99. (Refused) [THANK & TERMINATE]

V3. Did you personally take part in the decision to participate in the [Performance Plus/New Home Construction] program? [DO NOT READ. ACCEPT ONE]

- 1. (Yes)
- 2. (No/The Builder made the decision)
- 98. (Don't know)
- 99. (Refused)

V4. Did you take part in the decisions regarding the energy efficiency measures to install through the [Performance Plus/New Home Construction] program? [DO NOT READ. ACCEPT ONE]

- 1. (Yes)
- 2. (No/The Builder made the decision)
- 98. (Don't know)
- 99. (Refused)

V5. Which of the following statements would you say best describes when you became involved in the decisions about the energy efficiency of your home? Would you say... [READ STATEMENTS IN ORDER – CODE ONE ONLY]

- 1. You were involved from the initial planning and design stage. This is when your home existed only on paper.
- 2. You were involved after the plans for your home were finalized but had the option to choose energy efficient upgrades.

3. You were involved after the energy efficiency measures were installed but before the Final Review of your completed home, or
4. You were not involved in any of these decisions or bought the home after it was completed.
98. (Don't know)
99. (Refused)

Satisfaction with Program (S Series)

CS1. How did you first learn about this program? **[DO NOT READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]**

1. Media advertising
2. Contacted directly by Efficiency Nova Scotia
3. Through a third party contractor or service provider
4. Efficiency Nova Scotia website
5. Facebook or other social media
6. Word of mouth
97. (Other **[SPECIFY _____]**)
98. (Don't know)
99. (Refused)

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the [Performance Plus/New Home Construction] Program? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

1. Yes
2. No
98. (Don't know)
99. (Refused)

IF YES IN CS2, CONTINUE. OTHERWISE, SKIP TO CS27

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with **[READ AND ROTATE. CODE ONE RESPONSE FOR EACH STATEMENT]**

- b. The responsiveness of employees to your requests and enquiries in a timely manner
- e. The speed with which the application was approved
- g. The value of the program relative to the time and cost involved

___ Response ___ 98 Don't Know ___ 99 Refused

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

___ Response

___98 Don't Know

___99 Refused

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

1. Yes

2. No

98. (Don't know)

99. (Refused)

IF 'YES' IN CS6, CONTINUE, OTHERWISE SKIP TO CS27.

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

1. Completely satisfied

2. Mostly satisfied

3. Mostly dissatisfied

4. Completely dissatisfied

97. (Neither satisfied nor dissatisfied)

98. (Don't know)

99. (Refused)

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's ...: **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**

a. Service attitude

b. Knowledge of programs available

c. Ability to provide advice

1. Completely satisfied

2. Mostly satisfied

3. Mostly dissatisfied

4. Completely dissatisfied

97. (Neither satisfied nor dissatisfied)

98. (Don't know)

99. (Refused)

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others? **[CODE ONE ONLY]**

1. Definitely
2. Probably
3. Probably not
4. Definitely not
97. (Not eligible to any other programs)
98. (Don't know)
99. (Refused)

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs? **[CODE ONE ONLY]**

1. Definitely
2. Probably
3. Probably not
4. Definitely not
98. (Don't know)
99. (Refused)

S10. Thinking of when you or the builder completed and sent the request for payment form to Efficiency Nova Scotia's program partner, how long, in days, was it before you received the rebate? **[RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]**

[ASK FR SECTION IF V3=1 AND/OR V4=1]

Moving along to another topic now....

Free-Ridership (FR Series)

FR1. Did you decide to build or buy a house with a high level of energy efficiency, **before participating** in the [Performance Plus/New Home Construction] program?

1. Yes
2. No
98. (Don't know)
99. (Refused)

[IF FR1=YES]

FR1a. I just want to make sure I understand - **Before** you decided to participate in the [Performance Plus/New Home Construction] program, you had already made the decision to build or buy a house with a high level of energy efficiency?

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the [Performance Plus/New Home Construction] program.

If you had not participated in the [Performance Plus/New Home Construction] program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely **Would Not** Have Taken the Action," and a 10 indicating that you "Definitely **Would Have** Taken the Action." [AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: "AND NEXT, In the absence of the Program, would you have ... DO NOT ACCEPT A RANGE – ASK FR2 SEQUENCE IN ORDER/DO NOT RANDOMIZE]

FR2a. **PERFORMANCE PLUS:** built or bought a house with the exact same level of efficiency, therefore reaching an EnerGuide rating of [EnerGuide rating]? **NEW HOME CONSTRUCTION:** built or bought a house with the exact same level of efficiency, therefore achieving ENERGY STAR certification or higher and consuming less than 19,000 kWh?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2b. **PERFORMANCE PLUS:** built or bought a standard house, designed to code, instead of a house with a high level of energy efficiency that has an EnerGuide rating of [EnerGuide rating]? **NEW HOME CONSTRUCTION:** built or bought a standard house, designed to code, instead of a house that would have achieved ENERGY STAR certification or higher and consuming less than 19,000 kWh?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2c. **PERFORMANCE PLUS:** built or bought a house with the exact same level of efficiency, therefore reaching the same EnerGuide rating of [EnerGuide rating], but at a later date? **NEW HOME CONSTRUCTION:** built or bought a house with the exact same level of efficiency, *but at a later date*?

___ Response ___ 98 Don't Know ___ 99 Refused

IF FR2c > 5, THEN ASK:

FR2d. DO NOT ASK FR2d IF DON'T KNOW OR REFUSED IN Q.FR2c You indicated in your response to a previous question that if the [Performance Plus/New Home Construction]

program had not been available there was [a/an] **[INSERT RESPONSE FROM FR2c]** in 10 likelihood that you would have built or bought a house with the exact same level of efficiency, but at a later date. Approximately how many months later would you have built or bought this house? **[DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

1. _____ months later
2. (Never)
3. (At the same time)
97. (Don't Know)
98. (Refused)

FR2e. **[IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2d ANSWER IN MONTHS, READ]:**
Would it have been ...

1. Less than 6 months?
2. Within 6 months to less than 1 year later?
3. 1 to less than 2 years later?
4. 2 to less than 3 years later?
5. 3 to less than 4 years later?
6. 4 or more years later?
7. (Never)
98. (Don't Know)
99. (Refused)

[ASK FR3_1 IF, IN SAMPLE, TOTAL INCENTIVE>0]

FR3_1. Efficiency Nova Scotia paid you \$[Total incentive] for the energy efficiency level that you achieved in your new house. If you had not received the rebate from Efficiency Nova Scotia, would you have paid for the full cost to reach this energy efficiency level? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely Would Not Have Paid" and a 10 indicating that you "Definitely Would Have Paid." **[PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

____ Response

96. (Did not receive that rebate)
97. (Don't Know)
98. (Refused)

[ASK FR3_2 IF, IN SAMPLE, TOTAL INCENTIVE=EMPTY]

FR3_2. Efficiency Nova Scotia gave you a rebate for the energy efficiency level that you achieved in your new house. If you had not received the rebate from Efficiency Nova Scotia, would you have paid for the full cost of the additional measures required to reach this energy efficiency level? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely Would Not Have Paid” and a 10 indicating that you “Definitely Would Have Paid.” [PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

___ Response

- 97. (Did not receive that rebate)
- 98. (Don’t Know)
- 99. (Refused)

FR4. Next, I’m going to ask you to rate the importance of the [Performance Plus/New Home Construction] program as well as other factors that might have influenced your decision to build or buy a house with a high level of energy efficiency. Using a scale from 0 to 10, where 0 means “Not at all important” and 10 means “Extremely important”, please rate the importance of each of the following in your decision to achieve [PERFORMANCE PLUS: an EnerGuide rating of [EnerGuide rating] for your new house. NEW HOME CONSTRUCTION: an ENERGY STAR certification and a house that consumes less than 19,000 kWh. [PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

Factor (READ AND RANDOMIZE)	Responses		
a. The program incentive	___ Response	___ 98 Don’t Know	___ 99 Refused
b. Expert advice provided by the Energy Advisor	___ Response	___ 98 Don’t Know	___ 99 Refused
c. Feedback received from the review of home plans	___ Response	___ 98 Don’t Know	___ 99 Refused
d. [PERFORMANCE PLUS: The EnerGuide Label and designation itself NEW HOME CONSTRUCTION: The ENERGY STAR certification or EnerGuide Label itself	___ Response	___ 98 Don’t Know	___ 99 Refused
e. Previous experience with the Performance Plus program, or a similar program either from Efficiency Nova Scotia or Nova Scotia Power	___ Response	___ 98 Don’t Know	___ 99 Refused

Demographic Characteristics (D Series)

[ASK ALL HOMEOWNERS]

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

- D1. What type of residence do you live in? [READ RESPONSES 1-5; SELECT ONE RESPONSE]
1. Detached single-family home
 2. Semi-detached house
 3. Mobile home or house trailer
 4. Townhouse or duplex which share adjacent walls
 5. Row house (Single story apartment building)
 96. Other [SPECIFY: _____]
 98. (Don't know)
 99. (Refused)
- D2. How many bedrooms are in your home? [98=DK; Enter zero for a studio apartment with no bedrooms]
- D5. Is your home occupied year round, or is it a seasonal home?
1. Year round residence
 2. Seasonal / vacation home
 96. (Other Specify _____)
 98. (Don't know)
 99. (Refused)
- D6. Including yourself, how many people live in this residence on a full-time basis?
Number of people: _____
- [NOTE: DON'T ALLOW ZERO FOR A RESPONSE]
- D11. What temperature do you normally set your thermostat to when you are at home? [RECORD ANSWER IN CELSIUS. PROBE FOR SPECIFIC ANSWER. 98=DON'T KNOW, 99=REFUSED]

D7. In which age category do you fall? Are you...[READ]

1. 18 to 24
2. 25 to 34
3. 35 to 44
4. 45 to 54
5. 55 to 64
6. 65 or over
99. (Refused)

D8. What is the highest grade of schooling completed by the head of your household? [DO NOT READ]

1. (Less than high school graduation diploma)
2. (High school graduation diploma and/or some post secondary)
3. (Trades certificate or diploma)
4. (College certificate or diploma)
5. (University degree, certificate or diploma)
98. (Don't know)
99. (Refused)

D9. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category. [READ LIST; SELECT ONE RESPONSE]

1. Less than \$15,000
2. \$15,000 - \$24,999
3. \$25,000 - \$34,999
4. \$35,000 - \$49,999
5. \$50,000 - \$69,999
6. \$70,000 - \$79,999
7. \$80,000 or more
98. (Don't know)
99. (Refused)

D10. [DO NOT READ] Gender:

1. Male
2. Female

END: That is all the questions I have for you. Thank you for taking the time to respond to this survey.

APPENDIX II

PARTICIPANT SURVEY RESULTS

The participant survey results are presented in the following tables.

CS1. How did you first learn about this program?

Sources of Awareness*	2012**	2013***	2014
<i>Sample Size</i>	30	67	48
Word of mouth	20%	34%	29%
Through a third-party contractor or service provider	30%	24%	25%
Media advertising	13%	13%	15%
At a home show	7%	3%	13%
Internet in general	13%	4%	4%
Previous experience with ENSC	-	-	4%
ENSC website	17%	18%	2%
Research	-	3%	-
When purchasing the equipment	3%	-	-
Facebook or other social media	3%	-	-
Through Nova Scotia Power	3%	-	-
Others	17%	6%	8%
Don't know/Can't recall	3%	6%	4%
*Multiple responses **Source: 2012 C-Sat Residential Study ***In 2013, this question was only asked of those who took part in the decision, while in 2012 and 2014 it was asked of all respondents.			

V3. Did you personally take part in the decision to participate in the [Performance Plus/New Home Construction] program?

Homeowner Involved in Decision to Participate in Program	2012	2013	2014
<i>Sample Size</i>	70	70	48
Yes	99%	96%	100%
No/The builder was the only one involved	1%	4%	-
Don't know	-	-	-

V4. Did you take part in the decisions regarding the energy efficiency measures to install through the [Performance Plus/New Home Construction] program?

Homeowner Involved in Decision to Implement the Energy Efficiency Measures	2012	2013	2014
<i>Sample Size</i>	70	70	48
Yes	94%	91%	96%
No/The builder made the decision	3%	4%	4%
Don't know	3%	4%	-

V5. Which of the following statements would you say best describes when you became involved in the decisions about the energy efficiency of your home? Would you say...

When Homeowner Became Involved	2012	2013	2014
<i>Sample Size</i>	70	70	48
Initial planning/design stage	77%	86%	83%
After plan finalization, before measure implementation	14%	11%	10%
Not involved/bought home after project completion	6%	3%	4%
After measure implementation, before final review of home	3%	-	2%

FR4. Next, I'm going to ask you to rate the importance of the [Performance Plus/New Home Construction] program as well as other factors that might have influenced your decision to build or buy a house with a high level of energy efficiency. Using a scale from 0 to 10, where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to achieve [PERFORMANCE PLUS: an EnerGuide rating of [EnerGuide rating] for your new house. NEW HOME CONSTRUCTION: an ENERGY STAR certification and a house that consumes less than 19,000 kWh].

Importance of Program in Influencing Homeowner Decision to Build or Buy a House with a High Level of Energy Efficiency	2012		2013		2014	
	Sample Size*	Important	Sample Size*	Important	Sample Size*	Important
Mean (0 = "Not at all important"; 10 = "Extremely important")						
Incentive	69	8.2	69	8.6	48	7.3
The EnerGuide label and designation itself/Energy Star certification	68	7.2	69	7.4	47	7.1
Expert advice provided by the CEA	66	7.1	68	7.5	46	6.6
Feedback received from the review of home plans	68	7.0	68	7.7	45	5.9
Previous experience with Performance Plus/New Home Construction, or a similar program from either Efficiency Nova Scotia or Nova Scotia Power	62	4.1	54	4.5	42	3.7
**Don't know/'Refused' excluded from calculations						

CS2. Did you have direct contact with Efficiency Nova Scotia employees regarding the [Performance Plus/New Home Construction] Program?

Homeowner Contact with ENSC	2012*	2013	2014
Sample Size	30	70	48
Yes	53%	70%	79%
No	43%	27%	19%
Don't know	3%	3%	2%
*Source: 2012 C-Sat Residential Study			

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with...

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

Homeowner Satisfaction with Overall Performance	2012***		2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Mean (1=Not at all satisfied, 10=Completely satisfied)**						
ENSC's overall performance in working with you	16	8.2	49	8.9	38	8.2
Responsiveness of employees to requests and enquiries in a timely manner	15	8.1	49	8.6	38	8.2
Speed with which the application was approved	16	8.6	48	8.3	38	8.1
Value of the program relative to the time and cost involved	16	8.4	49	9.1	38	8.0
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of 'Refused' and 'Don't know' ***Source: 2012 C-Sat Residential Study						

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

Homeowner Contact with ENSC Contact Centre Staff	2012* (#)	2013 (%)	2014 (%)
Sample Size	16	49	38
Yes	14	86%	97%
No	2	14%	3%
Don't know	-	-	-
*Source: 2012 C-Sat Residential Study			

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's ...:

Homeowner Satisfaction with Overall Performance*	2012*** (#)		2013 (%)		2014 (%)	
	Sample Size	Satisfied**	Sample Size	Satisfied**	Sample Size	Satisfied**
Service attitudes	14	13	41	98%	37	95%
Level of service provided	14	13	42	96%	37	95%
Knowledge of programs available`	12	11	41	95%	36	92%
Ability to provide advice	10	9	42	98%	37	89%
*Base: Number of respondents who had contact with ENSC contact centre staff **Number or percentage of respondents who gave a rating of 5 or 4 on a scale where 5 = 'Very satisfied' and 1 = 'Not at all satisfied'; `Don't know' removed from calculations ***Source: 2012 C-Sat Residential Study ****Percentage of respondents who gave a rating of completely or mostly satisfied.						

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others?

Would Recommend ENSC Programs to a Family Member or Friend	2012**	2013	2014
Sample Size*	30	70	48
Definitely	90%	89%	77%
Probably	7%	11%	8%
Probably not	-	-	6%
Definitely not	3%	-	8%
**Don't know/'Refused' have been removed from calculations **Source: 2012 C-Sat Residential Study			

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs?

Would Participate in Other ENSC Programs	2012**	2013	2014
Sample Size*	30	70	47
Definitely	87%	73%	64%
Probably	10%	27%	21%
Probably not	-	-	6%
Definitely not	3%	-	9%
**Don't know/'Refused' have been removed from calculations **Source: 2012 C-Sat Residential Study			

S10. Thinking of when you or the builder completed and sent the request for payment form to Efficiency Nova Scotia's program partner, how long, in days, was it before you received the rebate?

Length of Time to Receive Rebate	2014
<i>Sample Size*</i>	34
10-19 days	9%
20-29 days	9%
30-49 days	26%
50 days or more	56%
Mean*	46.6
**"Don't know/refused" have been removed from calculation	

D1. What type of residence do you live in?

Type of Residence	2012	2013	2014
<i>Sample Size</i>	70	70	48
Detached single-family home	81%	94%	96%
Mobile home or house trailer	9%	3%	4%
Townhouse or duplex	4%	-	-
Semi-detached house	4%	3%	-
Others	-	-	-
Don't know	1%	-	-

D2. How many bedrooms are in your home?

Number of Bedrooms in Home	2012	2013	2014
<i>Sample Size</i>	70	70	48
1	1%	3%	2%
2	17%	16%	15%
3	54%	51%	60%
4	21%	20%	19%
5+	4%	10%	4%
Don't know	1%	-	-

D5. Is your home occupied year round, or is it a seasonal home?

Type of Home	2012	2013	2014
<i>Sample Size</i>	70	70	48
All year	100%	97%	94%
Seasonal/vacation home	-	3%	6%
Don't know/Refused	-	-	-

D6. Including yourself, how many people live in this residence on a full-time basis?

Number of Full-time residents	2012	2013	2014
<i>Sample size</i>	70	70	48
1	11%	6%	10%
2	47%	46%	35%
3	16%	19%	17%
4	20%	24%	21%
5	3%	4%	6%
6+	3%	1%	10%
Don't know/Refused	-	-	-

D7. In which age category do you fall? Are you...

Age	2012	2013	2014
<i>Sample Size</i>	70	70	48
18-24	1%	-	-
25-34	34%	23%	15%
35-44	14%	26%	25%
45-54	19%	29%	23%
55-64	24%	19%	25%
65+	7%	4%	10%
Refused	-	-	2%

D8. What is the highest grade of schooling completed by the head of your household?

Education	2012	2013	2014
<i>Sample Size</i>	70	70	48
Less than high school graduation certificate	4%	1%	6%
High-school grad and/or some post-secondary	11%	16%	13%
Trades certificate or diploma	6%	7%	17%
College certificate or diploma	24%	24%	21%
University certificate or diploma	51%	51%	42%
Others	1%	-	-
Refused	1%	-	2%

D9. Which of the following income categories best describes your total annual household income before taxes in 2013?

Household Income	2012	2013	2014
<i>Sample Size</i>	70	70	48
Less than \$15,000	1%	-	-
\$15,000-\$24,999	-	-	-
\$25,000-\$34,999	4%	4%	4%
\$35,000-\$49,999	9%	1%	2%
\$50,000-\$69,999	13%	7%	19%
\$70,000-\$79,999	6%	13%	10%
\$80,000 or more	53%	64%	56%
Refused	13%	10%	6%
Don't know	1%	-	2%

D10. Gender:

Gender	2012	2013	2014
<i>Sample Size</i>	70	70	48
Male	76%	59%	71%
Female	24%	41%	29%

D11. What temperature do you normally set your thermostat to when you are at home?

Thermostat Temperature	2014
<i>Sample Size</i>	48
20 or lower	44%
21-22	42%
23+	15%
Mean	20.5

APPENDIX III BUILDER SURVEY QUESTIONNAIRE

INSTRUCTION

PARTICIPANT BUILDERS= SAMPLE TAB "PARTICIPANT"

NON PARTICIPANT BUILDERS= [SAMPLE TAB "NON PARTICIPANT" OR VR3=0 OR [VR2≠0] AND [VR4 = 2 (NO)]

Hello may I please speak with [INSERT NAME]?

- 1 Yes [GO TO INTRODUCTION]
- 2 No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION – PARTICIPANT BUILDERS (FROM SAMPLE)

Hello, my name is _____ and I am with CRA (Corporate Research Associates), and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your company has recently participated in Efficiency Nova Scotia Corporation's Performance Plus and/or New Home Construction program for new houses. The Performance Plus program provided rebates to the homeowner or builder for achieving certain EnerGuide ratings. The New Home Construction program provides a rebate if Energy Star certification is achieved, and those homes that consume less than 19,000 kilowatt hours receive an additional incentive. We would appreciate your collaboration in answering questions related to your participation in this program and the residential new construction market in general. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about fifteen minutes. Is this a good time for you? [GO TO VRP1]

INTRODUCTION – NON PARTICIPANT BUILDERS (FROM SAMPLE)

Hello, my name is _____ and I am with CRA (Corporate Research Associates), a Halifax-based survey research company. We are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. We would appreciate your collaboration in answering questions about the residential new construction market in Nova Scotia and Efficiency Nova Scotia's residential programs for new houses. These programs incent builders to go above and beyond the building code to build more efficient homes. Specifically, the Performance Plus program provided rebates to the homeowner or builder for achieving certain EnerGuide ratings. The New Home Construction program provides a rebate if Energy Star certification is achieved, and those homes that consume less than 19,000 kilowatt hours receive an additional incentive. The information you provide will be used to help

Efficiency Nova Scotia Corporation evaluate and improve their program. The survey will take about fifteen minutes. Would you be the right person to answer this survey?

1. Yes [GO TO VR1]
2. No [PROMPT: "Are you sure? This program provides rebates for installing energy efficient upgrades in newly constructed houses. Plans for the house are reviewed and recommendations are given for upgrades to install in the new homes. The home buyer can receive rebates to cover some of the cost of energy efficiency measures. " RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO: "Is there someone else who would know about the Performance Plus and/or New Home Construction program?"]
 1. Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
 98. Don't know [PROMPT: "This program provides rebates for installing energy efficient measures in newly constructed houses. Plans for the house are reviewed and recommendations are given for upgrades to install in the new homes. The home buyer can receive rebates to cover some of the cost of energy efficiency upgrades after they are installed." RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS DON'T KNOW: "Is there someone else who would know about the Performance Plus and/or New Home Construction program?"]
 1. Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
 2. No [THANK & TERMINATE]
 99. Refused [THANK AND TERMINATE]

[ASK NON PARTICIPANT BUILDERS] (FROM SAMPLE)

Verification and Recall (VR Series)

- VR1. Are you in the business of building and/or selling homes?
1. Yes [CONTINUE]
 2. No [THANK & TERMINATE]
 98. (Don't know) [THANK & TERMINATE]
 99. (Refused) [THANK & TERMINATE]

VR2. Approximately how many new houses, including single units, semi-detached units and row houses, has your firm built so far in 2014 in Nova Scotia? If you built semi-detached units in 2014 in Nova Scotia, please count as two units.

[PROBE FOR A SPECIFIC ANSWER.DO NOT ACCEPT A RANGE] [IF NUMBER IS 0 OR DK OR REFUSED THANK AND TERMINATE]

1. [ENTER NUMBER]

98. (Don't know)

99. (Refused)

VR3a. Among the new houses that you have built so far in 2014 in Nova Scotia, how many have been built under the Performance Plus program? To be eligible for the Performance Plus program, you would have had to register the new houses before January 1, 2014. I just want to remind you that the Performance Plus program provided rebates to the homeowner or builder for achieving certain EnerGuide ratings. [PROBE FOR A SPECIFIC ANSWER.DO NOT ACCEPT A RANGE]

1. [ENTER NUMBER]

98. (Don't know)

99. (Refused)

VR3b. Among the new houses that you have built so far in 2014 in Nova Scotia, how many have been built under the New Home Construction program? To be eligible for the New Home Construction program, you would have had to register the new houses after January 1, 2014. I just want to remind you that the New Home Construction program provides a rebate if Energy Star certification is achieved, and those homes that consume less than 19,000 kilowatt hours receive an additional incentive. [PROBE FOR A SPECIFIC ANSWER.DO NOT ACCEPT A RANGE]

1. [ENTER NUMBER]

98. (Don't know)

99. (Refused)

[ANSWER TO VR3 CANNOT BE HIGHER THAN ANSWER TO VR2]

[IF ANSWER TO VR3A AND/OR B IS 0, CONSIDER NON-PARTICIPANT BUILDER AND GO TO SECTION M]

IF DON'T KNOW TO BOTH VR3a AND VR3b, CONSIDER NON PARTICIPANT BUILDER AND GO TO SECTION M.

[IF ANSWER IS HIGHER THAN 0, GO TO VR4]

VR4. I just want to be sure, you or someone else from your firm participated in the Performance Plus and/or New Home Construction program for houses you built or are currently building? Did you participate in... **[READ RESPONSES IN ORDER]**

1. **[ONLY ASK IF VALID NUMBER GIVEN IN VR3A]** Performance Plus in 2014/ that is, registered the home(s) **before** January 1, 2014 [BECOME PERFORMANCE PLUS PARTICIPANT BUILDER AND GO TO VRP5]
2. **ONLY ASK IF VALID NUMBER GIVEN IN VR3B]** New Home Construction in 2014/that is registered the home(s) **after** January 1, 2014 [BECOME NEW HOME CONSTRUCTION PARTICIPANT BUILDER AND GO TO VRP5]
3. **ONLY ASK IF VALID NUMBER GIVEN IN VR3A OR B]** Participated in both programs in 2014 [BECOME BOTH PARTICIPANT BUILDER AND GO TO VRP5]

VOLUNTEERED

4. Neither [GO TO SECTION M] CONSIDER NON-PARTICIPANT BUILDER
98. Don't know [PROMPT: "Did you or someone else from your firm participate in the Performance Plus and/or New Home Construction program for houses you built in 2014 or are currently building?" RECODE AS "YES" IF THE PROMPT WORKS; RECODE AS NO, IF THE RESPONDENT SAYS NO; IF RESPONDENT STILL SAYS DON'T KNOW, THANK AND TERMINATE.]
99. Refused [THANK AND TERMINATE]

[ASK PARTICIPANT BUILDERS] (FROM SAMPLE)

Verification and Recall (VRP Series)

VRP1. Are you in the business of building and/or selling homes?

1. Yes [CONTINUE]
2. No [THANK & TERMINATE]
98. (Don't know) [THANK & TERMINATE]
99. (Refused) [THANK & TERMINATE]

VRP2. We understand you or someone else from your firm participated in the Performance Plus and/or New Home Construction program for houses you built or are currently building. Did you participate in...

1. Performance Plus in 2014/ that is, registered the home(s) **before** January 1, 2014 [CONTINUE] CONSIDER PERFORMANCE PLUS PARTICIPANT BUILDER
2. New Home Construction in 2014/that is, registered the home(s) **after** January 1, 2014 [CONTINUE] CONSIDER NEW HOME CONSTRUCTION PARTICIPANT BUILDER
3. In both programs in 2014 [CONTINUE] CONSIDER BOTH PP AND NHC PARTICIPANT BUILDER

VOLUNTEERED

4. Neither [PROMPT: "Are you sure? This program provides rebates for installing energy efficient upgrades in newly constructed houses. Plans for the house are reviewed and recommendations are given for upgrades to install in the new homes. The home buyer can receive rebates to cover some of the cost of energy efficiency measures. " RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO: "Is there someone else who would know about having participated in the Performance Plus and/or New Home Construction program?"]
1. Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
98. Don't know [PROMPT: "This program provides rebates for installing energy efficient measures in newly constructed houses. Plans for the house are reviewed and recommendations are given for upgrades to install in the new homes. The home buyer can receive rebates to cover some of the cost of energy efficiency upgrades after they are installed." RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS DON'T KNOW: "Is there someone else who would know about having participated in the Performance Plus and/or New Home Construction program?"]
1. Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
2. No [THANK & TERMINATE]
99. Refused [THANK AND TERMINATE]

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"]

[SCHEDULED, IF NECESSARY, FOR: _____]

VRP3. Approximately how many new houses, including single units, semi-detached units and row houses, has your firm completed so far in 2014 in Nova Scotia? If you built semi-detached units in 2014 in Nova Scotia, please count as two units.

[PROBE FOR A SPECIFIC ANSWER.DO NOT ACCEPT A RANGE] [IF ANSWER IS 0 OR DK OR REFUSED, THANK AND TERMINATE]

1. [ENTER NUMBER]
98. (Don't know)
99. (Refused)

FOR BUILDERS THAT PARTICIPATED IN BOTH PROGRAMS (VRP2=3), ASK VRP4a and VRP4b

VRP4a. **[ASK PP PARTICIPANT BUILDERS BASED ON VRP2 = 1 OR 3]** Among the new houses that you have built so far in 2014 in Nova Scotia, how many have been built under the Performance Plus program? To be eligible for the Performance Plus program, you would have had to register the new houses before January 1, 2014. I just want to remind you that the Performance Plus program provided rebates to the homeowner or builder for achieving certain EnerGuide ratings. [PROBE FOR A SPECIFIC ANSWER.DO NOT ACCEPT A RANGE]

- 1. [ENTER NUMBER]
- 98. (Don't know) SKIP TO VRP5
- 99. (Refused) SKIP TO VRP5

VRP4b. **[ASK NHC PARTICIPANT BUILDERS BASED ON VRP2 = 2 OR 3]** Among the new houses that you have built so far in 2014 in Nova Scotia, how many have been built under the New Home Construction program? To be eligible for the New Home Construction program, you would have had to register the new houses after January 1, 2014. I just want to remind you that the New Home Construction program provides a rebate if Energy Star certification is achieved, and those homes that consume less than 19,000 kilowatt hours receive an additional incentive. [PROBE FOR A SPECIFIC ANSWER.DO NOT ACCEPT A RANGE]

- 1. [ENTER NUMBER]
- 98. (Don't know) SKIP TO VRP5
- 99. (Refused) SKIP TO VRP5

IF ANSWER IS 0 FOR BOTH VRP4A AND VRP4B, THANK AND TERMINATE] NUMBER OF VRP4A+VRP4B CAN'T BE LARGER THAN VRP3

IF DON'T KNOW TO BOTH VRP4A/VRP4B, OR ZERO TO ONE, AND DK TO THE OTHER THANK AND TERMINATE.

PARTICIPANT BUILDER VR4 = 1, 2 OR 3

OR

VRP4A AND/OR VRP4B = >0

NON PARTICIPANT BUILDER = VR3A/B= 0, OR VR4=4

VRP5. Moving along ... Usually, who makes the decision to participate in the Performance Plus and/or New Home Construction program, is it you or the future owner? [DO NOT READ. ACCEPT ONE]

1. (Me, the builder usually makes the decision)
2. (The future homeowner usually makes the decision)
3. (Both builder and future homeowner make decision)
98. (Don't know)
99. (Refused)

Please note that during this interview, we would like you to consider your overall experience with the Performance Plus and/or New Home Construction program in 2014 and not just one specific new house you have built through the program. If we would like you to think of a specific aspect, we will let you know.

[ASK PARTICIPANT BUILDERS]

Free-Ridership (FR Series)

FOR BUILDERS WHO PARTICIPATED IN BOTH PROGRAMS [VRP2=3 or VR4=3], STATE: Given that you have participated in both the Performance Plus and New Home Construction programs in 2014, we ask that you think only of the [PERFORMANCE PLUS/NEW HOME CONSTRUCTION PROGRAM] for the purpose of the following questions. **[FOR PARTICIPANT BUILDERS: BASED ON HIGHER AMOUNT FROM VRP4A and VRPB], FOR NON-PARTICIPANT BUILDERS WHO BECAME PARTICIPANT BUILDERS: HIGHER AMOUNT FROM VR3A OR VR3B.**

Now, I would like to examine the influence of the [Performance Plus/ New Home Construction] program on your decision to build houses with a high level of efficiency.

FR1. Without the [Performance Plus/New Home Construction] program, its energy modelling service, and its rebate, would you have built the same number of houses [FOR PERFORMANCE PLUS SAY: with the exact same level of efficiency, therefore reaching an EnerGuide rating of 83 or higher in Nova Scotia in 2014, [FOR NEW HOME CONSTRUCTION SAY: that achieved ENERGY STAR certification or higher and consumed less than 19,000 kWh?

1. Yes
2. No
98. (Don't know)
99. (Refused)

[IF FR1=1]

- FR1a. I just want to make sure I understand - If the [Performance Plus/New Home Construction] program had **NOT** been in place and had not offered incentives, advice, and home modelling services to build houses **FOR PERFORMANCE PLUS SAY**: reaching an EnerGuide rating of 83 or higher”, **[FOR NEW HOME CONSTRUCTION SAY** “to achieve ENERGY STAR certification or higher and consume less than 19,000 kWh,]” you would have still built the same number of houses with the exact same level of efficiency?
1. Yes [GO TO SECTION MP]
 2. No
 98. (Don’t know)
 99. (Refused)

[IF VRP4 or VR3=NUMERIC ANSWER]

- FR2a. From the [ANSWER TO VRP4 OR VR3] houses that you have built under the program in 2014 in Nova Scotia, how many houses **[FOR PERFORMANCE PLUS SAY]**: with an EnerGuide rating of 83 or higher would you have built if the Performance Plus program had **NOT** been in place? **[FOR NEW HOME CONSTRUCTION SAY]**: that achieved ENERGY STAR certification or higher and consumed less than 19,000 kWh would you have built if the New Home Construction program had **NOT** been in place?
1. [ENTER NUMBER] [CAN’T BE HIGHER THAN VRP4 OR VR3]
 98. (Don’t know)
 99. (Refused)
- FR3. Using a scale from 0 to 10, where 0 means “Not at all important” and 10 means “Extremely important”, please rate the importance of the following, in terms of your decision to build houses **[PP**: with an EnerGuide rating of 83 or higher/**NHC**: that achieved ENERGY STAR certification and consumed less than 19,000 kWh].
- a. The Performance Plus/New Home Construction program in general
 - b. The energy modeling service and advice
 - c. The incentive provided through the program
 1. [0 to 10] Probe for an exact number
 98. (Don’t know)
 99. (Refused)

[ASK NON PARTICIPANT BUILDERS]

Market Effects – Non Participants (M Series)

We will now talk about the houses you have built in 2014 without participating in the Performance Plus and/or New Home Construction program.

M1. Before today, had you ever heard of the Performance Plus and/or New Home Construction program from Efficiency Nova Scotia? [CHOOSE ONLY ONE ANSWER, PROBE FOR APPROPRIATE YES RESPONSE]

1. Yes – Both [GO TO M2]
2. Yes – Performance Plus only [GO TO M2]
3. Yes – New Home Construction only [GO TO M2]
4. No, neither [GO TO SECTION F]
98. (Don't know) [GO TO SECTION F]
99. (Refused) [GO TO SECTION F]

M2. Has your firm ever participated in the Performance Plus and/or New Home Construction program? [CHOOSE ONLY ONE ANSWER]

1. Yes
2. No
98. (Don't know)
99. (Refused)

M3. Among the [VR2] houses you told me you or your firm have built in 2014 in Nova Scotia, approximately how many would have reached the energy efficiency level required by Efficiency Nova Scotia's programs for new houses? [ENTER NUMBER] [IF DON'T KNOW OR REFUSED, GO TO SECTION F]

98. (Don't know)
99. (Refused)

SHOW ON SCREEN FOR INTERVIEWER TO READ IF NECESSARY: Either reaching an EnerGuide rating of 83 or higher under Performance Plus and/or achieving an ENERGY STAR certification and houses consuming less than 19,000 kWh when modelled in Natural Resources Canada's HOT2000 software under New Home Construction

M4. Did you implement any of the following energy efficiency measures in those houses but not as part of any of Efficiency Nova Scotia's programs? [FOR EACH MEASURE READ, CODE: YES=1, NO=2, DK=98, REFUSED=99. ROTATE]

- a. Programmable electronic thermostat
- b. CFL and/or LED lighting
- c. ENERGY STAR qualified windows

- d. More insulation than is required by code
- e. Mini-split heat pumps
- f. Ducted heat pumps
- g. Drain water heat recovery equipment
- h. Electric water heater tank wrap
- i. Electric water heater pipe wrap
- j. Solar domestic water heating system
- k. Optimization of the shape and orientation of home
- l. Efficient wall assemblies to minimize thermal bridging
- m. High efficiency heat recovery ventilation (HRV)
- n. Any others? Specify: _____

M5. [DO NOT ASK IF NONE IN M4 MENTIONED] What is the likelihood that you would have implemented those measures if you had never heard of or participated in any of Efficiency Nova Scotia's programs or heard of the EnerGuide rating? Please answer on a scale from 0 to 10, where 0 means "very unlikely" and 10 "very likely." [PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

___ Response

- 98. (Don't Know)
- 99. (Refused)

M6. Why did you not take part in the Performance Plus and/or New Home Construction program for houses built in 2014 in Nova Scotia? [DO NOT READ. PROBE FOR SPECIFIC REASONS. ACCEPT MULTIPLE]

- 1. (I was following the homeowner's wish not to participate in the program)
- 2. (Did not believe the measures or rebates applied to those houses)
- 3. (Participated in another program instead)
- 4. (I did not have a positive past experience with the program)
- 5. (The program is too complicated)
- 6. Time commitment for participating in the program is unreasonable)
- 7. (Rebate reduction/Change in incentive)
- 96. (Other, please specify: _____)
- 98. (Don't know)
- 99. (Refused)

[ASK PARTICIPANT BUILDERS]

[[IF VRP3-VRP4=0] SKIP TO SECTION S]

Market Effects – Participants (MP Series)

We will now talk about the houses you have built in 2014, but without participating in the Performance Plus and/or New Home Construction program.

MP1. **[DO NOT ASK IF DK/REFUSED IN VRP4 OR VR3 – IN THIS CASE DK/REFUSED=0]** You told me that you or your firm have built approximately [VRP3 OR VR2] houses, including single units, semi-detached units and row houses, so far in 2014 in Nova Scotia. Among these houses, you told me that roughly [VRP4 OR VR3] have been built under the Performance Plus and/or New Home Construction program. It means that you or your firm have built [VRP3-VRP4 OR VR2-VR3] houses so far in 2014 in Nova Scotia without participating in the Performance Plus and/or New Home Construction program. Is that correct? [CHOOSE ONLY ONE ANSWER]

1. Yes
2. No [READ INSTRUCTION BELOW]
98. (Don't know)
99. (Refused)

INSTRUCTION

READ: "Can you please tell me which answer(s) need(s) to be corrected between the number of new houses you or your firm have built so far in 2014 in Nova Scotia and the number of houses built in Nova Scotia under the Performance Plus and/or New Home Construction program? [CHANGE ANSWER TO VRP3 AND/OR VRP4 BASED ON ANSWER FROM RESPONDENT]

1. [CHANGE VRP3]
2. [CHANGE VRP4 -]
3. [CHANGE VRP3 AND VRP4]

[DO NOT ASK IF VRP4 OR VR3=DK OR REFUSED – IN THIS CASE DK/REFUSED=0]

MP2. Among the [VRP3-VRP4 OR VR2-VR3, **IF PARTICIPATED IN BOTH PROGRAMS, USE TOTAL NUMBER OF HOUSES BUILT**] homes you told me you or your firm have built so far in 2014 without participating in the Performance Plus and/or New Home Construction program, how many would have reached the energy efficiency level required by Efficiency Nova Scotia's programs for new houses? (? [ENTER NUMBER] [IF DON'T KNOW OR REFUSED, GO TO SECTION S])

SHOW ON SCREEN FOR INTERVIEWER TO READ IF NECESSARY: Either reaching an EnerGuide rating of 83 or higher under Performance Plus and/or achieving an ENERGY STAR certification and houses consuming less than 19,000 kWh when modelled in Natural Resources Canada's HOT2000 software under New Home Construction

MP3. Did you implement any of the following energy efficiency measures in those houses but not as part of any of Efficiency Nova Scotia's programs? [FOR EACH MEASURE READ, CODE: YES=1, NO=2, DK=98, REFUSED=99. ROTATE]

- a. Programmable electronic thermostat
- b. CFL and/or LED lighting
- c. ENERGY STAR qualified windows
- d. More insulation than is required by code
- e. Mini-split heat pumps
- f. Ducted heat pumps
- g. Drain water heat recovery equipment
- h. Electric water heater tank wrap
- i. Electric water heater pipe wrap
- j. Solar domestic water heating system
- k. Optimization of the shape and orientation of home
- l. Efficient wall assemblies to minimize thermal bridging
- m. High efficiency heat recovery ventilation (HRV)
- n. Any others? Specify: _____

MP5. [DO NOT ASK IF NONE IN MP3 MENTIONED] What is the likelihood that you would have implemented those measures if you had never participated in Efficiency Nova Scotia's programs or heard of the EnerGuide rating?? Please answer on a scale from 0 to 10, where 0 means "very unlikely" and 10 "very likely." [PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

____ Response

98. (Don't Know)
99. (Refused)

MP6. Why did you not take part in the Performance Plus and/or New Home Construction program for those houses? [DO NOT READ. PROBE FOR SPECIFIC REASONS. ACCEPT MULTIPLE]

1. (I was following the homeowner's wish not to participate in the program)
2. (Did not believe the measures or rebates applied to those houses)
3. (Participated in another program instead)
4. (I did not have a positive past experience with the program)
5. (The program is too complicated)
6. Time commitment for participating in the program is unreasonable)
7. (Rebate reduction/Change in incentive)
96. (Other, please specify: _____)
98. (Don't know)
99. (Refused)

[ASK PARTICIPANT BUILDERS]

Satisfaction with Program (S Series)

CS1. How did your company first learn of the programs offered by Efficiency Nova Scotia?
DO NOT PROVIDE RESPONSE CATEGORIES. CODE AS MANY AS APPLICABLE.

1. Media advertising
2. Respondent was contacted directly by Efficiency Nova Scotia
3. Through a third-party contractor
4. Respondent contacted Efficiency Nova Scotia directly
5. Word-of-mouth
6. Efficiency Nova Scotia website
7. Facebook or other social media
98. Other [**SPECIFY:** _____]
99. Cannot recall

CS2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent?
CODE ONE ONLY

1. Directly with Efficiency Nova Scotia
2. Third-party contractor or agent
3. Both

SKIP TO CS6

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with **READ AND ROTATE**

CODE ONE RESPONSE FOR EACH FACTOR

- a. The technical expertise of Efficiency Nova Scotia employees related to the program
- b. The responsiveness of Efficiency Nova Scotia employees to your requests and enquiries in a timely manner
- c. The length of time between the initial audit and the report including recommendations for energy-efficient measures
- d. The value of the program relative to the time and cost involved
- j. The ability to provide estimates of the savings or return on investment associated with the program

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia’s overall performance in working with your company?

CODE ONE RESPONSE

- 01. Not at all satisfied
- 02.
- 03.
- 04.
- 05.
- 06.
- 07.
- 08.
- 09.
- 10. Completely satisfied
- 98. Don’t know/No answer

CS6. Did you speak directly to any of Efficiency Nova Scotia’s contact centre representatives?

[DO NOT READ RESPONSES – CODE ONE ONLY]

- 1. Yes
- 2. No
- 98. (Don’t know)
- 99. (Refused)

IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO CS28.

- CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**
1. Completely satisfied
 2. Mostly satisfied
 3. Mostly dissatisfied
 4. Completely dissatisfied
 97. (Neither satisfied nor dissatisfied)
 98. (Don't know)
 99. (Refused)
- CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's... **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**
- a. Service attitude
 - b. Knowledge of programs available
 - c. Ability to provide advice
 1. Completely satisfied
 2. Mostly satisfied
 3. Mostly dissatisfied
 4. Completely dissatisfied
 97. (Neither satisfied nor dissatisfied)
 98. (Don't know)
 99. (Refused)
- CS28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia? **CODE ONE ONLY**
1. Definitely
 2. Probably
 3. Probably not
 4. Definitely not
 7. [VOLUNTEERED] Not eligible for any other programs
 8. [VOLUNTEERED] Don't know
 9. Refused

- CS29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others? CODE ONE ONLY
1. Definitely
 2. Probably
 3. Probably not
 4. Definitely not
 8. [VOLUNTEERED] Don't know
 9. Refused
- S10. Thinking of when you or the homeowner completed and sent the request for payment form to Efficiency Nova Scotia's program partner, how long, in days, was it before you or the homeowner received the rebate? [RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

[ASK ALL]

Firmographics (F Series)

The final question is asked for statistical purposes only.

- F1. Approximately how many full-time equivalent workers are employed by your company/organization within Nova Scotia?
1. Fewer than 5
 2. 5 to 9
 3. 10 to 19
 4. 20 to 49
 5. 50 to 99
 6. 100 to 249
 7. 250 or More
 98. (Don't know)
 99. (Refused)

END: That is all the questions I have for you. Thank you for taking the time to respond to this survey.

APPENDIX IV

BUILDER SURVEY RESULTS

The builder survey results are presented in the following tables.

CS1. How did your company first learn of the programs offered by Efficiency Nova Scotia?

Source of Awareness*	2013	2014
<i>Sample Size</i>	47	26
Delivery agent from Nova Scotia Home Builders Association	17%	38%
Word of mouth – neighbour, friend, co-worker, family member, etc.	19%	12%
Delivery agent from Sustainable Housing	9%	12%
Media advertising	6%	8%
Through a third-party contractor	2%	8%
Contacted directly by ENSC	9%	4%
Through a home builder	6%	4%
ENSC Website	-	4%
Through previous involvement with ENSC	9%	-
Internet	2%	-
Others	13%	12%
Don't know/Can't recall	11%	4%
*Multiple responses		
**2012 data not shown because 2013 codes were changed to match C-Sat question codes		

VRP5. Moving along ... Usually, who makes the decision to participate in the Performance Plus and/or New Home Construction program, is it you or the future owner?

Builders' Decision to Register	2012	2013	2014
<i>Sample Size</i>	50	47	26
I, the builder, usually make the decision	74%	64%	58%
Future homeowner usually makes the decision	16%	17%	15%
Both builder and future homeowner make the decision	10%	17%	23%
Don't know	-	2%	4%

FR3. Using a scale from 0 to 10, where 0 means “Not at all important” and 10 means “Extremely important”, please rate the importance of the following, in terms of your decision to build houses [Performance Plus: with an EnerGuide rating of 83 or higher/New Home Construction: that achieved ENERGY STAR certification and consumed less than 19,000 kWh].

Importance in Influencing Builder Decision to Build Houses with a High Level of Energy Efficiency	2012		2013		2014	
	Sample Size*	Important	Sample Size*	Important	Sample Size*	Important
Mean (1=Not at all important, 10=Extremely important)**						
Incentive	30	9.1	89	9.1	12	9.3
Performance Plus/New Home Construction in general	n/a	n/a	81	8.5	11	8.7
Energy modelling service	n/a	n/a	69	7.9	12	8.5
*Base: Respondents who would not have built the same number of houses without Performance Plus/New Home Construction **Mean excludes responses of 'Refused' and 'Don't know'						

CS2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent?

Builder Contact with ENSC	2013	2014
Sample Size	47	26
Third-party contractor or agent	60%	69%
Directly with ENSC	34%	31%
Both	6%	-

CS4. Now I will read you a list of factors and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with...

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with your company?

Builder Satisfaction with Overall ENSC Performance	2013		2014	
	Sample Size*	Satisfied	Sample Size*	Satisfied
Mean (1=Not at all satisfied, 10=Completely satisfied)**				
Technical expertise of ENSC employees related to the program	18	8.4	8	9.4
Responsiveness of employees to requests and enquiries in a timely manner	19	8.6	8	9.0
ENSC's overall performance in working with your company	19	8.8	8	8.9
Ability to provide estimates of the savings or return on investment associated with the program	19	8.5	7	8.7
Length of time between your initial assessment and the report including recommendations for energy-efficient measures	17	8.2	8	8.4
Value of the program relative to the time and cost involved	19	8.5	7	8.3
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of 'Refused' and 'Don't know'				

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

Contact with ENSC Contact Centre Staff	2014 (%)
Sample Size	26
Yes	42%
No	54%
Don't know	4%

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's...

Satisfaction with ENSC Contact Centre Staff	2014	
	Sample size*	Satisfied** (#)
Knowledge of programs available	11	100%
Service attitude	11	100%
Ability to provide advice	10	100%
Overall level of service provided by ENSC contact centre staff	11	91%
*Base: Number of respondents who had contact with ENSC staff **Number of respondents who gave a rating of completely satisfied or mostly satisfied'; Don't know removed from calculations		

CS28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia?

Would Participate in Other ENSC Programs	2013	2014
Sample Size*	46	26
Definitely	57%	58%
Probably	43%	38%
Probably not	-	4%
Definitely not	-	-
*Don't know/'Refused' have been removed from calculations		

CS29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others?

Would Recommend ENSC Programs to Other Businesses or Companies	2013	2014
Sample Size*	47	26
Definitely	77%	62%
Probably	21%	35%
Probably not	2%	4%
Definitely not	-	-
*Don't know/'Refused' have been removed from calculations		

S10. Thinking of when you or the homeowner completed and sent the request for payment form to Efficiency Nova Scotia's program partner, how long, in days, was it before you or the homeowner received the rebate?

Length of Time for Homeowner to Receive Rebate	2014 (#)
<i>Sample Size*</i>	14
10-19 days	7%
20-29 days	7%
30-49 days	14%
50 days or more	71%
Mean*	57.5
**"Don't know/refused" have been removed from calculation	

F1. Approximately how many full-time equivalent workers are employed by your company/organization within Nova Scotia?

Full-Time Employees	2012			2013			2014		
	Overall (%)	Participating Builders (%)	Non-Participating Builders (#)	Overall (%)	Participating Builders (%)	Non-Participating Builders (#)	Overall (%)	Participating Builders (%)	Non-Participating Builders (#)
<i>Sample Size</i>	57	50	7	51	47	4	28	26	2
Fewer than 5	25%	24%	2	41%	38%	3	36%	38%	-
5 to 9	28%	26%	3	22%	21%	1	19%	27%	1
10 to 19	26%	26%	2	14%	15%	-	11%	12%	-
20 to 49	16%	18%	-	6%	6%	-	18%	15%	1
50 to 99	4%	4%	-	8%	9%	-	-	-	-
100 to 249	2%	2%	-	2%	2%	-	-	-	-
250 or more	-	-	-	2%	2%	-	-	8%	-
Don't know	-	-	-	6%	6%	-	-	-	-

APPENDIX V

ALGORITHM FOR FREE-RIDERSHIP CALCULATION - PARTICIPANT

The figures below present the algorithms for calculating the free-ridership level. The participant and builder survey questionnaires included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant or builder.

Participant

FR2a. If you had not participated in PPP/New Home Construction, what is the likelihood that you would have built or bought a house with the exact same level of efficiency? (Scale 0 to 10)	FR2a = Answer x 10%
FR2b. If you had not participated in PPP/New Home Construction, what is the likelihood that you would have built or bought a standard house instead of a house reaching an EnerGuide rating of 83 or higher or achieved ENERGY STAR certification or higher and consuming less than 19,000 kWh? (Scale 0 to 10)	FR2b = (10 – Answer) x 10%
PA1 Score:	MEAN VALUE OF: (FR2a ; FR2b)
FR1. Did you decide to build or buy a house with a high level of energy efficiency, before participating in PPP/New Home Construction?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%
FR1a. I just want to make sure I understand - Before you decided to participate in PPP/New Home Construction, you had already made the decision to build or buy with a high level of energy efficiency?	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%
FR3. If you had not received the rebate from ENSC, would you have paid for the full cost of the additional measures required to reach this level of efficiency?(Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3
FR4. Level of influence (Scale 0 to 10) Factors a, b, c, e = Program factors Factors d= Non Program factors	FR4_P = SUM(a; b; c; e) FR4_NP = FR4d
PA3 Score:	100% - [FR4_P/(FR4_P+FR4_NP)]
Final Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3)
Inconsistency Test #1	IF ABS(FR2a – FR2b) ≥ 30%: PA1 = MIN OF (FR2a ; FR2b)
Inconsistency Test #2	IF FR3 ≥ 70% AND IF (FR2a OR FR2b < 70%: PA2 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3)

Builder

FR1. Without PPP/New Home Construction, its energy modelling service, and its rebate, would you have built the same number of houses with the exact same level of efficiency?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%
FR1a. I just want to make sure I understand – If PPP/New Home Construction had not been in place and had not offer incentives to build houses reaching an EnerGuide rating of 83 or higher or to achieve ENERGY STAR certification or higher and consume less than 19,000 kWh, you would you have still built the same number of houses with the exact same level of efficiency?	IF 1. Yes: FR1 = 100% AND GO TO FR3 IF 2. No OR 99 : FR1 = 0%
FR2a. From the [#] houses that you have built under the program in 2014 in Nova Scotia, how many houses with an EnerGuide rating of 83 or higher or that achieved ENERGY STAR certification or higher and consumed less than 19,000 kWh would you have built if the program had not been in place?	$FR2 = FR2a / \text{[#] of houses}$
PA1 Score:	IF FR1 = 0% : FR2 / 2 OTHERWISE : FR1
FR3. Rate the importance of the program and the incentive it offers in your decision to build houses reaching an EnerGuide rating of 83 or higher or that achieved ENERGY STAR certification and consumed less than 19,000 kWh?(Scale 0 to 10)	$FR3 = (10 - \text{Answer}) \times 10\%$
PA2 Score:	FR3
Final Free-Ridership	MEAN VALUE OF: (PA1 ; PA2)
Inconsistency Test #1	IF $(FR2 - FR3) \geq 30\%$: PA1 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2)

APPENDIX VI

INTERNAL SPILLOVER METHODOLOGY

The marketing of New Home Construction is primarily conducted through builders who receive promotion and awareness documents on various energy efficiency measures. Consequently, market effects, which constitute a form of spillover, can occur when a builder decides to implement energy efficiency measures in new construction projects without participating in the program.

Questions were asked to understand how program promotion affected builders' design decisions and to determine if, because of the program's influence, they had built energy-efficient houses without participating in the program. An average attribution level was then established among the builders to establish the percentage of non-participating eligible houses built due to the influence of the program.

To calculate the number of non-participating eligible houses, the Evaluator first established the total number of non-participating houses by subtracting the number of new houses having participated in New Home Construction (from the 2014 tracking sheet) from the total number of houses built in Nova Scotia in 2014 (from Statistics Canada data). Then the proportion of non-participating houses having reached eligibility criteria of New Home Construction was estimated based on the builders' declarations. Finally, the number of non-participating eligible houses built due to the influence of the program was obtained using the attribution level. This number divided by the total number of participating houses corresponds to the market effects.

VR2. Approximately how many new houses, including single units, semi-detached units and row houses, has your firm built so far in 2014 in Nova Scotia?	Total number of houses: Σ VR2
VR3a. Among the new houses that you have built so far in 2014 in Nova Scotia, how many have been built under the Performance Plus program?	Number of participating houses: Σ VR3a
VR3b. Among the new houses that you have built so far in 2014 in Nova Scotia, how many have been built under the New Home Construction program?	Number of participating houses: Σ VR3b
MP1. In 2014, have you built energy-efficient houses without participating in the Performance Plus and/or New Home Construction program ?	IF 1. Yes: Continue IF 2. No: Read Instruction
MP2. Approximately how many houses have you built so far in 2014 without participating in Performance Plus and/or New Home Construction program?	Number of non-participating houses with EnerGuide $\geq$ 83 and/or achieving an ENERGY STAR certification and houses consuming less than 19,000 kWh : Σ MP2
% of non-participating houses with EnerGuide $\geq$ 83 and/or achieving an ENERGY STAR certification and houses consuming less than 19,000 kWh	$\%N-P = \Sigma MP2 / \Sigma VR2$
MP5. What is the likelihood that you would have implemented those measures if you had never participated in the Performance Plus/New Home Construction program? (Scale 0 to 10)	MP5 = Answer x 10%
Attribution Level	$\%Attrib = MP5 \times MP2 / \Sigma MP2$
MP3. What measures have you implemented in those houses but not as part of Performance Plus/New Home Construction program?	Validation of measures
MP6. Why did you not take part in the Performance Plus/New Home Construction program for those houses?	Validation of eligibility
Final Spillover	$SO = \%N-P \times \%Attrib$



ECONOLER

RESIDENTIAL DIRECT INSTALL 2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ECONOLER

ABBREVIATIONS

ARet	Appliance Retirement
DA	Delivery Agent
CATI	Computer-assisted Telephone Interviewing
CBSM	Community Based Social Marketing
CFL	Compact Fluorescent Lamp
CRA	Corporate Research Associates
CSA	Canadian Standard Association
DHW	Domestic Hot Water
DSM	Demand-side Management
ENSC	Efficiency Nova Scotia Corporation
HEA	Home Energy Assessment
LED	Light Emitting Diode
LIH	Low Income Homeowner
MEF	Modified Energy Factor
NTGR	Net-to-Gross Ratio
OPA	Ontario Power Authority
PM	Program Manager
RDI	Residential Direct Install
TRM	Technical Reference Manual
UMP	Uniform Methods Protocol

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.

Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VIII
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	2
2.1 Presentation of the Team	2
2.2 Evaluation Activities	2
2.2.1 Interview with Program Manager	3
2.2.2 Interviews with Delivery Agents	3
2.2.3 On-site Visits.....	3
2.2.4 Surveys.....	3
2.2.5 Unitary Savings Review	5
3 PROCESS EVALUATION.....	6
3.1 Participation in RDI	6
3.2 Follow-up on 2012 Evaluation Report Recommendations	6
3.3 Program Documentation and Design	8
3.4 Tracking System.....	8
3.5 On-site Visits during the Installation Process.....	10
4 MARKET EVALUATION	11
4.1 Partner Perspectives.....	11
4.2 Participant Perspectives.....	12
4.2.1 RDI Awareness.....	12
4.2.2 Motivations and Barriers to Participation	13
4.2.3 RDI Impact.....	14
4.2.4 Satisfaction with RDI.....	15
4.2.5 Recommendations for Improvement.....	16
5 IMPACT EVALUATION FOR RDI.....	17
5.1 Gross Savings	17
5.1.1 CFLs	17
5.1.2 LED Lamps	18
5.1.3 LED Nightlights	23
5.1.4 Faucet Aerators	23
5.1.5 Low-flow Showerheads.....	26

5.1.6	Pipe Insulation	28
5.1.7	Hot Water Tank Wraps	29
5.1.8	Smart Power Controller for Audiovisual Equipment.....	32
5.1.9	Installation Rates	33
5.1.10	Demand-to-Energy Ratio	34
5.1.11	Revised Gross Savings	34
5.2	Interactive Effects	38
5.3	Net-to-Gross Ratio	40
5.3.1	Free-ridership	40
5.3.2	Internal Spillover	40
5.3.3	NTGR Calculation	40
5.4	Net Savings	41
6	IMPACT EVALUATION FOR THE CBSM PILOT.....	46
6.1	Unitary Savings Analysis	46
6.1.1	Demand-to-Energy Ratio	49
6.2	Interactive Effects	49
6.3	Net-to-Gross Ratio	49
6.4	Net Savings	49
	CONCLUSION.....	50
	APPENDIX I 2014 RECOMMENDATIONS	52
	APPENDIX II INTERVIEW GUIDE WITH DELIVERY AGENTS	53
	APPENDIX III ON-SITE VISIT SAMPLING METHODOLOGY AND PROTOCOL – AFTER INSTALLATION	57
	APPENDIX IV ANNUAL PARTICIPANT SURVEY QUESTIONNAIRE	61
	APPENDIX V ANNUAL PARTICIPANT SURVEY RESULTS	75
	APPENDIX VI CBSM PILOT PARTICIPANT SURVEY RESULTS	89
	APPENDIX VII QUARTERLY PARTICIPANT SURVEY QUESTIONNAIRE	103
	APPENDIX VIII QUARTERLY PARTICIPANT SURVEY RESULTS	115
	APPENDIX IX ALGORITHM FOR FREE-RIDERSHIP CALCULATION.....	122
	APPENDIX X INTERNAL SPILLOVER METHODOLOGY	123

LIST OF TABLES

Table 1: Distortion Effects and Overall Net-to-Gross Ratio Calculation.....	x
Table 2: Comparison of Tracked and Evaluated Savings at the Generator.....	x
Table 3: Annual Survey Sample Size and Margin of Error	4
Table 4: Quarterly Survey Sample Size and Margin of Error.....	5
Table 5: Implementation Status of Recommendations in 2012 Executive Summary	7
Table 6: Sources of Awareness	12
Table 7: Reasons for Participating.....	13
Table 8: Concerns with RDI Prior to Taking Part.....	14
Table 9: Behavioural Changes.....	14
Table 10: Satisfaction with RDI.....	15
Table 11: Recommendations for Improvement.....	16
Table 12: Tracked Unitary Savings Values for Each Category of CFL	18
Table 13: Tracked Unitary Savings Values for Each Category of LED	19
Table 14: Residential Lighting Metering Studies.....	21
Table 15: Revised Unitary Savings Values for Each Category of LED	22
Table 16: Tracked Unitary Savings Value for LED Nightlights.....	23
Table 17: Revised Unitary Savings Value for LED Nightlights.....	23
Table 18: Revised Unitary Savings Value for Low-flow Faucet Aerators.....	25
Table 19: Revised Unitary Savings Value for Low-flow Showerheads	27
Table 20: Revised Unitary Savings Value for Hot Water Tank Wraps	31
Table 21: Percentage of Products Installed and Installation Rate	33
Table 22: Tracked Evaluation Results – Gross Energy and Peak Demand Savings by Product.....	35
Table 23: Interactive Effects Calculation for Lighting Products.....	38
Table 24: Interactive Effect Factors for CFLs, LED Lamps and LED Nightlights	39
Table 25: Interactive Effect Factor for Pipe Insulation and Hot Water Tank Wraps.....	39
Table 26: Overall NTGR Calculation for RDI	41
Table 27: Evaluated Net Energy and Peak Demand Savings by Product	42
Table 28: Comparison of Tracked and Evaluated Savings at the Generator.....	45
Table 29: Average Number of Laundry Loads per Week.....	46
Table 30: Average Water Usage of Clothes Dryers per Year of Purchase	48
Table 31: CBSM Pilot Net Evaluated Energy Savings.....	49

LIST OF FIGURES

Figure 1: Methodological Model.....	2
Figure 2: Participation in RDI	6

EXECUTIVE SUMMARY

This report presents the results of the 2014 process and impact evaluation of Residential Direct Install (RDI), which is a component of the Existing Residential Program. The 2014 evaluation was based on interviews with the Program Manager (PM) and two delivery agents (DAs), 53 on-site visits, a quarterly and an annual telephone survey with a total of 110 and 500 participants respectively, and a unitary savings review.

Program Component Overview

Efficiency Nova Scotia Corporation's (ENSC) RDI offers free low-cost energy efficiency upgrades to Nova Scotian homeowners and renters. RDI provides participants with direct installation of new energy-efficient products, free of charge, as part of the standard upgrade. Until July 2014, participants could also purchase specialty compact fluorescent lamps (CFLs) and/or light-emitting diode (LED) lamps at a reduced cost as part of the upgrade package. After July 1, 2014, CFL lamps were no longer installed, and homeowners received LEDs as part of the standard package for free.

The products installed through RDI in 2014 were the following:

- › CFLs (until July 1, 2014)
- › LED lamps
- › LED nightlights
- › Faucet aerators
- › Low-flow showerheads
- › Pipe insulation
- › Hot water tank wraps (for electric water tanks)
- › Smart power controllers for audiovisual equipment

RDI targets low-income residents in particular, but also targets participants of other ENSC residential program components, namely participants from Low Income Homeowner (LIH), Appliance Retirement (ARet), Home Energy Assessment (HEA), Green Heat and Solar. In 2014, RDI was opened up to all residents of Nova Scotia.

RDI aimed to achieve net electricity savings of 23.0 GWh and peak demand savings of 5.4 MW for 2014.

Key Findings

The 2014 evaluation of RDI demonstrated that the program is running efficiently. RDI totalled 13,945 participants for the year 2014, compared to 23,587 participants in 2013 and 28,397 in 2012. Targets for RDI were reduced in 2014, but the savings per home increased, especially after the introduction of LEDs as part of the standard package, and the addition of smart power controllers.

These two changes to RDI had a large effect on the savings per home, meaning that DAs did not have to visit as many homes to reach the energy savings targets. Thus, even though the number of participants has declined in 2014, RDI has reached its targets in terms of savings, and demand remains strong.

In 2014 RDI generated 24.552 GWh in terms of net energy savings, compared to 37.275 GWh in 2013 and 37.043 GWh in 2012.

Awareness and Influence

Survey results showed that word of mouth was, by far, the main source of awareness for RDI in 2014. This way of learning about RDI was more prevalent among 2013 and 2014 participants. RDI was a new program component in 2012, it is therefore not surprising that word of mouth has increased as more residents participate and share their experience with friends and family. This result is very positive for RDI as word of mouth is a good indication of participant satisfaction. Advertising from ENSC, including mailings and the website, were also mentioned by a smaller proportion of participants.

The majority of participants recalled receiving information about energy-efficient products from the installer who came to their house. This information led to a change in behaviour for half of the participants, with the most common behavioural change being related to turning off the lights. Other behavioural changes include being more aware of power usage and saving energy, turning off appliances and reducing water consumption.

Satisfaction

RDI achieved a very high level of satisfaction, with the majority of participants highly satisfied with the program overall. Nearly all participants were satisfied with the time required to complete the work, the quality of the work performed, program communication and the energy conservation measures installed. Nearly all participants also found the application process for RDI to be easy.

There are a number of reasons as to why participants were satisfied with RDI. In addition to the benefit of saving energy, some participants also mentioned that they liked the installer who visited the home or had received good service. Overall, participants were satisfied with the work conducted by the DAs.

The DAs themselves also expressed positive feedback about RDI. Though opinions about their relationship with ENSC were mixed, both DAs agreed that ENSC provides them with sufficient opportunity to give input on RDI. They also believe that RDI provides an opportunity for energy efficiency education in general and for the promotion of other ENSC programs. Both of them have also complimented ENSC staff for their timely response and communication. Even though they are responsible for the majority of the promotional efforts under RDI, the DAs did provide

recommendations to improve marketing, which, according to them, is the greatest impediment to program delivery.

Energy Savings

To calculate the net savings of RDI in 2014, the Econoler team reviewed the gross savings estimated by ENSC and conducted 50 on-site visits to establish the installation rates for each category of products installed through the program.

Econoler took into consideration the free-ridership and spillover measured for non-low-income participants as part of the quarterly survey. Through this approach, a 15 percent free-ridership level was captured, while a 6 percent spillover was identified for this group of participants. For the low-income customers, the distortion effects of the program are assumed to be insignificant and the net-to-gross ratio (NTGR) was established at 1. Using the proportion of low-income and non-low-income participants, the overall NTGR associated with the program is 0.93. This value was applied to the gross savings calculation.

Table 1: Distortion Effects and Overall Net-to-Gross Ratio Calculation

Group of Participants	Non-Low-Income	Low-Income
Free-ridership Level	15%	-
Spillover Level	6%	-
NTGR	0.91	1.00
Proportion ¹	77%	23%
Overall NTGR	0.93	

The evaluation revealed that RDI generated net energy savings of 24.552 GWh and peak demand savings of 5.721 MW at the generator in 2014.

Table 2: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings					
Tracked Savings from ENSC	32.001 GWh	32.001 GWh	28.423 GWh	0.88	24.960 GWh
Evaluation Results	32.917 GWh	30.821 GWh	26.400 GWh	0.93	24.552 GWh
Peak Demand Savings					
Tracked Savings from ENSC	7.454 MW	7.454 MW	6.621 MW	0.878	5.814 MW
Evaluation Results	7.670 MW	7.181 MW	6.151 MW	0.93	5.721 MW

¹ Weighted average of the low-income factor registered in the tracking sheet with the revised gross savings.

The evaluated values calculated for the program are slightly lower than those calculated from the tracking system. This can be explained by the differences in some of the parameters used by ENSC and the Evaluator to estimate gross and net savings:

- › Econoler revised some of the unitary savings values used by ENSC in the tracking system, which had a significant impact mostly on faucet aerators, low-flow showerheads and hot water tank wraps. These adjustments resulted in a small decrease in the initial gross savings. However, ENSC's tracked initial gross savings include the installation rates, which explains why they are still lower than the evaluated value.
- › Installation rates were updated for all products installed through the program. Those installation rates were generally lower than the values tracked based on the 2012 evaluation.
- › The NTGR measured during this evaluation is higher than the one used by ENSC. For non-low-income participants, the level of free-ridership decreased from 19 percent to 15 percent, while the internal spillover increased from 3 percent to 6 percent. This compensated for the negative adjustments made to gross savings and resulted in an evaluated net savings value close to the tracked value.

In addition to the regular RDI savings, 438 participants took part in the Community-based Social Marketing (CBSM) Pilot, which encouraged them to use less warm water to do laundry. This pilot initiative generated 0.055 GWh in energy savings and 0.013 MW in peak demand savings at the generator.

RECOMMENDATIONS

Overall, the Econoler team finds that RDI has reached its maturity and performs very efficiently. In addition to the general recommendations presented for all ENSC program components in the overall executive summary of the 2014 demand-side management (DSM) programs, the team outlines specific recommendations throughout the report to optimize RDI. Based on the evaluation results, here are the most important recommendations:

RDI-R1. Provide participants with more streamlined and personalized information during the visit from the installer. The evaluation results indicated that a majority of participants recalled receiving information about energy-efficient products from the installer who came to their house, and that this information led to a change in behaviour for half of those participants. This result shows that the visit from the installer is a good time to educate participants about RDI or other ENSC program components, but also to provide information that is more specific to their household. Because the majority of the promotional efforts rest on the DAs, but require ENSC's approval, the Evaluator recommends that ENSC work closely with the DAs to develop more streamlined and personalized promotional materials to further improve RDI's educational outreach. More specifically, the DAs suggested grouping materials in one folder, similar to the HEA toolkit folder, and tailoring the information to the participant's individual needs.

RDI-R2. Follow up with DAs to identify the cause of entry errors. In 2014, the installation rates observed by the Evaluator during the on-site visits were generally lower than those calculated in 2012. While a portion of this decrease was due to higher removal rates of products by the participants, it was found that a significant amount of missing products were due to potential entry errors by the DAs. It should be noted that ENSC's quality assurance program did not uncover the same discrepancies as those observed by the Evaluator. It is therefore recommended that ENSC investigates the source of those errors, as this had a sizable impact on the gross savings evaluated in 2014.

1 PROGRAM DESCRIPTION

In July 2012, Efficiency Nova Scotia Corporation (ENSC) launched Residential Direct Install (RDI). RDI offers free low-cost energy efficiency upgrades to homeowners and renters. It was created following the success of several direct-install pilot projects offered to customers involved in Home Energy Assessment (HEA), Low Income Homeowner (LIH) and other programs in the fall of 2011. Since July 2012, RDI has been operating as a stand-alone program component. For service delivery, ENSC has contracted two delivery agents (DAs) to cover the entire province.

RDI provides participants with direct installation of new energy-efficient products, free of charge, as part of the standard upgrade. In addition, until July 2014, participants could also purchase specialty compact fluorescent lamps (CFLs) and/or light-emitting diode (LED) lamps at reduced costs as part of the upgrade package. After July 1, 2014, CFL lamps were no longer installed, and homeowners received LEDs as part of the standard package for free.

The products installed through RDI in 2014 were the following:

- › CFLs (until July 1, 2014)
- › LED lamps
- › LED nightlights
- › Faucet aerators
- › Low-flow showerheads
- › Pipe insulation
- › Hot water tank wraps (for electric water tanks)
- › Smart power controllers for audiovisual equipment

Funding is provided by two different sources, depending on the type of energy saved. Upgrades that reduce electricity consumption are paid for by ENSC with funds from electricity ratepayers. Upgrades that reduce the use of other fuels are paid for by ENSC with funds from the Province of Nova Scotia.

RDI targets low-income residents in particular, but also targets participants of other ENSC residential program components. RDI promotion is conducted in conjunction with other ENSC program components, namely LIH, Appliance Retirement (ARet), HEA, Green Heat and Solar. In 2014, RDI was opened up to all residents of Nova Scotia.

RDI aimed to achieve net electrical energy savings of 23.0 GWh and peak demand savings of 5.4 MW for 2014. Savings generated by RDI are accounted for under the Existing Residential program.

In the fall of 2013, some RDI participants were randomly selected to participate in a pilot project. The Community-based Social Marketing (CBSM) Pilot aimed to raise awareness among participants about washing their clothes in cold water. During the installation visit, the DA informed participants of the benefits of using cold water for laundry and gave them a brochure or a removable reminder to stick on their clothes washer. Participants were then asked to agree to several commitments, namely a verbal commitment or a pledge, in order to monitor the changes in their behaviour.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and the activities carried out for the RDI evaluation.

2.1 Presentation of the Team

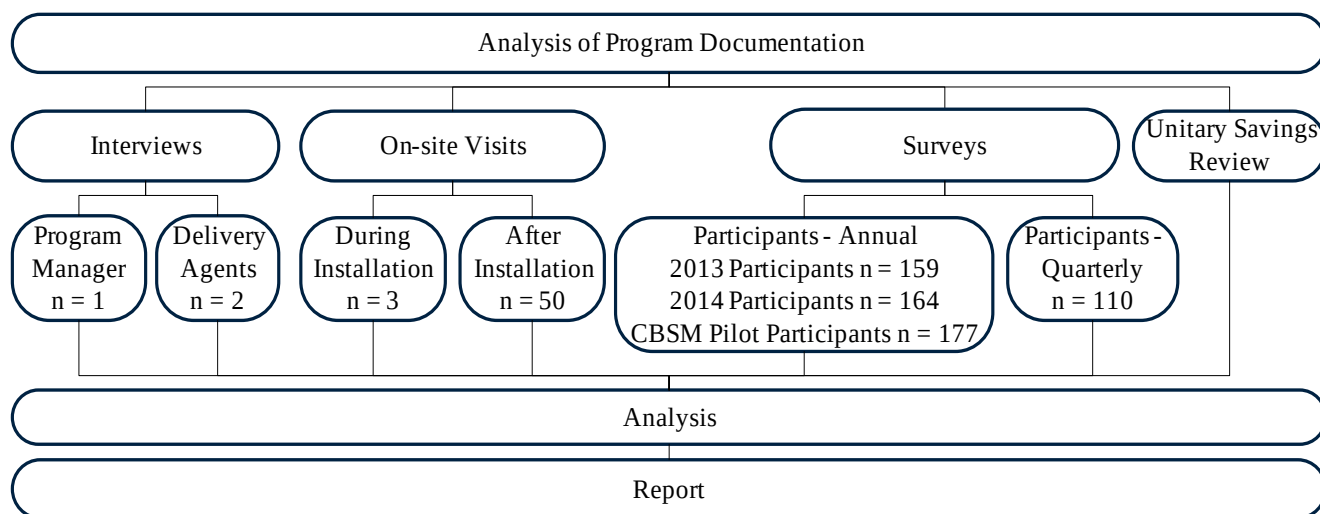
To carry out the 2014 evaluation, Econoler worked with two partner entities: Corporate Research Associates (CRA) and Equilibrium Engineering. Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all deliverables.
- › CRA conducted the interviews with the DAs, as well as performed the annual and quarterly telephone surveys. CRA also analyzed and reported on the data collected from these activities.
- › Equilibrium Engineering conducted the on-site visits, reviewed the tracking sheet and assisted Econoler with certain parts of the impact evaluation. Equilibrium Engineering was also in charge of the analysis and reporting that followed these different activities.

2.2 Evaluation Activities

Figure 1 illustrates the research strategy and data collection activities used for the 2014 evaluation.

Figure 1: Methodological Model



Each step of this methodological model is further detailed in the following sub-sections.

2.2.1 Interview with Program Manager

The Econoler team conducted one interview with the PM in September 2014. This interview was intended, among other things, to follow up on the 2012 evaluation recommendations and to understand the main changes made to program delivery in 2014. Based on the information obtained in this interview, a list of questions and topics to include in the data collection tools was prepared.

2.2.2 Interviews with Delivery Agents

In October 2014, two interviews were conducted with the DAs in order to understand their involvement in RDI, their participation process, as well as their perception of and satisfaction with RDI.

The guide used for the interviews with the DAs is presented in Appendix II for reference.

2.2.3 On-site Visits

In the fall of 2014, 50 on-site visits were conducted in households where energy-efficient products had been installed by the DAs. These visits were conducted by Equilibrium, Econoler's subcontractor. They aimed at validating whether the products had been properly installed based on the information contained in the tracking sheet and at establishing installation rates. Technical information, such as lamp wattages, was validated during the on-site visits and used to review the unitary savings assumptions. A copy of the on-site visit sampling methodology and protocol is included in Appendix III.

Equilibrium also conducted three on-site visits while the DA was installing products. The main purpose of these visits was to validate the overall installation process, including key components such as confirming the data recorded by the DA, providing information to the participant, selecting the right energy-efficient products to be installed and ensuring that only less energy-efficient products were being replaced.

2.2.4 Surveys

An annual telephone survey of 500 participants and four quarterly telephone surveys with a total of 110 participants were conducted by CRA staff in Halifax.

Annual Participant Survey

The annual survey conducted for RDI in July 2014 targeted three different groups of participants: 2013 participants, 2014 participants and participants who took part in the CBSM Pilot in late 2013. The interviews were conducted using computer-assisted telephone interviewing (CATI) technology. The average length of the survey was 11 minutes.

The annual survey was meant to receive feedback on the following aspects of RDI:

- › Spillover
- › Program awareness
- › Participant motivations, concerns and barriers
- › Satisfaction with the program
- › Behavioural changes
- › Recommendations for improvement

Moreover, participants were asked questions about their clothes washing habits in order to compare the behaviours of the CBSM Pilot participants with those of a control group comprised of 2013 and 2014 participants and establish the savings resulting from the CBSM Pilot. Because survey results associated to CBSM Pilot participants are used for savings calculation only, they are not reported in the Market Evaluation section of this report; only 2013 and 2014 participants are mentioned in this section.

The annual survey questionnaire is presented in Appendix IV. The complete survey results of the 2013 and 2014 participants are presented in Appendix V, while Appendix VI provides the complete survey results of the CBSM Pilot participants. Table 3 shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 annual telephone survey.

Table 3: Annual Survey Sample Size and Margin of Error

Survey	Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
CBSM Pilot Participants	438	177	± 4.8%
2014 Participants	13,945	164	± 6.4%
2013 Participants	23,587	159	± 6.5%
2012 Participants	13,271	181	± 6.1%

Quarterly Participant Surveys

For the quarterly surveys, four series of interviews with a total of 110 participants were conducted using CATI technology during four periods in April, July, October and December 2014. Such surveys were conducted to shorten the time gap between when participants started participating in the program and when they were contacted for evaluation purposes. The average length of the survey was 9.5 minutes.

The quarterly surveys were used to gain a better understanding of the following RDI features:

- › Free-ridership
- › Satisfaction with the program and ENSC

The questionnaire and complete quarterly survey results are presented in Appendix VII and Appendix VIII. Table 4 shows the population and sample size, as well as the corresponding margin of error at a 90 percent confidence level.

Table 4: Quarterly Survey Sample Size and Margin of Error

Quarterly Surveys	Population	<i>Sample Size (n)</i>	Margin of Error at 90% Confidence Interval
2014 Participants	13,945	110	± 7.8 %

The margin of error is used to determine the measurement's level of precision², and its associated confidence level indicates the probability that a measure will fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or bias, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

2.2.5 Unitary Savings Review

To review the unitary savings values used in the tracking sheet, the Econoler team validated the parameters currently used in the tracked savings calculations by conducting a literature review of the technical reference manuals and public evaluation reports of similar jurisdictions and choosing the most recent and accurate data sources. When no reliable or representative source could be found in the literature, engineering calculations were made to estimate savings.

A literature review and engineering calculations were also used, along with the annual survey results, to evaluate the energy savings that result from the change in clothes washing habits of the CBSM Pilot participants.

² Precision refers to how close the measured values are to each other. It does not take into consideration how close the measured value is to the true value, which refers to accuracy.

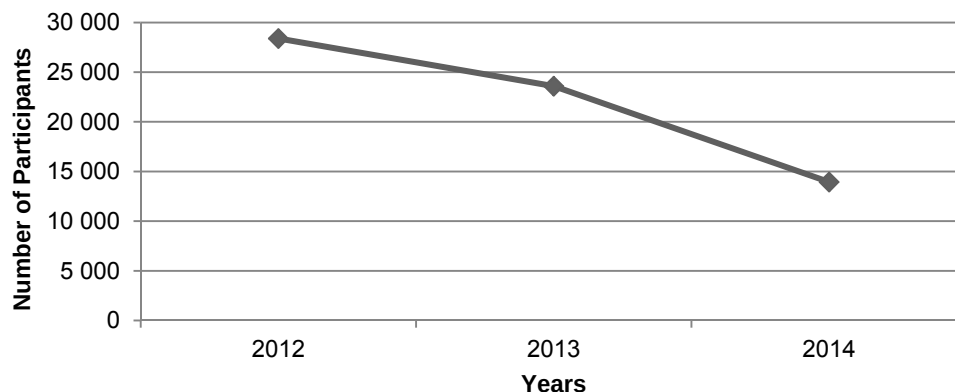
3 PROCESS EVALUATION

This section presents the findings of the 2014 RDI process evaluation, which has been carried out on the basis of the information gathered from the RDI documentation and tracking system, as well as an interview with the PM and on-site visits during the installation process.

3.1 Participation in RDI

RDI totalled 13,945 participants for the year 2014, compared to 23,587 participants for 2013 and 28,397 participants for 2012. Even though the number of participants per se has decreased in 2014, RDI has reached its targets in terms of savings, and demand remains strong. Targets for RDI were lowered in 2014, but the savings per home increased, especially after the introduction of LEDs in the standard package, and the addition of smart power controllers. These two changes to RDI had a sizeable effect on the savings per home, meaning that DAs did not have to visit as many homes to reach the energy savings targets.

Figure 2: Participation in RDI



3.2 Follow-up on 2012 Evaluation Report Recommendations

This section reports on the progress made in acting on the recommendations made by the Evaluator in the 2012 evaluation report. The Evaluator follows up on recommendations from 2012 only because the 2013 evaluation was limited to a tracked savings report with no recommendations.

To monitor the progress in implementing the recommendations, the PM has been using a monitoring tool, namely a table that documents all the recommendations made and the corresponding implementation status. This tool is an excellent initiative which serves to enhance the program memory principle.

The Evaluator analyzed the content of the file to determine whether ENSC followed up on the recommendations. Table 5 gives a brief summary of the implementation status of each recommendation presented in the Executive Summary section of the 2012 evaluation report.

Table 5: Implementation Status of Recommendations in 2012 Executive Summary

Recommendation	Status
2012 RDI-R1 Fine-tune the program marketing approach	Implemented
2012 RDI-R2 Continue informing participants about energy-efficient products	Implemented
2012 RDI-R3 Improve the content of the tracking sheet	Implemented
2012 RDI-R4 Ensure that there is a real need for nightlights in the household before offering LED nightlights to participants	Implemented
2012 RDI-R5 Follow the penetration of regular CFLs in the next years	Implemented

All the 2012 executive summary recommendations were implemented by ENSC and allowed for overall program improvement. The implementation of these recommendations has resulted in a number of changes in RDI. Among these, it is worth mentioning that since July 2014, CFL installations have transitioned to LED installations. This follows the Evaluator's recommendation to monitor the penetration level of regular CFLs in the market to eventually stop offering their free installation (2012 RDI-R5). Survey results during the 2012 evaluation indeed revealed that CFLs were the product that tended to increase the global free-ridership level of the program. Furthermore, the on-site visits demonstrated that most participants already had CFLs installed in their house before their participation. ENSC has since monitored the market, and the new federal regulation phasing out incandescent bulbs, which will eventually make CFLs the new standard, has come into effect. ENSC has thus taken action to transition from CFLs to LEDs. CFLs may still be installed in specific situations where an LED product is not suitable.

The 2012 evaluation also revealed that some participants had removed or given away their LED nightlights, sometimes because they did not need them. Consequently, the Evaluator recommended to avoid LED nightlight removal (2012 RDI-R4). ENSC has complied with this recommendation and instructed the delivery agent to make sure there is a real need for nightlights in households and that LED nightlights would actually replace old incandescent nightlights used on a regular basis before offering LED nightlights.

In line with the Evaluator's recommendation to refine the marketing approach of the program (2012 RDI-R1), ENSC met with the DAs during planning in January 2013 to come up with a plan to market the program. It was decided to work closely with the DAs on marketing the program and keep an eye on participation numbers, while also managing demand. Also, it was decided to mass market the program in 2014, which would eliminate recruitment challenges that the DAs face regularly.

The 2012 evaluation pointed out the importance of the educational component of the visit (2012 RDI-R2). The information or advice provided by the program advisor during the installation had

an impact on the decision to install energy-efficient products, and this information encouraged many participants to change their behaviour in terms of energy use at home. In 2013, installers attended training, during which a focus was placed on having an educational chat with homeowners during the first 10-15 minutes of the installation. Support tools were also provided to installers (cheat sheets, upgrade guidelines documentation).

3.3 Program Documentation and Design

As part of the evaluation, the Evaluator analyzed the program documentation and worked together with the PM to improve and revise the content of the program manual, evaluation plan and logic model, where applicable. More specifically, this revision work made it possible to define relevant barriers to RDI that can also be found in every program documentation. Moreover, under the logic model, the Evaluator recommended that activities meant to address each of the barriers in the program theory column be clearly identified.

In addition to this revision work, the Evaluator noted certain characteristics of RDI that should be explained in greater detail in the program manual, namely:

- › The reason for transitioning from CFLs to LED lamps to replace incandescent lamps.
- › The procedure to identify low-income participants who are the focus of the program.
- › The main differences between RDI and MURB since RDI also targets multi-unit customers and both program components have a similar offer (direct installation of energy-efficient products). This addition would address the issue of possible overlapping.

3.4 Tracking System

The Econoler team reviewed the 2014 RDI tracking sheet content. It was presented under the form of a spreadsheet, in which each of the DA's installations is compiled. At this point in time, ENSC does not use the DSMDS for the day-to-day management of RDI, even though some progress has been made. The tracking sheet provides the relevant information required for both program administration and evaluation. The number of each type of projects installed can be constantly monitored, and the energy savings can be compared against annual targets.

The tracking sheet contains fields for the contact information of participants. In nearly all cases, names, addresses and phone numbers were available. While all participants were assigned a unique tracking number by ENSC, one of the DAs also provided their own tracking number. The tracking system also indicates if participants were encouraged to partake in other ENSC initiatives, such as Home Energy Assessment, Green Heat, Appliance Retirement or Solar.

In addition, the tracking sheet collects data that is relevant to the impact evaluation, such as the type of residence, rate code, space and domestic hot water heating sources, and whether an air conditioner is in use. All records showed the space heating source, and the hot water heating source

and the use of an air conditioner were missing in a negligible number of records, though 21 percent of the rate codes were not available. It appears that the DAs continue to have difficulty retrieving this information, which is used to establish the line loss factor. It should also be noted that this percentage is an improvement from last year's evaluation, down from 35 percent.

RDI targets both low-income and non-low-income participants, on which different net-to-gross ratios are applied. Participants are asked what income range is applicable to them or are provided the opportunity to forego this question. The income level was provided for 75 percent of the participants, and the corresponding average regional low-income factor was entered for the rest of the participants.

In terms of the savings, the gross and net energy savings calculations are embedded into the tracking system, which enables the Evaluator to easily identify the parameters used, such as product quantities and unitary savings. Furthermore, in the case of lighting products and low-flow showerheads, the tracking system provides an area for capturing the characteristics of the replaced product (wattage or flow rate), which enables more precise unitary savings calculations. For each product, the savings calculation references unitary savings value listed in a separate table. The table also includes the reference source for the unitary savings values.

Overall, the Evaluator concludes that the tracking sheet is complete and allows for efficient program monitoring. It is moreover apparent that some of the 2012 recommendations have been implemented. These implemented improvements are as follows: (1) a unique identification number for each participant, (2) the products installed in each multi-unit residential have been identified, and (3) the information on the use of air conditioning is being collected. Still, the Evaluator further recommends the following to facilitate future program evaluation:

- › **Make sure that all the fields are systematically filled out:** The Evaluator observed that some fields were left blank:
 - Rate code: This field is used to determine the line loss factor. It was blank in 21 percent of the records.
 - Space Heat Source: There are two fields—one indicating the main space heating source and the other indicating the secondary space heating source. While the main space heating source was complete without blanks, the secondary space heating source should also be systematically filled out. The absence of a secondary source should be stated, thus indicating that the main heat source is used at 100 percent.

All of the tracking system information can be helpful for the various tasks involved in the impact evaluation. Therefore, it is recommended to ensure that these fields are systematically filled out.

- › **Set limitations for entries and develop a validation process:** The Evaluator found that for some products, a mix of "0" and blank entries were used to indicate that no product had been installed. This is possibly due to the different data gathering process from one DA to another. Econoler recommends that ENSC standardize entries into the DSMDS, which should facilitate the identification of missing entries.

3.5 On-site Visits during the Installation Process

For the 2014 impact evaluation, three site visits with both RDI DAs were performed during the installation process.

At the beginning of the appointment, the DA collected general information from the participant, such as their space heating and DHW energy sources, their air conditioning usage and the number of occupants in the home. The DA also reviewed the efficient products that could be installed and their respective benefits with the participants. These benefits were explained in terms of either wattage or water flow rate reductions. No mention of energy cost savings was made to the participants. The DA also inquired whether there were some products the participant did not wish to replace (i.e., showerheads). In all cases, efficient products replaced less efficient ones.

On all three on-site visits, a number of bulbs could not be replaced, as the replacement LED bulb would not physically fit into the fixture (i.e., fixtures with a globe-shaped light cover). One DA left the existing bulbs as found, but one DA still offered 13 W and 23 W CFLs for applications where the LED bulb would not fit into the existing fixture. In each case, the participant was notified of this situation.

A quality check was performed on each installed product to make sure it was functioning properly. There were no spare efficient products or inefficient products left behind. If premature failure of any non-lighting product occurs, both DAs declared that they would return to replace it. The participants were advised to contact the lighting manufacturer should the LED bulbs fail. ENSC was informed of this and stated that as per their contract, DAs must return to the home and replace any defective products and deal with the manufacturer directly. ENSC has contacted the DAs to make this requirement clear once again.

Both DAs encountered domestic hot water tanks that had an existing tank wrap installed. In both cases, the tank wrap was too short for the tank and was not properly sealed. These existing wraps were removed and replaced with a new R5.1 tank wrap and sealed with aluminum foil tape. However, because the marginal energy savings would be much lower than the unitary savings for tanks that were not previously wrapped, the DAs were later advised by ENSC to not install wraps on tanks that already had one.

At the time of the on-site visits, only one DA had inventory for the smart power controllers. The explanation for the proper operation of the device was very time-consuming for the DA and contained a significant amount of information for participants to remember for the future.

At the end of the appointment, the DA recorded the required information about the removed and installed products into an electronic device, as well as the participant's signature. Before leaving the site, each DA encouraged the participant to recommend RDI to others. This was done in two ways: one DA provided additional RDI brochures and the other DA handed a sheet to fill out with the contact information of any interested persons that could be faxed or emailed to their office.

Overall the installation process was found to be very systemic and conducted in a professional manner.

4 MARKET EVALUATION

This section presents the findings of the 2014 RDI market evaluation from the partner and participant perspectives.

4.1 Partner Perspectives

Interviews with two DAs were conducted as part of the RDI evaluation. Overall, RDI is viewed as valuable, efficiently administered, and effective in promoting energy efficiency. Changes made to RDI over the past year, specifically CFLs no longer being included since July (with some exceptions) and LED bulbs having been added, have not hindered program delivery and required only minor adjustments.

Marketing is viewed as the greatest impediment to program delivery. Specifically, the limited reach of marketing initiatives and its ineffectiveness in promoting the fact that the program is free of charge and includes LED lamps are viewed as affecting the program uptake. Of note, while ENSC is responsible for approving marketing materials, the majority of the promotional efforts rest on the DAs. Despite this, DAs believe RDI performed well in terms of participation primarily due to referrals and word of mouth, which is consistent with results from the participant surveys.

One DA expressed dissatisfaction with the short-term contractual agreement with ENSC, which limits their ability for long-term planning. As an answer to this problem, ENSC has extended the period of its contractual agreement in 2014. While they are responsible for product selection and purchasing, DAs believe that the small product selection within RDI limits their profit margins. This DA is also under the impression that the longevity of the lower-priced products installed is limited, thus potentially having to handle customers' complaints with product performance after the contractual agreement with ENSC has ended.

In terms of relationship with ENSC staff, mixed opinions were expressed. While one DA praises staff for being available, attentive, helpful and supportive, the other DA is more critical without providing any clarifications. Of note, the least satisfied DA is also the least responsive to participating in the evaluation process. Nonetheless, both DAs believe that ENSC provides them with sufficient opportunity to give input. Both of them have also complimented ENSC staff for their timely response and communication. DAs have limited, but satisfactory interactions with each other.

Both DAs believe that RDI provides an opportunity for energy efficiency education in general and for the promotion of other ENSC programs. To further improve RDI's educational outreach, DAs recommend streamlining promotional materials left with participants by grouping materials in one folder, which is a similar approach to what is currently being done with HEA. This approach would also offer DAs the opportunity to tailor the information to the participant's individual needs. Overall, DAs believe they are knowledgeable of the other ENSC programs that may be of value to participants, and that ENSC provides them with sufficient information and marketing materials in that regard.

Participant complaints are not formerly tracked by DAs, although they are addressed within 24 or 48 hours following receipt and resolved to the participants' satisfaction. Delays are primarily due to the complainants' being unavailable. Complaints are escalated only when a resolution cannot be achieved by the front-line staff. Most complaints relate to CFL bulbs burning out, limited product selection and missed appointment times. However, on-site visit results did not show any particular issues with regular CFLs burning out (only 1 burnt out CFL listed over 600).

4.2 Participant Perspectives

An annual participant survey and four quarterly surveys were conducted as part of the RDI evaluation. In addition to the questions designed for impact evaluation purposes, survey participants were asked questions related to program awareness, barriers and satisfaction.

4.2.1 RDI Awareness

Survey respondents were asked how they found out about RDI. Word of mouth was more likely a source of awareness for 2013 and 2014 participants. RDI was a new program component in 2012, therefore it is not surprising that word of mouth has increased as more residents participate and share their experience with friends and family. Other sources of awareness included advertising from ENSC through mailings, newspapers, and the ENSC website.

Table 6: Sources of Awareness

Sources of Awareness*	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
TOTAL ADVERTISING	29%	19%	26%
Mailings from ENSC	11%	9%	10%
Newspaper	6%	5%	7%
ENSC Website	4%	3%	7%
Radio	8%	3%	2%
Co-worker, family, friend	24%	50%	52%
Mall/In-store booth/display	-	3%	6%
Television	-	6%	5%
ENSC staff/DA	24%	9%	4%
Home show/Trade show	-	2%	3%
Other participants	2%	3%	2%
Participated in other programs or completed an energy audit	16%	2%	1%
Brochure/Pamphlet	2%	1%	-
Others	8%	8%	10%
Don't know	5%	9%	5%
*Multiple responses			

4.2.2 Motivations and Barriers to Participation

The main reason for participating in RDI is to save on energy costs, which has been a consistent reason over the last three years.

Table 7: Reasons for Participating

Reasons for Participating	2012		2013		2014	
	Most Important Motivation	Other Important Motivations*	Most Important Motivation	Other Important Motivations*	Most Important Motivation	Other Important Motivations*
<i>Sample Size</i>	181	179	159	155	164	163
To save on energy/energy costs	69%	20%	76%	19%	73%	20%
No cost for services/program was free	8%	6%	9%	8%	7%	3%
To help protect the environment	3%	7%	1%	9%	4%	8%
Wanted energy efficient upgrades	-	-	1%	5%	4%	2%
To receive CFLs	7%	6%	3%	1%	2%	4%
To become more informed about energy efficient upgrades	-	-	2%	1%	2%	1%
To receive LED lights at a discounted price	1%	1%	3%	-	1%	2%
To reduce water consumption	1%	2%	-	-	-	3%
Comfort	-	1%	-	-	-	1%
To reduce greenhouse gas emissions	-	4%	-	1%	-	-
Others	10%	8%	4%	3%	7%	7%
None/no other reasons	-	41%	-	55%	-	56%
Don't know	1%	11%	3%	2%	1%	1%
Refused	-	2%	-	-	-	-
*Multiple responses						

Some expressed concerns with RDI prior to taking part in the program—they were worried they *would have to pay fees*, that *the program would not really be free*, that they *would not actually save energy*, or they would be *uncomfortable letting someone into their home*.

Table 8: Concerns with RDI Prior to Taking Part

Concerns with RDI Prior to Taking Part	2012	2013	2014
<i>Sample Size</i>	181	159	164
No	93%	94%	96%
Yes	7%	5%	4%
Don't know	-	1%	-

4.2.3 RDI Impact

The majority of participants recalled receiving information about energy efficient products from the installer (70% in 2014). This information led to a change in behaviour for approximately one-half of those who received the information (51%). Table 9 indicates the behavioral changes mentioned by those participants.

Table 9: Behavioural Changes

Behavioural Changes*	2012	2013	2014
<i>Sample Size**</i>	66	65	58
I turn off my lights now	48%	48%	52%
More aware of power usage/saving energy	18%	34%	17%
I turn off appliances	5%	8%	14%
Reduce water consumption/Not wasting water	9%	12%	10%
Unplug items not in use	-	-	5%
I use energy-efficient light bulbs	9%	6%	3%
I use cold water to wash my clothes	9%	5%	3%
I set my water heater thermostat at lower temperatures	3%	-	3%
Bought energy-efficient appliances	-	-	3%
Use appliances more efficiently/Run dishwasher at night	8%	5%	2%
Aware of how to use CFLs properly/let CFLs warm up	12%	3%	2%
I set my heating thermostat at lower temperatures	3%	3%	2%
Improved insulation	-	2%	2%
Use Embertec/audiovisual controller to shut off TV/stereo	-	5%	-
I hang my clothes to dry	-	3%	-
Installed new heating system/heat pump	-	3%	-
I decided to participate in ENSC's Home Energy Assessment program	-	2%	-
I decided to participate in ENSC's Appliance Retirement	2%	-	-
Others	14%	8%	14%
Don't know	-	5%	10%
*Base: Respondents who indicated their behaviour had changed			
**Multiple responses			

4.2.4 Satisfaction with RDI

RDI achieved a very high level of satisfaction, with the majority of participants highly satisfied with the program overall. Nearly all participants are satisfied with the time required to complete the work, and participants reported that it took on average 13 days for the products to be installed after they were first contacted by ENSC. As for other aspects of the program, participants are highly satisfied with the quality of the work performed, program communication and the energy conservation measures installed. Nearly all participants also found the application process for RDI to be easy.

Table 10: Satisfaction with RDI

Satisfaction with RDI	2012		2013		2014	
	Sample Size*	%**	Sample Size*	%**	Sample Size*	%**
Time required to complete the work	181	98%	158	96%	164	99%
Quality of the work completed	181	97%	158	95%	162	97%
Overall program communication	181	95%	158	91%	160	94%
Program overall	179	96%	159	89%	163	90%
Energy conservation measures installed	175	96%	153	90%	158	85%
Application process***	171	92%	155	93%	160	96%
Don't know removed from calculations **Percentage of respondents who gave a rating of 5 or 4 on a scale where 5 = "Very satisfied" and 1 = "Not at all satisfied" *Percentage of respondents who gave a rating of 5 or 4 on a scale where 5 = "Very easy" and 1 = "Very difficult"						

There are a number of reasons as to why participants were satisfied with RDI. In addition to the benefit of saving energy, some participants also mentioned that they liked the installer who visited the home or had received good service. Several participants commented on how efficient the installer was. One participant commented: *"The installer was fast at doing it, and it seemed he was in and out in no time. Very efficient."*

Reasons given by the few dissatisfied participants are similar to those provided in previous years, with participants indicating they did not experience a decrease in their energy costs, did not like the light bulbs they received or expected more out of the program. Those who commented that the program had not met their expectations had special situations that were difficult to accommodate or that were inappropriate for upgrades.

4.2.5 Recommendations for Improvement

As in previous years, many participants were unable to offer recommendations to improve RDI. A small number mentioned that more products or measures should be installed through the program, including heat pumps, LED bulbs, various appliances or thermostats.

Table 11: Recommendations for Improvement

Suggestions*	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Offer more products/measures to be installed	6%	9%	10%
Better advertising/program awareness	13%	5%	4%
Offer more information on the products/measures installed	5%	4%	3%
Better/brighter light bulbs	2%	3%	3%
Improve communication	5%	2%	2%
Improve quality of work	1%	1%	1%
Complete work faster	-	-	1%
Rebates for measures already installed/ Compensation for bigger projects	3%	-	-
Issues with faucet aerator	1%	-	-
None/no other recommendations	67%	73%	68%
Others	4%	8%	10%
*Multiple responses			

5 IMPACT EVALUATION FOR RDI

The objective of the 2014 RDI impact evaluation is to determine the gross and net energy savings generated by the energy-efficient products installed in participating households.

Both electrical energy and peak demand savings are estimated in the impact evaluation by analyzing the following parameters:

- › Unitary savings values used for each product type
- › Installation rates
- › Demand-to-energy ratio
- › Interactive effect factors
- › Free-ridership
- › Spillover

5.1 Gross Savings

The quantities of products installed under the program were computed in the tracking sheet. For each product, ENSC uses a unitary savings estimate that is based on past evaluation results, a literature review and technical data collected on-site.

The following sections describe how these unitary savings values were estimated by ENSC and present Econoler's review of these values based on the most recent studies and data collected during the on-site visits.

5.1.1 CFLs

Tracked Savings

In the tracking sheet, the quantity of CFLs installed is recorded under a different field for each combination of replaced lamp wattage (40 W, 60 W or 100 W) and new lamp wattage (13 W or 23 W). ENSC uses a different unitary savings value for each category, based on the difference between the old and new wattages. For instance, the "13-watt CFLs replacing a 40-watt incandescent lamp" category corresponds to a displaced wattage of 27 watts.

ENSC lists the unitary savings values for each category of CFL, along with the assumptions used for their calculation, in a separate tab titled "Reference Table". The Reference Table presents the wattage values for both the old and the new lamps, as well as the hours of operation—a value of 2.7 hours per day. This value comes from a metering study conducted for Hydro-Québec's CFL program and takes into account the proportions of CFLs installed inside and outside the home. The unitary savings values for all categories of CFL are therefore consistent with the recommended values contained in the last evaluation report.

The unitary savings values presented in Table 12 were calculated by ENSC using the following equation for each category of CFL:

$$\text{Annual Unitary Savings} \left[\frac{kWh}{yr} \right] = \frac{(\text{Old Wattage} - \text{New Wattage}) \times 2.68 \frac{h}{day} \times 365 \frac{day}{yr}}{1000 \frac{W}{kW}}$$

Table 12: Tracked Unitary Savings Values for Each Category of CFL

Category of CFL	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (h/day)	Unitary Savings Value (kWh/year)
13 W replacing 40 W	40	13	27	2.7	26.6
13 W replacing 60 W	60	13	47	2.7	46.3
13 W replacing 100 W	100	13	87	2.7	85.7
23 W replacing 40 W	40	23	17	2.7	16.8
23 W replacing 60 W	60	23	37	2.7	36.5
23 W replacing 100 W	100	23	77	2.7	75.9
Specialty	61.4	14.5	46.9	2.7	46.2

Revised Savings

Because the regular CFLs were removed from RDI in July 2014, the unitary savings values tracked by ENSC and based on the past evaluation were still considered adequate for this evaluation and were not revised.

5.1.2 LED Lamps

Tracked Savings

Since the removal of CFLs, LED lamps are offered for free to the RDI participants. In the current tracking sheet, the amount of LED lamps installed is recorded under a different field for each combination of replaced lamp wattage (40 W, 60 W or 100 W) and new lamp wattage (8 W, 10.5 W, 11 W or 12 W).

As for CFLs, the unitary savings estimate for each product category is based on the real wattage values of the new LED lamp and the old incandescent lamp it replaces, as well as the hours of operation. Contrarily to CFLs, ENSC uses a value of 2.68 hours per day for hours of operation. This value also comes from the Hydro-Québec's metering study, but is specific to indoor usage.

Table 13: Tracked Unitary Savings Values for Each Category of LED

Category of LED	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (h/day)	Unitary Savings Value (kWh/year)
8 W replacing 40 W	40	8	32	2.68	31.3
8 W replacing 60 W	60	8	52	2.68	50.9
8 W replacing 100 W	100	8	92	2.68	90
10.5 W replacing 40 W	40	10.5	29.5	2.68	28.9
10.5 W replacing 60 W	60	10.5	49.5	2.68	48.4
10.5 W replacing 100 W	100	10.5	89.5	2.68	87.5
11 W replacing 40 W	40	11	29	2.68	28.4
11 W replacing 60 W	60	11	49	2.68	47.9
11 W replacing 100 W	100	11	89	2.68	87.1
12 W replacing 40 W	40	12	28	2.68	27.4
12 W replacing 60 W	60	12	48	2.68	47
12 W replacing 100 W	100	12	88	2.68	86.1

Revised Savings

All of the above values were reviewed by Econoler during this evaluation. To do so, the Evaluator analyzed the information on lamp wattages collected during on-site visits and performed a literature review to validate the hours of operation.

Displaced Wattage

The displaced wattage is currently based on the real wattage values of the old lamp that was replaced and the new LED lamp that was installed.

In the vast majority of cases, the replacement lamp light output was consistent with the output of replaced incandescent lamps. Only a small percentage of cases with significant light output differences were identified. For instance, approximately two percent of the installed 13-W CFLs replaced 100-W incandescent lamps, while 13-W CFLs are equivalent to either 40 W or 60 W incandescent lamps. It was assumed that this was due to initial illumination levels that were too high, and was not identified as a problem because it represented a small proportion of the installed lamps.

Because lamps are replaced before they reach the end of their useful life, changing regulations and market do not affect the baseline. Moreover, LED lamps are only installed to replace incandescent or halogen lamps and not CFLs. Therefore, the Evaluator concludes that ENSC's displaced wattage calculations are adequate.

Hours of Operation

To review the hours of operation, Econoler applied some of the principles promoted by the Uniform Methods Protocol (UMP). Since it was impossible to conduct a metering study specific to Nova Scotia due to budgetary constraints, the Evaluator relied on a literature review of secondary data to establish the hours of operation of the LED lamps installed through RDI.

As noted by the UMP, LED lamps are only beginning to represent significant percentages of savings in energy efficiency programs in North America. Consequently, few metering studies apply specifically to this type of lamp, and the literature review conducted by the Evaluator includes mainly studies focusing on the hours of operation of CFLs. Furthermore, many other jurisdictions that have included LED lamps in their energy efficiency programs also calculate the resulting savings based on metered hours of operation of CFLs. This is the case, for instance, for Massachusetts³, the California Municipal Utilities Association⁴, Maine⁵ and Illinois⁶. It was therefore assumed that all metering studies on residential lighting could be used to estimate the hours of operation of LED lamps.

Residential lighting metering studies were therefore selected by the Evaluator, based on the following criteria recommended by the UMP⁷:

- › Similarities in service territories
- › Appropriate sample size
- › Length of metering period

³ Massachusetts Electric and Gas Energy, *Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, 2013-2015 Program Years*, 2012, p. 39

⁴ Energy & Resource Solutions, *Savings Estimation Technical Reference Manual for the California Municipal Utilities Association*, May 5, 2014, 136 p.

⁵ Efficiency Maine, *Residential Technical Reference Manual, version 2014.1*, July 1, 2013, p. 7

⁶ State of Illinois, *Illinois Statewide Technical Reference Manual for Energy Efficiency, version 3.0*, February 24, 2014, 675 p.

⁷ NREL, *Uniform Methods Protocol Chapter 6 : Residential Lighting Evaluation Protocol*, February 2014, p. 6-20, available at < http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf>

While the UMP suggests to prioritize studies that reflect varying hours of use by room type, it was not done in this case, as all sockets containing incandescent or halogen lamps—independently from their location—are replaced by RDI DAs. Table 14 presents relevant CFL metering studies conducted in the northeastern United States and in Canada. Some studies already included in the 2012 evaluation were kept, while newer studies were added to this selection.

Table 14: Residential Lighting Metering Studies

Region and Year	Hours of Use (hrs/day)	Number of Homes	Number of Loggers	Metering Period
Hydro-Québec, 2011 ⁸	Indoor: 2.68 Outdoor: 3.6	200	787	2010
Michigan, 2012 ⁹	Indoor: 2.2 Outdoor: 3.0	152	628	2010–2012
New England States, 2014 ¹⁰	All bulbs: 2.7 Efficient bulbs: 3.0	848	4,462	2012-2013
Illinois, 2012	Indoor: 2.57 Outdoor: 5.0	67	527	2010-2011

The study for the New England states (Massachusetts, Rhode Island, Connecticut, New York) is of particular interest for the following reasons: (1) it is the most recent study, (2) its sample is by far the greatest of all studies and (3) it includes a very detailed analysis of variations in hours of operation by type of bulbs (including LEDs), geographical location and household type.

Indeed, some conclusions of this study allow for a better understanding of the lighting usage patterns that apply to the RDI participants. For instance, the study did not find many significant differences between areas, home types and income types, but it did reveal significant differences comparing hours of operation by bulb efficiency. Bulbs considered to be inefficient included halogen and incandescent bulbs, while efficient bulbs consisted of CFLs, LEDs and fluorescent bulbs.

While it would seem logical to use the efficient bulb value of 3.0 hours per day for LEDs in comparison to 2.7 hours per day for all bulb types, the explanation given in this study for the variation between the hours of operation of all bulbs and efficient bulbs suggests otherwise. Three different theories have been put forward to explain why efficient bulbs are used a greater number of hours:

- › Differential socket selection: the assumption that most used sockets in a household will be selected to install efficient bulbs.
- › Shifting usage: the assumption that once an efficient bulb is installed, it will be favoured over other sockets containing inefficient bulbs.

⁸ Econoler, *Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel*, Report presented to Hydro-Québec, Quebec, March 30, 2011.

⁹ Opinion Dynamics & The Cadmus Group, *CFL Hours of Use Study Summary of Approach and Results*, July 2012.

¹⁰ NMR Group inc. and DNV GL, *Northeast Residential Lighting Hours-of-Use Study*, May 5, 2014, 69 p.

- › Snapback: the assumption that there is a tendency to use an efficient product more than the inefficient product it replaced.

Since in RDI almost every incandescent and halogen bulb in the house is replaced by LEDs (except if the fixture cannot house a LED lamp), the opportunity for differential socket selection and shifting usage is expected to be very limited.. In addition, the additional time of use that resulted from the snapback effect should also be removed from the average hours of operation used to estimate savings following the installation of a more efficient light bulb. Consequently, the average hours of operation for all bulbs, initially estimated at 2.7 hours per day, is considered to be the most appropriate value for the LED lamps installed through RDI. This value is similar to the hours of operation used for CFLs, which were based on Hydro-Québec's metering study. Both values account for a proportion of lamps installed outdoors, which is a good thing since this year's on-site visits have demonstrated that a proportion of LED lamps installed through RDI were installed outside. Therefore, a small adjustment was made to the hours of operation used in the tracked savings calculation, increasing the hours from 2.68 hours per day to 2.7 hours per day. The revised unitary savings values for each category of LED lamp are presented in Table 15.

Table 15: Revised Unitary Savings Values for Each Category of LED

Category of LED	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (h/day)	Unitary Savings Value (kWh/year)
8 W replacing 40 W	40	8	32	2.7	31.5
8 W replacing 60 W	60	8	52	2.7	51.2
8 W replacing 100 W	100	8	92	2.7	90.7
10.5 W replacing 40 W	40	10.5	29.5	2.7	29.1
10.5 W replacing 60 W	60	10.5	49.5	2.7	48.8
10.5 W replacing 100 W	100	10.5	89.5	2.7	88.2
11 W replacing 40 W	40	11	29	2.7	28.6
11 W replacing 60 W	60	11	49	2.7	48.3
11 W replacing 100 W	100	11	89	2.7	87.7
12 W replacing 40 W	40	12	28	2.7	27.6
12 W replacing 60 W	60	12	48	2.7	47.3
12 W replacing 100 W	100	12	88	2.7	86.7

5.1.3 LED Nightlights

Tracked Savings

For LED nightlights installed through RDI, ENSC uses an estimated unitary savings value of 29.3 kWh per year. The assumptions used to make the savings calculation are presented in Table 16.

Table 16: Tracked Unitary Savings Value for LED Nightlights

Parameter	Value
Old Wattage (incandescent nightlight)	7 W
New Wattage (LED nightlight)	0.3 W
Average Displaced Wattage	6.7 W
Operating Time	12 h/day
Unitary Savings	29.3 kWh/year

Revised Savings

The old wattage for incandescent nightlights and their hours of operation are still considered adequate. This year, the only variation is on the wattage value of the LED nightlights installed. One DA installed a 0.5 W nightlight, while the product used by the other DA had a wattage of 0.3 W. The Evaluator consequently used a weighted average of the wattage, based on the amount of nightlights installed by each DA. This results in a revised annual unitary savings of 29.1 kWh.

Table 17: Revised Unitary Savings Value for LED Nightlights

Parameter	Value
Old Wattage	7 W
New Wattage	0.36 W
Average Displaced Wattage	6.7 W
Hours of operation	12 h/day
Unitary Savings	29.1 kWh/year

5.1.4 Faucet Aerators

Tracked Savings

For all faucet aerators installed in homes with electrical domestic hot water (DHW) systems through RDI, ENSC uses a unitary savings value of 176.3 kWh per year. This value comes from the 2011 Ontario Power Authority (OPA) Prescriptive Measures and Assumptions report.

The OPA reports a base flow rate of 2.2 gpm (8.33 L/min) having been reduced to 1.5 gpm (5.68 L/min) as a result of installing the faucet aerator, which represents a reduction of 31.8 percent.

The daily use of hot water in faucets is estimated at 28.27 liters per day per household, equally divided between three faucets. Therefore, the unitary savings value used by ENSC corresponds to an average value per faucet.

Revised Savings

The Econoler team reviewed this unitary savings value by conducting a literature review to validate the assumptions used by the OPA in its 2011 Prescriptive Measures and Assumptions¹¹. It should be noted that while the OPA published a new version of that document in 2014, the calculation details for faucet aerators were not available at the time of this evaluation, and so the assumptions used by the OPA in 2011 were retained.

The OPA provides assumptions for the base (2.2 gpm) and low flow (1.5 gpm) rates of faucet aerators, and the average daily hot water usage for the total number faucets in a household. The OPA uses the full throttle flow rates for the pre- and post-installation of the faucet aerator, which rarely occurs as people often use only a part of the faucet total flow rate. The absolute flow rate reduction is therefore inferior to the gap between the regular and low-flow full throttle.

As part of a 2003 Aquacraft residential metering study¹², cited in the Illinois Technical Reference Manual (TRM) references, a metering of flow rates and hot water tanks was conducted. A total of 99 aerators and 10 hot water tanks were metered for a period of two weeks before and after the retrofit of the faucet aerators. The nominal flow rate of 79 of the 99 aerators used in the study is 1.5 gpm, which corresponds to the flow rate of aerators being installed as part of RDI (the remaining 20 aerators had a flow rate of 2.2 gpm). The metering data indicated that 1.2 gpm and 0.94 gpm were the average flow rates pre- and post-retrofit, respectively. The reduction in flow rate resulting from the installation of an aerator is therefore lower at only 0.26 gpm (or 21.7% savings with respect to the initial 1.2 gpm rate), than the 0.7 gpm (31.8% savings) claimed in the OPA report.

The faucet aerators installed through RDI are currently being registered in the tracking sheet with an indication of their respective faucet locations, i.e., kitchen or bathroom. The Econoler team was unable to find reliable and specific savings estimates or flow rate values that would take the faucet locations into account. Similarly to the OPA, most jurisdictions estimate an average annual savings divided equally across all faucets in a household. One program evaluation conducted by Cadmus for the state of Wisconsin¹³ considered that, on average, each kitchen faucet was used 4.51 minutes per day per person, while each bathroom faucet is used 1.65 minutes per day per person. Since the only

¹¹ Ontario Power Authority, *2011 Prescriptive Measures and Assumptions, Release Version 1*, March 2011, 646 p., available at <<http://www.powerauthority.on.ca/sites/default/files/2011PrescriptiveMeasuresAssumptionsListVersion1.pdf>> (Last accessed November 24, 2014)

¹² Aquacraft, Inc. Water Engineering and Management, *Residential Indoor Water Conservation Study*, July 2003.

¹³ The Cadmus Group, Inc. *Focus on Energy Evaluated Deemed Savings Changes for the Public Service Commission of Wisconsin*, November 26, 2013, available at <[https://focusonenergy.com/sites/default/files/FOC_XC_Deemed_WriteUp_12122013%20\(2\).pdf](https://focusonenergy.com/sites/default/files/FOC_XC_Deemed_WriteUp_12122013%20(2).pdf)> (Last accessed September 24, 2014)

justification for those values were “engineering estimates”, the Evaluator chose not to modify their methodology based on this study.

The OPA states that the total number of faucets per single-family house, without specifying the average number of people per household, is three (one in the kitchen and two in the bathrooms). The Evaluator, however, made their own estimate on the number of faucets per household, based on the results of the 2014 on-site visits, which is 2.8 faucets per household. The OPA extracted the value for hot water faucet consumption per household (22.4 gpd) from a CBEEDAC article ¹⁴.

Using the assumptions from all of these sources, the Econoler team determined a new unitary savings value of 125 kWh per year for RDI low-flow faucet aerators, which more accurately portrays the RDI scenario.

Table 18 lists the variables, and their respective sources, used to establish the unitary savings value for low-flow faucet aerators.

Table 18: Revised Unitary Savings Value for Low-flow Faucet Aerators

Parameter	Unitary Savings (kWh/year)	Source
Housing Type	Single Family	-
Baseline Flow Rate [gpm]	1.2	2003 Aquacraft Study
Low-flow Rate (gpm)	0.94	2003 Aquacraft Study
DHW Used per Household for Total Number of Faucets [gpd]	22.3	CBEEDAC
Number of Faucets per Household	2.8	RDI 2014 On-site visits (n=47)
Specific Heat of Water (Cp) [Btu/lb°F]	1	Convention
Density of Water (ρ) [lb/ft ³]	62.43	Convention
Temperature Rise in Electric Water Heater (ΔT) [°F]	79	2011 OPA
Days per Year	365	Convention
Unit Conversion #1 (UC1)	1 kWh / 3412 Btu	Convention
Unit Conversion #2 (UC2)	0.1337 ft ³ / 1 gal	Convention
Electric Water Heater Efficiency (η)	97%	Pennsylvania Public Utility Commission TRM
Unitary Savings	125 kWh/year	

¹⁴ Canadian Building Energy End-Use Data & Analysis Centre, *Domestic Water Heating and Water Heater Energy Consumption in Canada*, April 2005, page 29.

The algorithm used to calculate the unitary saving value is as follows:

$$\text{Base DHW Consumption} = (22.3 \text{ gpd} \div 2.8 \text{ faucets}) = 7.96 \text{ gpd}$$

$$\% \text{ DHW Reduction} = \frac{(1.2 \text{ gpm} - 0.94 \text{ gpm})}{1.2 \text{ gpm}} = 0.217$$

$$\text{Efficient DHW Consumption} = 7.96 \text{ gpd} \times (1 - 0.217) = 6.24 \text{ gpd}$$

$$\Delta kWh = \frac{(\text{Base} - \text{Eff}) \times Cp \times \rho \times \Delta T \times \frac{\text{Days}}{\text{yr}} \times UC1 \times UC2}{\eta}$$

$$\Delta kWh = \frac{(7.96 - 6.24) \times 1 \times 62.43 \times 79 \times 365 \times \left(\frac{1}{3412}\right) \times 0.1337}{97\%}$$

$$\Delta kWh = 125 \text{ kWh per year}$$

5.1.5 Low-flow Showerheads

Tracked Savings

For low-flow showerheads installed in homes with electrical DHW systems through RDI, ENSC uses a specific unitary savings value of 288 kWh, 377 kWh or 607 kWh depending on the flow rate reduction, which can be respectively 0.5 gpm, 0.75 gpm or 1.0 gpm. This unitary savings value is derived from the 2011 OPA Prescriptive Measures and Assumptions.

Revised Savings

The Econoler team reviewed this unitary savings value by conducting a literature review to validate the assumptions used by the OPA. The OPA provides assumptions for the showerhead base (1.75 gpm to 2.25 gpm) and low flow (1.25 gpm) rates, the number of showers per day per household, the average showering time and the average shower temperature. The hot water consumption is, however, not provided, and multiple attempts at deriving 288 kWh, 377 kWh or 607 kWh as values were not successful.

To determine the savings for the three possible flow rate reductions, the average shower duration and the percentage of DHW used in the mixed shower water was obtained from an extensive water metering study by Mayer and Oreo¹⁵ and the CBEEDAC¹⁶ respectively. The Mayer and Oreo study also provided data from which the average number of showers per day and per person was obtained. The average number of people per household was extracted from the RDI 2014 annual survey.

¹⁵ Mayer, P. W., W. B. Oreo et al., *Residential End Uses of Water*, published by the AWWA Research Foundation, 1999, p.99-102.

¹⁶ Canadian Building Energy End-Use Data & Analysis Centre, *Domestic Water Heating and Water Heater Energy Consumption in Canada*, April 2005, page 29.

Table 19 lists the variables used to establish the revised unitary savings value associated with each flow rate reduction and is followed by the equations used to obtain those savings.

Table 19: Revised Unitary Savings Value for Low-flow Showerheads¹⁷

Parameter	Unitary Savings (kWh/year)	Source
Baseline Flow Rate (gpm)	Variable (2.0 gpm, 2.25 gpm or 2.5 gpm)	Tracking sheet
Low-flow Rate (gpm)	1.5	On-site visits
Number of People per Household (RDI)	2.4	RDI 2014 Annual Survey (n=164)
Average Number of Showers per Day per Person	0.67	Mayer and Oreo
Average Shower Time per Person (min)	8.3	Mayer and Oreo
Percentage of Hot Water Used in Showers	73%	CBEEDAC
Specific Heat of Water (Cp)	1 Btu/lb°F	Convention
Density of Water (ρ)	62.43 lb/ft ³	Convention
Temperature Rise in Electric Water Heater (ΔT)	79°F	OPA
Days per Year	365	OPA
Unit Conversion #1 (UC1)	1 kWh / 3412 Btu	Convention
Unit Conversion #2 (UC2)	0.1337 ft ³ / 1 gal	Convention
Electric Water Heater Efficiency (η)	97%	Pennsylvania Public Utility Commission TRM ¹⁸
Unitary Savings	Flow rate reduction of 0.5 gpm	354 kWh/year
	Flow rate reduction of 0.75 gpm	531kWh/year
	Flow rate reduction of 1 gpm	708kWh/year

¹⁷ Pennsylvania Public Utility Commission, *Technical Reference Manual*, State of Pennsylvania, June 2013, pages 45–48.

¹⁸ Pennsylvania Public Utility Commission, *Technical Reference Manual*, State of Pennsylvania, June 2013, page 174.

The algorithm used to calculate the unitary saving value is as follows:

$$\begin{aligned} & \frac{DHW \text{ reduction}}{\text{year}} \\ &= (flowrate_{base} - flowrate_{eff}) \text{ gpm} \times 2.4 \text{ persons} \times 73\% \times 8.36 \frac{\text{min}}{\text{shower}} \\ & \times \frac{0.58 \text{ shower}}{\text{day.person}} \times \frac{365 \text{ days}}{\text{year}} = 150,2,325 \text{ or } 3,100 \text{ gal DHW/year} \\ & \Delta kWh = \frac{DHW \text{ reduction} \times Cp \times \rho \times \Delta T \times UC1 \times UC2}{\eta} \\ & \Delta kWh = \frac{(DHW \text{ reduction}) \times 1 \times 62.43 \times 79 \times \left(\frac{1}{3412}\right) \times 0.1337}{97\%} \end{aligned}$$

5.1.6 Pipe Insulation

Tracked Savings

For each three-foot unit of insulated pipe, ENSC uses a savings value of 38 kWh per year. The source of this value is the OPA 2011 report. No further savings are given when the length of the insulated piping is greater than 15 ft, for a maximum value of 190 kWh.

Revised Savings

To revise the savings, the Evaluator consulted various technical reference manuals from similar jurisdictions. It was found that the savings per foot of pipe varied significantly. For instance, the Mid-Atlantic 2013 TRM¹⁹ claims gross savings as much as 104 kWh for 4 ft of pipe insulation. Other jurisdictions, such as Maine²⁰, base their savings on a percentage of the total DHW energy usage (3%).

However, the OPA value of 38 kWh per 3 ft, which is also maintained in the new version (2014) of the OPA Prescriptive Measures List and Assumptions, seems to be the most applicable. It uses the same thickness of insulation as what is installed under RDI (1/2 in). Furthermore, it considers that the heat losses in pipes containing hot water (at 55 °C) only occur for 1,475 hours per year, while some other studies use the assumption that these losses occur 8,760 hours per year. The OPA assumption is considered more realistic because, to keep the water in the pipe at a high temperature, water from the domestic hot water tank would have to flow regularly. Otherwise, the water in the pipe loses heat to the ambient air (more slowly if it is insulated), until it reaches a balance point where no heat is exchanged.

¹⁹ Northeast Energy Efficiency Partnerships, *Mid-Atlantic Technical Reference Manual, Version 3.0*, March 2013, p. 135.

²⁰ Efficiency Maine Trust, *Residential Technical Reference Manual*, July 1, 2013, p. 25

Therefore, the Evaluator decided to keep using the unitary savings value of 38 kWh per year per length of 3 ft, based on the OPA report.

Even though this was not the case at the time of conducting the last evaluation, the length of installed pipe insulation is now documented for each unit. It was found that, contrary to what was concluded in the 2012 evaluation, a large proportion of participants (more than 50 %) had more than 15 ft of insulation installed on their pipes. In 2012, the suggestion was made to limit savings to the value corresponding to 15 ft of insulation, mostly to avoid calculating large savings in homes where too much insulation had potentially been installed. ENSC however made the decision to keep installing insulation on all exposed surfaces, even beyond 15 ft per house, mainly to ensure the satisfaction of participants. The on-site visits conducted this year by the Evaluator showed that most homes where a large quantity of insulation had been installed had exposed piping in the basement, which was effectively reducing heat losses. No maximum length of pipe insulation was therefore applied to the energy savings calculation for RDI in 2014.

5.1.7 Hot Water Tank Wraps

Tracked Savings

Hot water tank wraps are installed on electric tanks under RDI. For this product, ENSC uses a unitary savings value of 270 kWh per year, based on the 2011 OPA Prescriptive Measures and Assumptions. It is worth mentioning that OPA still uses the same savings value in its 2014 version of this list. This value is based on a conductance value of 1.429 W/°C for a heater without a tank wrap and of 0.6348 W/°C for an insulated heater with a tank wrap.

Revised Savings

In 2014, the installed tank wrap RSI-value was 0.90 m²·°C/W. This was confirmed with DAs during on-site visits.

Econoler reviewed the assumptions and the engineering calculations used by both the Pennsylvania Public Utility Commission and the OPA. Both use the same equation to estimate savings:

$$\text{Unitary savings for HW tank wrap} = \frac{(U_{\text{base}}A_{\text{base}} - U_{\text{insul}}A_{\text{insul}}) \times (T_{\text{setpoint}} - T_{\text{ambient}})}{\eta_{\text{Elec}}} \times \text{HOU}$$

Where:

- › U_{base} : thermal transmittance per area unit of water heater prior to adding tank wrap [W/m²·°C]
- › A_{base} : surface area of storage tank prior to adding tank wrap [m²]
- › U_{insul} : thermal transmittance per area unit of water heater after addition of tank wrap [W/m²·°C]
- › A_{insul} : surface area of storage tank after addition of tank wrap [m²]
- › η_{Elec} : thermal efficiency of electric heater element [-]
- › T_{setpoint} : setpoint temperature of the DHW tank [°C]
- › T_{ambient} : ambient temperature [°C]
- › HOU: hours of operation [hrs]

The main difference between the OPA and the Pennsylvania Public Utility Commission TRM is the following: the OPA document does not provide the values used for the thermal transmittance per area unit and the total area of the tank, but only one aggregated value for their product ($U \times A$), while the Pennsylvania Public Utility Commission TRM gives both values for a number of different tank sizes and levels of insulation.

The equation used by both utilities presents one significant drawback: as the insulation thickness increases, so does the outside area of the tank. This does not faithfully represent heat transfer, as the difference in temperature between hot water and ambient air does not occur on the outside diameter of the tank wrap, which can result in the heat loss of the DHW tank being overestimated. Therefore, the Evaluator adjusted the engineering calculation to better estimate the energy savings associated with the specific tank wraps installed in RDI. These energy savings are equal to the difference in heat losses from the circumference of the tank before and after the addition of the tank wrap, which are calculated using the formula of heat transfer in an insulated cylinder:

$$R_{layer} = \frac{\ln(r_e/r_i)}{2\pi k}$$

$$R_{cyl} = R_{layer1} + R_{layer2}$$

$$Q_{cyl} = \frac{T_i - T_e}{R_{cyl}} L$$

$$Q_{top} = \frac{A_{top} \times (T_i - T_e)}{R_{top}}$$

$$Annual\ energy\ consumption = \frac{(Q_{cyl} + Q_{top}) \cdot HOU}{\eta_{heater}}$$

Where:

- › R_{layer} : thermal resistance of a layer of material in the cylinder (e.g., insulation inside the tank, tank wrap) [$m \cdot ^\circ C/W$]
- › r_e : external radius of the layer [m]
- › r_i : internal radius of the layer [m]
- › k : thermal conductivity of the layer [$W/m \cdot ^\circ C$]
- › R_{cyl} : overall thermal resistance of the cylinder [$m \cdot ^\circ C/W$]
- › Q_{cyl} : heat transfer through the cylinder [W]
- › T_i : temperature at the internal radius of the cylinder
- › T_e : temperature at the external radius of the cylinder
- › L : length of the cylinder [m]
- › Q_{top} : heat transfer through the top of the tank [W]
- › A_{top} : area of the top of the tank [m^2]
- › R_{top} : thermal resistance of the top of the tank [$m \cdot ^\circ C/W$]
- › HOU: hours of use
- › η_{heater} : thermal efficiency of heating element

The typical tank is an entry-level domestic water heater with a capacity of 60 imperial gallons. This tank capacity was established based on the on-site visits conducted by the Econoler team; a majority of the visited participants had a tank of this capacity.

The values presented in Table 20 were used in conjunction with the previous formulas to obtain the unitary savings for the tank wraps installed in 2014.

Table 20: Revised Unitary Savings Value for Hot Water Tank Wraps

Variable	Value	Unit	Source
Layer 1: Interior Insulation of Tank			
r_e	0.300	M	Giant ²¹
r_i	0.262	M	Idem
k	0.018	W/m°C	Idem
R_{layer}	1.198	m°C/W	Calculation
R_{Top}	2.113	m°C/W	Giant
Layer 2: Tank Wrap RSI-0.90			
r_e	0.338	M	Estimated from Frost King Insulation Blanket specification ²²
r_i	0.300	M	Giant
k	0.042	W/m°C	Estimated from Frost King Insulation Blanket specification
R_{layer}	1.65	m°C/W	Calculation
R_{Top}	3.013	m°C/W	Specification of the blanket
Heat Transfer			
L	1.52	M	Giant
A_{top}	0.283	m ²	Calculated from Giant's data
T_e	21	°C	Assumption for standard ambient temperature indoors
T_i	60	°C	OPA Prescriptive Measures and Assumptions 2011
HOU	8760	h/yr	Assumption
η_{heater}	97%		Pennsylvania Public Utility Commission ²³
Q_{tank}	59.9	W	Calculation
$Q_{tank+RSI-0.90}$	43.3	W	Calculation
Unitary Savings	150	kWh	Calculation

²¹ Giant Inc., *Engineering Submittal Data Sheet 172ETE Models*, < <http://www.giantinc.com/tech-data/FT-172E-An.pdf> > (Last accessed February 18, 2015).

²² Frost King Weatherization Products, *Water Heater Insulation Blanket*, <<http://www.frostking.com/water-heater-insulation-blanket/>> (Last accessed January 4, 2014)

²³ Pennsylvania Public Utility Commission, *Technical Reference Manual*, State of Pennsylvania, June 2013, page 174.

5.1.8 Smart Power Controller for Audiovisual Equipment

Tracked Savings

The smart power controller for audio-visual equipment was included in RDI in 2013. For this product, ENSC uses a unitary savings value of 411 kWh per year, as validated by an independent verification conducted by the Victorian State Government for use in the Victorian White Certificate Scheme²⁴.

This unitary savings value is based on a study conducted in 15 South African households representing a medium-level international audiovisual usage.²⁵ The first trial savings were normalized to 411 kWh per year to represent the savings in an average home audiovisual environment.

Revised Savings

No new study on the energy savings potential of this product was published since the Econoler team reviewed the unitary savings in 2013. Furthermore, the on-site visits conducted by the Evaluator showed that a large majority of participants were indeed using the devices with multiple audiovisual pieces of equipment, which corresponds to the intended use analyzed in the measurement study quoted previously. In fact, only two participants out of a sample of 35 who still used their smart power controller at the time of the on-site visit used it with some non-audiovisual equipment, and all 35 participants had on average three pieces of equipment plugged into their device. Therefore, the unitary savings value is still considered adequate.

²⁴ Embertec – Energy Efficiency Technologies, *Solution Provider Presentation, Maximum Savings – Zero Effort*.

²⁵ Karebo Systems, *Audiovisual standby power controller: Energy savings field trial, South Africa - June-August 2012*, Field trial data analysis, 6 March 2013.

5.1.9 Installation Rates

In order to calculate the RDI installation rates, 50 on-site visits were conducted in participating households. The quantity of installed products was recorded and verified against the quantity indicated in the tracking system. The ratios between the recorded data and the on-site results were calculated and applied as installation rates if the error margin was considered acceptable. Table 21 shows the data collected and the associated installation rates applied to the gross savings calculation.

Table 21: Percentage of Products Installed and Installation Rate

Type of Product	Quantity Installed – From Tracking Sheet	Quantity Installed – From On-site Visits	Percentage of Products Installed	Error Margin ²⁶	Installation Rate Applied to Savings
CFL	600	582	97%	3.1%	97%
LED	658	639	97%	2.8%	97%
LED Nightlights	54	47	87%	7.0%	87%
Hot Water Tank Wrap	30	30	100%	0%	100%
Pipe Insulation (ft)	468	418	89%	7.0%	89%
Faucet Aerators	94	83	88%	7.2%	88%
Low Flow Showerheads	70	64	91%	4.8%	91%
Smart Power Controllers	45	35	78%	13.8%	78%

The smart power controller percentage of installed products was the lowest value of all. All smart power controllers that were uninstalled at the time of the on-site visit had been removed by participants who were not satisfied with the product. Other products that had an installation rate inferior to 90 percent include LED nightlights, pipe insulation and faucet aerators. For nightlights, the low installation rate was mostly due to removals by participants (7 out of 54), while pipe insulation and faucet aerators presented a fair number of entry errors in the program tracking sheet.

Since all installation rates had an acceptable margin of error, each of them was applied to the savings. While the installation rate of smart power controllers presented a slightly higher margin of error, the on-site visits demonstrated that the removal issue is a recurrent problem and not an isolated case. In fact, all uninstalled units (10 out of 45) were removed by the participant for similar reasons. Additionally, the absolute error associated with this installation rate being ± 0.10 , the installation rate remains below 1, even in the event that the error reaches its maximum value ($0.78 + 0.10 = 0.88$).

²⁶ Calculated for a confidence interval of 90%.

5.1.10 Demand-to-Energy Ratio

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.233 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by RDI in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

5.1.11 Revised Gross Savings

The annual gross savings for each category of products installed through the program are presented in Table 22. They were calculated using the revised unitary savings values presented in the previous section. Overall, the total gross energy and peak demand savings amount to 28.019 GWh and 6.528 MW at the meter.

The gross savings at generator level are also estimated in Table 22, using a line loss factor between the meter and the generator of 1.100. This value was provided by Nova Scotia Power for residential customers: more than 99.9 percent of RDI participants have residential rate codes, and the few remaining participants are multi-unit renters from the commercial sector. As a result, the energy and peak demand savings at the generator are respectively of 30.821 GWh and 7.181 MW.

Table 22: Tracked Evaluation Results – Gross Energy and Peak Demand Savings by Product

Category of Product	CFLs						
	13W Replacing 40W	13W Replacing 60W	13W Replacing 100W	23W Replacing 40W	23W Replacing 60W	23W Replacing 100W	Specialty CFLs
Energy Savings							
Total Number of Units	5,308	109,972	2,088	322	6,773	25,794	1,338
Installation Rate	97%	97%	97%	97%	97%	97%	97%
Total Number of Units Installed	5,149	106,673	2,025	312	6,570	25,020	1,298
Unitary Savings Value (kWh)	26.6	46.3	85.7	16.8	36.5	75.9	46.2
Total Gross Energy Savings – at meter (GWh)	0.137	4.939	0.174	0.005	0.240	1.899	0.060
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Gross Energy Savings – at generator (GWh)	0.151	5.433	0.191	0.006	0.264	2.089	0.066
Peak Demand Savings							
Demand-to-Energy Ratio (MW/GWh)	0.233	0.233	0.233	0.233	0.233	0.233	0.233
Total Gross Peak Demand Savings – at meter (MW)	0.032	1.151	0.040	0.001	0.056	0.442	0.014
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Gross Peak Demand Savings – at generator (MW)	0.035	1.266	0.044	0.001	0.061	0.487	0.015

(Continued)

Category of Product	LED Lamps									
	8W Replacing 40W	8W Replacing 60W	8W Replacing 100W	10.5W Replacing 40W	10.5W Replacing 60W	10.5W Replacing 100W	11W Replacing 40W	11W Replacing 60W	11W Replacing 100W	12W Replacing 40W
Energy Savings										
Total Number of Units	35	91	2	8,465	14,3880	9,841	987	14,856	2,171	60
Installation Rate	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%
Total Number of Units Installed	34	88	2	8,211	139,564	9,546	957	14,410	2,106	58
Unitary Savings Value (kWh)	31.5	51.2	90.7	29.1	48.8	88.2	28.6	48.3	87.7	27.6
Total Gross Energy Savings – at meter (GWh)	0.001	0.005	0.000	0.239	6.811	0.842	0.027	0.696	0.185	0.002
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Gross Energy Savings – at generator (GWh)	0.001	0.005	0.000	0.263	7.492	0.926	0.030	0.766	0.203	0.002
Peak Demand Savings										
Demand-to-Energy Ratio (MW/GWh)	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233
Total Gross Peak Demand Savings – at meter (MW)	0.000	0.001	0.000	0.056	1.587	0.196	0.006	0.162	0.043	0.000
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Gross Peak Demand Savings – at generator (MW)	0.000	0.001	0.000	0.061	1.746	0.216	0.007	0.178	0.047	0.000

(Continued)

Category of Product	LED Lamps		LED Nightlights	Faucet Aerator	Low-Flow Showerhead			Pipe Insulation	Hot Water Tank Wrap	Smart Power Controllers	Total for All Products
	12W Replacing 60W	12W Replacing 100W			0.5 gpm Reduction	0.75 gpm Reduction	1.0 gpm Reduction				
Energy Savings											
Total Number of Units	133	56	10,868	15,923	161	2,663	7,381	104,752	7,441	4,137	-
Installation Rate	97%	97%	87%	88%	91%	91%	91%	89%	100%	78%	-
Total Number of Units Installed	129	54	9,455	14,012	147	2,423	6,717	93,229	7,441	3,227	458,857
Unitary Savings Value (kWh)	47.3	86.7	29.1	125	354	531	708	12.7	150	411	-
Total Gross Energy Savings –	0.006	0.005	0.275	1.752	0.052	1.287	4.756	1.184	1.116	1.326	28.019
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Gross Energy Savings – at generator (GWh)	0.007	0.005	0.303	1.927	0.057	1.415	5.231	1.302	1.228	1.459	30.821
Peak Demand Savings											
Demand-to-Energy Ratio (MW/GWh)	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	-
Total Gross Peak Demand Savings – at meter (MW)	0.001	0.001	0.064	0.408	0.012	0.300	1.108	0.276	0.260	0.309	6.528
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Gross Peak Demand Savings – at generator (MW)	0.002	0.001	0.071	0.449	0.013	0.330	1.219	0.303	0.286	0.340	7.181

5.2 Interactive Effects

In a home, interactive effects occur when the implementation of energy efficiency measures has an impact on the energy consumption of other elements such as heating and cooling. In the case of RDI, replacement of incandescent lighting products with CFLs or LEDs causes an increase in the heating load during winter and a decrease in the cooling load during summer. The same effect occurs for hot water insulation measures.

For lighting products, the evaluation of the interactive effect factor is based on a study conducted by ADS in 1992 for Hydro-Québec. The work carried out in this study was intended to modify certain parameters in simulations of an average home in Quebec to determine the impact of these changes on the interactive effects. The simulations were performed with the DOE-2 software²⁷, focusing on homes heated entirely by electricity. The simulations were carried out to analyze three interactive-effects scenarios: low, moderate and high interactive effects. The scenario with minimum interactive effects was finally selected for the calculation because it reflects the evolution of homes since 1992.

The table below presents the calculation details of the interactive effect factor for indoor CFLs, LED lamps and LED nightlights. It reflects the percentages of RDI participants in the 2014 tracking sheet who use electricity for heating and who use air-conditioning.

Table 23: Interactive Effects Calculation for Lighting Products

Parameter	% of Residences ²⁸	Interactive Effects ²⁹
Electric heating with air conditioning	14%	-54.4%
Electric heating without air conditioning	29%	-58.0%
No electric heating with air conditioning	13%	3.6%
No electric heating without air conditioning	44%	0.0%
Weighted Interactive Effect Factor	100%	-24.0%

These interactive effects occur only when the products are installed inside the house. Since CFLs and LED lamps installed through the program are also used for outdoor lighting, the interactive effect factor for these products was adjusted to take that into account. To do so, the proportions of CFLs and LED lamps installed inside houses and on outdoor sockets, as reported in the 2014 Atlantic Survey, were used. For LED nightlights, the interactive effect factor remains -24.0 percent.

²⁷ DOE-2 is a widely used and accepted building energy analysis software tool, developed with U.S. Department of Energy funding.

²⁸ From RDI 2014 tracking sheet.

²⁹ ADS ASSOCIÉS, *Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale*, Report presented to Hydro-Québec, 1992.

Table 24: Interactive Effect Factors for CFLs, LED Lamps and LED Nightlights

Category of Product	% Indoor	% Outdoor	Interactive Effect Factor
CFL	86%	14%	$(86\% \times -24.0\%) + (14\% \times 0\%) =$ -20.6%
LED Lamp	88%	12%	$(88\% \times -24.0\%) + (12\% \times 0\%) =$ -21.1%
LED Nightlight	100%	0%	-24.0%

For pipe insulation and hot water tank wraps, interactive effects of -100 percent are considered during the heating period in electrically heated houses. This estimate is based on the fact that, when there is no insulation, all the heat lost through the pipes and the hot water tank is released into the room. This means that 100 percent of the energy released from the hot water is used for the heating load. Conversely, during the cooling period, interactive effects are estimated at +100 percent in houses that use air conditioning. Based on the heating and cooling degree-days for the Halifax region³⁰, Econoler considered an eight-month heating period and a two-month cooling period in the interactive effects calculation. As a result, a weighted interactive effect factor of -24.2 percent has been considered. The table below presents the calculation details. Similar to the table presented for lighting products, this table shows the percentages of RDI participants who use electricity for heating and who use air conditioning.

Table 25: Interactive Effect Factor for Pipe Insulation and Hot Water Tank Wraps

Parameters	% of Residences ³¹	Interactive Effects During Heating Period	Interactive Effects During Cooling Period
Electric heating with air conditioning	14%	$-100\% \times 8/12 = -67\%$	$+100\% \times 2/12 = +17\%$
Electric heating without air conditioning	29%	$-100\% \times 8/12 = -67\%$	$0\% \times 2/12 = 0\%$
No electric heating with air conditioning	13%	$0\% \times 8/12 = 0\%$	$+100\% \times 2/12 = +17\%$
No electric heating without air conditioning	44%	$0\% \times 8/12 = 0\%$	$0\% \times 2/12 = 0\%$
Weighted Interactive Effect Factor	100 %	-28.8%	+4.6%
		-24.2%	

Finally, for all other products, the interactive effects are considered as negligible.

³⁰ RETScreen International, *Normalized climate data for Halifax International Airport*, Natural Resources Canada, 1997-2010.

³¹ From the 2014 tracking sheet.

5.3 Net-to-Gross Ratio

The net-to-gross ratio (NTGR) evaluation is based on a self-report approach which relies on a series of questions designed to measure the impact of RDI on the participants' decision to implement eligible energy efficiency upgrades and measures.

This section presents the methodology used to transform responses to survey questions into a NTGR. It includes the assessment of two distortion effects: free-ridership and internal spillover.

5.3.1 Free-ridership

In the case of RDI, free-ridership can occur when participants would have still installed the energy efficiency products in the absence of the program. The free-ridership level was measured through the quarterly surveys on a sample of 110 non-low-income participants, using the same algorithm as in the 2012 evaluation. The algorithm behind the free-ridership calculation is presented in Appendix IX.

The 2014 annual survey results revealed a global free-ridership level of 15 percent for RDI. This free-ridership level is lower to that obtained during the 2012 evaluation (19 %). It is possible that the installation of LED lamps instead of CFLs in the second half of 2014 has contributed to the reduction of the FR level.

5.3.2 Internal Spillover

The annual participant survey was also used to assess internal spillover, which can occur when participants purchase and install additional energy efficiency products following their previous participation in the program and because of its impact on their decision-making, thereby demonstrating the advantages of such products.

The methodology used to calculate the level of internal spillover is presented in Appendix X.

The 2014 annual survey results revealed an internal spillover effect factor of six percent among 2014 non-low-income participants. The 2012 evaluation revealed a slightly lower internal spillover level with three percent.

5.3.3 NTGR Calculation

The NTGR is calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership} + \% \text{ internal spillover})$$

Using the free-ridership and internal spillover levels established for non-low-income participants, the NTGR value for this group of participants is estimated at 0.91. NTGR for low-income participants is assumed to be 1.00. Using the proportion of savings from low-income and non-low-income participants, the overall NTGR associated with the program is 0.93. This value was applied to the gross savings calculation.

Table 26: Overall NTGR Calculation for RDI

Group of Participants	Non-low-income	Low-income
NTGR	0.91	1.00
Proportion ³²	77%	23%
Overall NTGR	0.93	

5.4 Net Savings

Net energy savings are estimated by applying the interactive effects and the NTGR to the gross energy savings, using the equation below.

$$\text{Net Energy Savings} = \text{Gross Energy Savings} \times (1 + \text{Interactive Effect Factor}) \times \text{NTGR}$$

The net energy savings were first calculated separately for each product because the interactive effects differed from one product to another. Table 27 presents the details of the calculation.

Overall, the tracked net energy savings and peak demand savings amount to 22.320 GWh and 5.201 MW at the meter and 24.552 GWh and 5.721 MW at the generator.

³² Weighted average of the low-income factor registered in the tracking sheet with the revised gross savings.

Table 27: Evaluated Net Energy and Peak Demand Savings by Product

Category of Product	CFLs						
	13W Replacing 40W	13W Replacing 60W	13W Replacing 100W	23W Replacing 40W	23W Replacing 60W	23W Replacing 100W	Specialty CFLs
Energy Savings							
Total Gross Energy Savings – at meter (GWh)	0.137	4.939	0.174	0.005	0.240	1.899	0.060
Interactive Effect Factor	-20.6%	-20.6%	-20.6%	-20.6%	-20.6%	-20.6%	-20.6%
NTGR	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Total Net Energy Savings – at meter (GWh)	0.101	3.647	0.128	0.004	0.177	1.402	0.044
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Net Energy Savings – at generator (GWh)	0.111	4.012	0.141	0.004	0.195	1.543	0.049
Peak Demand Savings							
Total Gross Peak Demand Savings – at meter (MW)	0.032	1.151	0.040	0.001	0.056	0.442	0.014
Interactive Effect Factor	-20.6%	-20.6%	-20.6%	-20.6%	-20.6%	-20.6%	-20.6%
NTGR	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Total Net Peak Demand Savings – at meter (MW)	0.024	0.850	0.030	0.001	0.041	0.327	0.010
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Net Peak Demand Savings – at generator (MW)	0.026	0.935	0.033	0.001	0.045	0.359	0.011

(Continued)

Category of Product	LED Lamps									
	8W Replacing 40W	8W Replacing 60W	8W Replacing 100W	10.5W Replacing 40W	10.5W Replacing 60W	10.5W Replacing 100W	11W Replacing 40W	11W Replacing 60W	11W Replacing 100W	12W Replacing 40W
Energy Savings										
Total Gross Energy Savings – at meter (GWh)	0.001	0.005	0.000	0.239	6.811	0.842	0.027	0.696	0.185	0.002
Interactive Effect Factor	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%
NTGR	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Total Net Energy Savings – at Meter (GWh)	0.001	0.003	0.000	0.175	4.998	0.618	0.020	0.511	0.136	0.001
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Net Energy Savings – at generator (GWh)	0.001	0.004	0.000	0.193	5.497	0.680	0.022	0.562	0.149	0.001
Peak Demand Savings										
Total Gross Peak Demand Savings – at meter (MW)	0.000	0.001	0.000	0.056	1.587	0.196	0.006	0.162	0.043	0.000
Interactive Effect Factor	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%	-21.1%
NTGR	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Total Net Peak Demand Savings – at meter (MW)	0.000	0.001	0.000	0.041	1.164	0.144	0.005	0.119	0.032	0.000
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Total Net Peak Demand Savings – at generator (MW)	0.000	0.001	0.000	0.045	1.281	0.158	0.005	0.131	0.035	0.000

(Continued)

Category of Product	LED Lamps		LED Nightlights	Faucet Aerator	Low-Flow Showerhead			Pipe Insulation	Hot Water Tank Wrap	Smart Power Controllers	Total for All Products
	12W Replacing 60W	12W Replacing 100W			0.5 gpm Reduction	0.75 gpm Reduction	1.0 gpm Reduction				
Energy Savings											
Total Gross Energy Savings – at meter (GWh)	0.006	0.005	0.275	1.752	0.052	1.287	4.756	1.184	1.116	1.326	28.019
Interactive Effect Factor	-21.1%	-21.1%	-24.0%	0.0%	0.0%	0.0%	0.0%	-24.2%	-24.2%	0.0%	-
NTGR	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	-
Total Net Energy Savings – at meter (GWh)	0.004	0.003	0.194	1.629	0.048	1.197	4.423	0.835	0.787	1.233	22.320
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Net Energy Savings – at generator (GWh)	0.005	0.004	0.214	1.792	0.053	1.316	4.865	0.918	0.866	1.357	24.552
Peak Demand Savings											
Total Gross Peak Demand Savings – at meter (MW)	0.001	0.001	0.064	0.408	0.012	0.300	1.108	0.276	0.260	0.309	6.528
Interactive Effect Factor	-21.1%	-21.1%	-24.0%	0.0%	0.0%	0.0%	0.0%	-24.2%	-24.2%	0.0%	-
NTGR	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	-
Total Net Peak Demand Savings – at meter (MW)	0.001	0.001	0.045	0.380	0.011	0.279	1.030	0.194	0.183	0.287	5.201
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Net Peak Demand Savings – at generator (MW)	0.001	0.001	0.050	0.417	0.012	0.307	1.134	0.214	0.202	0.316	5.721

Table 28: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings					
Tracked Savings from ENSC	32.001 GWh	32.001 GWh	28.423 GWh	0.88	24.960 GWh
Evaluation Results	32.917 GWh	30.821 GWh	26.400 GWh	0.93	24.552 GWh
Peak Demand Savings					
Tracked Savings from ENSC	7.454 MW	7.454 MW	6.621 MW	0.88	5.814 MW
Evaluation Results	7.670 MW	7.181 MW	6.151 MW	0.93	5.721 MW

The evaluated values calculated for the program are slightly lower than those calculated from the tracking system. On one hand, the Evaluator revised the unitary savings downwards for a few products, and most installation rates have decreased as well. On the other hand, the free-ridership level is lower than in 2012, and the spillover level has increased, resulting in a higher NTGR. The two effects largely compensated each other, resulting in only a 2 percent reduction between the evaluated and the tracked net energy savings

6 IMPACT EVALUATION FOR THE CBSM PILOT

The evaluation of the CBSM pilot aimed at quantifying the net savings resulting from the increased proportion of cold water washing done by the CBSM Pilot participants. A total of 438 participants took part in the CBSM Pilot. This section details the calculation methodology used by the Evaluator to establish these savings.

6.1 Unitary Savings Analysis

To obtain an average annual savings value per pilot participant, the following method was used:

- › Establishing the number of laundry loads done per week and the number of loads done in warm water for both the control and treatment groups, using the results of the annual phone survey;
- › Estimating the energy required for water heating for each load of laundry done in warm water.

The annual phone survey was conducted after participants had taken part in either RDI only or RDI and the CBSM Pilot. Various questions concerning the cold water washing habits of participants were included in this survey. The same questions were asked to both regular 2013 and 2014 RDI participants (the control group) and to the CBSM Pilot participants (the treatment group). To ensure that this comparison was actually valid, the Evaluator compared the following average characteristics of the control and participant groups: number of people per household, age of participants, proportion of participants who pay their own electricity bill. It was concluded that all participants of the two groups were similar and that the two groups could be compared against each other.

Table 29 presents the average number of both total laundry loads and cold water laundry loads per week done per household, for each survey group. To obtain a more reliable average, outliers, defined as the numbers of loads which were three times higher than the average of all participants (15 loads in total per week), were removed.

Table 29: Average Number of Laundry Loads per Week

Participant Type	Total Loads per Week	Cold Water Loads per Week	Proportion of Loads Done in Warm Water
Regular RDI Participants	4.42	3.53	20%
CBSM Pilot Participants	4.62	4.27	8%
Average	4.49		

The comparison of the CBSM Pilot participants with the control group showed at first that there were no significant differences between the total number of loads per week done by each group, with an average value of 4.49 loads per week. As for the proportion of loads done in warm water, the CBSM Pilot participants showed a much smaller proportion than the regular RDI participants, revealing that, as a result of the pilot, the number of loads done with warm water had decreased by 60 percent.

Engineering calculations were performed to evaluate the yearly electricity consumption related to water heating for clothes washers; the 60 percent reduction could then be applied to this value to estimate the unitary savings value per CBSM Pilot participant.

Water Heating Energy Usage per Load

Since the vast majority of the CBSM Pilot participants took part in the program in 2013, the total energy consumption for a clothes washer was taken from the 2013 evaluation report for Instant Savings, which was based on the average Modified Energy Factor (MEF) of all the non-compact non-ENERGY STAR clothes washers in the Energy Efficiency Ratings directory.³³ Using an MEF of 40.5 L/kWh/cycle and a capacity of 124.9 L, a consumption value of 3.08 kWh per load was obtained. This value represents the total energy consumption for the clothes washing process, including the movement of the washer, heating of water and heat required to remove the remaining moisture in the wash load.

According to Hydro-Québec's efficient appliances program evaluation report³⁴, the proportion of the total energy consumption going towards water heating amounts to 24.8 percent. Therefore, the water heating energy consumption represents 0.76 kWh per load.

A comprehensive survey on household energy usage conducted by Hydro-Québec³⁵ in the province of Quebec showed, however, that Quebecers used on average 33 percent less energy to heat water for clothes washing than what is assumed in the Canadian Standard Association (CSA) test procedure. The Evaluator considers that there is no evidence showing that laundry behaviors in Nova Scotia are significantly different from those in Quebec. Therefore, this factor has been applied without changes to the energy consumption estimated with the CSA-defined MEF. This results in an adjusted water heating energy consumption of 0.51 kWh.

Water Heating Electricity per Load

The percentage of hot water produced electrically was then determined. The percentage of washers with their own electrical resistance to heat water was assumed to be insignificant, as this information was only available for washers currently available on the market. It was found that 27 percent of efficient washers sold through Instant Savings in 2014 had an internal water heater, but the Evaluator estimated that this proportion must have been much smaller in 2007 (as the average age of washers was estimated at 7 years). The proportion of electric DHW tanks, as obtained from the RDI tracking

³³ Natural Resources Canada, *Energy Efficiency Ratings : Search – Clothes Washers*, < <http://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESWASHERS>> (Last accessed November 24, 2014)

³⁴ Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, Report presented to Hydro-Québec, p. 18, available at < http://www.regie-energie.qc.ca/audiences/Suivis/Suivi-R-3644-2007-ProcédurePGEE/HQD_RapportEvaluationPGEE_Electro_02fev2012.pdf>

³⁵ Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, Report presented to Hydro-Québec, p. 19, available at < http://www.regie-energie.qc.ca/audiences/Suivis/Suivi-R-3644-2007-ProcédurePGEE/HQD_RapportEvaluationPGEE_Electro_02fev2012.pdf>

sheet for the CBSM Pilot participants, was used to calculate the overall proportion of electrically heated water—71 percent.

Multiplying this ratio by the total energy use per laundry load, the electricity use becomes 0.36 kWh per load.

Adjustment for the Age of Clothes Washers

Because the MEF and capacity were first extracted from currently available data on new clothes washers in 2013, an adjustment needs to be made to take into account the increased energy efficiency of clothes washer over time. To do so, average water usage data was obtained for each year—between 2005 and 2010 (the last available year)—from Natural Resources Canada³⁶, as shown in Table 30.

Table 30: Average Water Usage of Clothes Dryers per Year of Purchase

Year	2005	2006	2007	2008	2009	2010
Litres per cycle	1.45	1.25	1.16	1.14	1.09	0.82

These values were used to calculate the average increase of water consumption per additional year of using the clothes dryers, which is 12%. Because the survey conducted with CBSM Pilot participants showed that participants' clothes washers were seven years old on average, the quantity of water used by those washers is estimated to be 2.2 times that of clothes washers purchased in 2013. As water heating energy is directly proportional to the amount of water being used by the washers, the electricity use per load was multiplied by this factor, and is estimated at 0.81 kWh/load.

Unitary Savings Value

As it has been previously determined, the reduction in warm water usage of CBSM Pilot participants with respect to the control group stands at 60 percent. This reduction, multiplied by the water heating electricity use per load, the average amount of laundry loads per week and the number of weeks per year gives an annual unitary savings value per CBSM Pilot participant of 114 kWh, as shown in the following equation.

$$\text{Annual unitary savings} = 0.81 \frac{\text{kWh}}{\text{load}} \times 60\% \times 4.49 \frac{\text{loads}}{\text{week}} \times 52 \frac{\text{weeks}}{\text{year}} = 114 \text{ kWh/year}$$

³⁶Natural Resources Canada, *Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990-2010*, available at <<http://www.nrcan.gc.ca/sites/oeo.nrcan.gc.ca/files/pdf/publications/statistics/cama12/cama12.pdf>> (Last accessed February 5, 2015)

6.1.1 Demand-to-Energy Ratio

The same demand-to-energy ratio as the one used for all products installed under the regular RDI program component was used to establish peak demand savings, which amounts to 0.233 MW/GWh.

6.2 Interactive Effects

The reduction of hot water demand for clothes washing is considered to have no significant impact on the heating load of a house. Therefore, the interactive effects were considered to be nil for the CBSM Pilot.

6.3 Net-to-Gross Ratio

The unitary savings value obtained by a direct comparison of the CBSM Pilot participants with a control group can be directly applied to the number of CBSM Pilot participants to establish net savings. This unitary savings value already takes possible distortion effects into account since it used the comparison of two groups for which the only variation between them is their participation in the CBSM Pilot.

6.4 Net Savings

In total, the CBSM Pilot generated net energy savings of 0.050 GWh at the meter and 0.055 GWh at the generator, and net demand savings of 0.012 MW at the meter and 0.013 MW at the generator, as shown in the table below.

Table 31: CBSM Pilot Net Evaluated Energy Savings

Parameter	Value
Energy Savings	
Total Number of Participants	438
Net Unitary Savings Value (kWh)	114
Interactive Effect Factor	0%
Total Net Energy Savings – at meter (GWh)	0.050
Line Loss Factor	1.100
Total Net Energy Savings – at generator (GWh)	0.055
Peak Demand Savings	
Demand-to-Energy Ratio (MW/GWh)	0.233
Total Net Peak Demand Savings – at meter (MW)	0.012
Line Loss Factor	1.100
Total Net Peak Demand Savings – at generator (MW)	0.013

CONCLUSION

The 2014 evaluation of RDI demonstrated that all of the recommendations made specifically for RDI in the last complete evaluation were implemented. The Evaluator commends ENSC on its efforts in improving and optimizing RDI. Among the improvements, the Evaluator noticed efforts made to fine-tune program marketing, keep informing participants about energy-efficient products, improve the tracking sheet and ensure the need for nightlights in participating households. Furthermore, CFL installations have transitioned to LED installations. Following the Evaluator's recommendation to follow the penetration of regular CFLs, ENSC has since monitored the market and taken actions to transition from CFLs to LEDs, except in specific situations where an LED product would not be suitable.

On-site visits conducted as part of the 2014 evaluation confirmed that the installation process was conducted in a professional and efficient manner. It was found, however, that the installation rates for many products (mainly faucet aerators, low-flow showerheads, pipe insulation and smart power controllers) were much lower than in previous years. This was found to be due in part to higher product removal rates by the participants, but also to entry errors made by the DAs. The Evaluator recommended that this situation be investigated.

Survey results showed that word of mouth was, by far, the main source of awareness for RDI in 2014. This result is very positive as word of mouth is a good indication of the satisfaction of participants. Participants were indeed very satisfied with RDI overall and its various aspects, such as the time required to complete the work, the quality of the work performed, program communication and the energy conservation measures installed. The DAs also expressed positive feedback about RDI. They believe RDI provides sufficient opportunity to provide education on energy efficiency in general and to promote other ENSC programs. Both DAs also complimented ENSC staff for their timely response and communication. Even if they are responsible for the majority of the promotional efforts under RDI, the DAs did provide recommendations to improve marketing, which, according to them, is the greatest impediment to program delivery.

The majority of participants recalled receiving information about energy-efficient products from the installer who came to their house. This information led to a change in behaviour for half of the participants, with the most common behavioural change being related to turning off the lights. Other behavioural changes include increased awareness of power usage and saving energy, turning off appliances and reducing water consumption.

A total of 13,945 participants participated in RDI in 2014, compared to 23,587 participants for 2013 and 28,397 participants for 2012. Even though the number of participants per se has decreased in 2014, RDI has reached its targets in terms of savings, and demand remains strong. Targets for RDI were lowered in 2014, but the savings per home increased, especially after the introduction of LEDs in the standard package, and the addition of smart power controllers. These two changes to RDI had a

sizeable effect on the savings per home, meaning that DAs did not have to visit as many homes to reach the energy savings targets.

The evaluation revealed that RDI generated net energy savings of 24.552 GWh, compared to 37.275 GWh in 2013 and 37.043 GWh in 2012, and peak demand savings of 5.721 MW at the generator in 2014, compared to 8.499 MW and 8.446 MW in 2012. To calculate the net savings of RDI in 2014, Econoler reviewed the gross savings estimated by ENSC and conducted 50 on-site visits to calculate installation rates for each category of product installed. Econoler took into consideration the free-ridership and spillover levels associated with the non-low-income participants. These distortion effects were measured as part of the quarterly participant survey.

In addition to the regular RDI savings, 438 participants took part in the CBSM Pilot, which encouraged them to use less warm water to do laundry. This pilot initiative generated 0.055 GWh in energy savings and 0.013 MW in peak demand savings at the generator.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix summarizes all the recommendations made by the Evaluator throughout this report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Provide participants with more streamlined and personalized information during the visit from the installer. The evaluation results indicated that a majority of participants recalled receiving information about energy-efficient products from the installer who came to their house, and that this information led to a change in behaviour for half of those participants. This result shows that the visit from the installer is a good time to educate participants about RDI or other ENSC program components, but also to provide information that is more specific to their household. Because the majority of the promotional efforts rest on the DAs, but require ENSC's approval, the Evaluator recommends that ENSC work closely with the DAs to develop more streamlined and personalized promotional materials to further improve RDI's educational outreach. More specifically, the DAs suggested grouping materials in one folder, similar to the HEA toolkit folder, and tailoring the information to the participant's individual needs.
	2 Follow up with DAs to identify the cause of entry errors. In 2014, the installation rates observed by the Evaluator during the on-site visits were generally lower than those calculated in 2012. While a portion of this decrease was due to higher removal rates of products by the participants, it was found that a significant amount of missing products were due to potential entry errors by the DAs. It should be noted that ENSC's quality assurance program did not uncover the same discrepancies as those observed by the Evaluator. It is therefore recommended that ENSC investigates the source of those errors, as this had a sizable impact on the gross savings evaluated in 2014.
Program Documentation and Design	3 Under the logic model, the Evaluator recommended that activities meant to address each of the barriers in the program theory column be clearly identified.
Tracking System	4 Make sure that all the fields are systematically filled out: The Evaluator observed that some fields were left blank, namely the rate code and the secondary space heating source. For instance, the absence of a secondary source should be stated, thus indicating that the main heat source is used at 100 percent. All of the tracking system information can be helpful for the various tasks involved in the impact evaluation. Therefore, it is recommended to ensure that these fields are systematically filled out.
	5 Set limitations for entries and develop a validation process: The Evaluator found that for some products, a mix of "0" and blank entries were used to indicate that no product had been installed. This is possibly due to the different data gathering process from one DA to another. Econoler recommends that ENSC standardize entries into the DSMDS, which should facilitate the identification of missing entries.

APPENDIX II

INTERVIEW GUIDE WITH DELIVERY AGENTS

How to complete this form

This is a Word document that integrates some form features. To enter your answers, simply position your cursor on the shaded sections and begin typing. Since this is a form, you cannot write anywhere else in the document. For the boxes, just click on the one next to your answer. Click again to uncheck it.

Please complete this form within the next 48 hours, [save the file](#) and send it back to us at cperreault@cra.ca

Thank you!

Part A: General Questions

Please indicate your company name.

QA1a. How would you describe your role(s) as an ENSC partner for the Residential Direct Installation of Efficient Products program?

QA1b. How long have you held that role/those roles (specify months or years)?

QA2a. Would you consider your involvement in the Residential Direct Installation of Efficient Products program to be straight forward or complicated?

- ☐ Straight forward
☐ Complicated

QA2b. If you checked "complicated," please indicate what makes your involvement in the program complicated.

Part B: Questions Specific to the RDIEP Program

QB1. On a scale from 1 to 10, where 1 is very poor and 10 is excellent, please rate your satisfaction in regard to the following aspects of the Residential Direct Installation of Efficient Products program.

Aspects of the program	Score 1 = very poor 10 = excellent NA = not applicable	Reason Please share the reason(s) for your score
The overall program		
The program marketing and outreach activities initiated by ENSC		
Your relationship with ENSC staff		
Your relationship with the other delivery agent		
The timeliness of communications from ENSC		

QB2a. Over the past year, a few modifications have been made to the Residential Direct Installation of Efficient Products program, specifically in terms of CFLs no longer included since July (with some exceptions), and LED bulbs having been added. Overall, have these changes...?

- ☐ Required minor changes in the way you work;
☐ Require major changes in the way you work; or
☐ Not affected the way you work

QB2b. If you answered "Required major changes in the way you work," would you say those major changes have caused problems in the way the program is managed or delivered?

- ☐ Yes
☐ No

QB2c. If you answered "Yes," what have those problems been?

QB3. In your opinion, what impedes the delivery of the Residential Direct Installation of Efficient Products program?

Please list the barriers in order of importance, with the first one listed being the greatest impediment.

QB4a. Apart from achieving increased energy efficiency, the Residential Direct Installation of Efficient Products program also aims at educating participants on energy efficiency in general as well as promoting Efficiency Nova Scotia and its programs and services. To what extent do you believe that this objective has been achieved this year?

QB4b. What else could be done to improve the educational component of the program?

Now, thinking about the products you install as part of the Residential Direct Installation of Efficient Products program...

QB5a. Under what circumstances would your installers replace a 75W incandescent bulb with a 13W CFL or 8W LED bulb?

☐ Not applicable

QB5b. Under what circumstances would your installers replace a 40W incandescent bulb with a 23W CFL or 12W LED bulb?

☐ Not applicable

Part C: Customer Interaction

Thinking about your interactions with program participants...

QC1a. Approximately how many complaints have you received from participants thus far in 2014? Please only consider concerns or questions from participants regarding the level of service, defective products, program design, and the product offering.

No complaints ☐

QC1b. (If complaints) What was the complaint/were the complaints about?

QC1c. (If complaints) How are participant complaints generally handled internally? Please also specify who is involved in reviewing the complaints.

QC1d. (If complaints) Are participant complaints shared with management within your organization?

☐ Yes

☐ No

QC1e. How much time does it take for a complaint to be addressed with participants after it is received?

QC1f. What may cause a delay between the time a complaint is received and when it is addressed with participants?

QC1g. (If complaints) How do you ensure complaints are resolved to the satisfaction of participants?

Part D: Communication

QD1a. Do you believe that Efficiency Nova Scotia gives you sufficient opportunity to provide input on the Residential Direct Installation of Efficient Products program?

☐ Yes

☐ No

QD1b. If you answered “No”, what else can Efficiency Nova Scotia do to involve delivery agents?

QD4a. How knowledgeable are you/your staff regarding the other ENSC programs that may be of value to Residential Direct Installation of Energy Efficient Products program participants?

- ☐ Very knowledgeable
☐ Somewhat knowledgeable
☐ Not very knowledgeable
☐ Not at all knowledgeable

QD4b. Does ENSC provide you with sufficient information and marketing tools to inform participants of other programs that may be of value to them?

- ☐ Yes
☐ No

Part E: Conclusion

QE1. What other suggestions do you have to improve the Residential Direct Installation of Efficient Products program performance?

Thank you very much for your time and co-operation.

Your answers will be treated in strict confidence—no names will ever be mentioned in the evaluation report. Our hope is that these results will contribute to improving program performance. You may be contacted by phone if we need to clarify your answers.

Date	
Your name	
Area code and phone number	
Email	

APPENDIX III

ON-SITE VISIT SAMPLING METHODOLOGY AND PROTOCOL – AFTER INSTALLATION

Sampling Methodology

For the 2014 RDI impact evaluation, 50 on-site visits were conducted with participants. The sampling plan was developed in September 2014 on the basis of the most up-to-date tracking data available. The sample selected included RDI participants from January through August 2014.

Since July 2014, LED lamps have replaced CFL lamps as RDI's normal lighting installation measure. To reflect this change, the Evaluator selected a sample with 40 percent of the sampled participants being those who had CFLs installed and 60 percent being those who had LEDs installed. This method allowed the Evaluator to establish the installation rates for both lamp types.

In addition to the lighting component, the Evaluator's analysis of the tracking system showed that 191 of the 11,486 participants had all the other RDI measures installed (i.e., hot water measures and Embertec). This initial screening based on the aforementioned criterion led to the selection of a random sample. Those participants who had the Embertec installed were of particular interest due to the results of the 2013 RDI on-site visits conducted in June 2014, which revealed many complaints about this device.

In addition, the sampling plan attempted to include an equal number of on-site visits among the participants serviced by each Delivery Agent (DA). This principle was successfully applied to only the 20 participants selected to represent the group who had CFLs installed prior to July 2014. It appears that one DA's territory is significantly larger than the other's; therefore, the remaining 30 participants who had LEDs installed were not equally split between the two DAs.

On-site Visit Protocol

On-site visits were conducted to validate the quantity of installed products documented in the tracking system against the actual situations observed on site. This process served two main purposes: 1) to establish the installation rates of the products, and 2) to determine whether any products had been removed and the reasons for the removal, where applicable. In addition, the Evaluator validated the assumptions used to calculate each product's unitary savings value by collecting the following types of information during the visits:

- › the type of lamp replaced and its respective wattage
- › the location of the new lamp (indoors or outdoors)
- › the domestic hot water (DHW) heating source and the tank size

- › the faucet aerator locations and their respective flow rates
- › the energy source for DHW heating
- › the quantity and type of equipment plugged into the Embertec

The Evaluator also gathered information about the space heating source and the use of an air-conditioner. These parameters were vital for determining the interactive effects caused by the lighting measures installed.

On-site Visit Data Collection Form

1 General Information

Date of Visit:		
Tracking Number:		
Address:		
Contact Name:		
Telephone:		
Type of Dwelling:		
Individually Metered:	Yes ☐	No ☐
Main Heat Type:		
DHW Heat Type:		
AC Used in Home	Yes ☐	No ☐

2 Product Installation Information

For Lighting Products

(Based on on-site observation and contact declaration)

Product	Number in Tracking Sheet	Number On Site	Explanation If Different	Type of Lamp Replaced	Wattage of Lamp Replaced	Inside or Outside
13W CFL						
23W CFL						
8W LED						
10.5W LED						
11W LED						
12W LED						
LED Nightlight						

Notes:

For Domestic Hot Water (DHW) Related Products

(Based on on-site observation and contact declaration)

Product	Number in Tracking Sheet	Number On Site	Explanation, If Different	Presence of Existing or Flow Rate
Hot Water Tank Wrap				
Pipe Insulation				
Faucet Aerators				
Low Flow Showerheads				

Notes:

For Smart Power Controllers

(Based on on-site observation and contact declaration):

Number in Tracking Sheet	Number On Site	Number AV Equipment	Number Home Office Equipment	Change since Installation	Comments

Notes:

APPENDIX IV ANNUAL PARTICIPANT SURVEY QUESTIONNAIRE

V1. Hello may I please speak with [INSERT NAME]?

1. Yes [GOTO INTRODUCTION]

2. No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

V2. Hello, my name is _____ and I am with CRA (Corporate Research Associates), and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your household recently participated in the Residential Direct Installation of Efficient Products (RDIEP) program. As part of this program, someone would have come to your house and installed new lighting or domestic water heating energy efficiency products, such as compact fluorescent light bulbs (CFLs) and faucet aerators, at no charge. We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about fifteen minutes. Is this a good time for you?

6 Yes [CONTINUE]

7 No, I don't remember the program / Don't know [PROMPT: "Are you sure? Someone would have come to your house and installed free energy-efficient products for you to save energy and money?" RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO: Is there someone else in the household who would know about having participated in the Efficiency Nova Scotia program?

8 Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
No [THANK & TERMINATE]

9 No, but they came to my previous home CONTINUE

99. Refused [THANK AND TERMINATE]

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"

[SCHEDULED, IF NECESSARY, FOR: _____]

Verification and Recall [V Series]

[ASK ALL RESPONDENTS]

V3. I am going to read you a list of energy-efficient products that, according to our records, were installed in your house by the program: [READ WHAT IS ON RECORD (MEASURE#0 IN THE DATABASE)]. For each one, can you please verify that this information is correct and that the product was installed? [1=YES, INSTALLED, 2=NO, NOT INSTALLED, 98=DON'T KNOW, 99=REFUSED]?

[NOTE FOR PROGRAMMER: DO NOT PUT THE NUMBER OF EACH MEASURE]

- a. CFL bulbs (CFLs 13W – CFLs 23W – Specialty CFLs)
- b. LED Bulbs (LEDs 8W – LEDs 12W)
- c. LED Nightlights
- d. Low flow showerheads (LFS)
- e. Faucet aerators (Faucet Aerator)
- f. Pipe insulation/Tank Wraps
- g. Embertec smart power controller for audio-visual equipment

V4. [FOR EACH OF V3a TO V3g = NO AND RECORD = YES] Are you sure? According to our records someone would have come to your place and installed ... [READ WHAT IS ON RECORD] [1=YES] [2=NO, 98=DON'T KNOW, 99=REFUSED → RECORD AS NO]

- V4a. [CFL bulbs (CFL's 13W – CFL's 23W – Specialty CFLs)]
- V4b. [LED Bulbs (LEDs 8W – LEDs 12W)]
- V4c. [LED Nightlights]
- V4d. [Low flow showerheads]
- V4e. [Faucet aerators]
- V4f. [Pipe insulation/Tank Wraps]
- V4g. [Smart power controller]

[THANK AND TERMINATE IF RESPONDENT SAY "NO", "DK" OR "REF" TO ALL QUESTIONS FROM V3 TO V4]

Installation of Embertec Controller [E Series]

[ASK PARTICIPANTS WHO HAD EMBERTEC CONTROLLER INSTALLED: IF V3g OR V4g=YES]

E1a. You just mentioned that an Embertec smart power controller for audio-visual equipment was installed in your household as part of the program. Do you still have this device installed in your household?

10 Yes

11 No

98. (Don't Know) [GO TO P SERIES]

99. (Refused) [GO TO P SERIES]

E1b. [ASK IF E1a=2 (NO)] Why did you choose to remove this device from your household?

[DO NOT READ, CODE ALL THAT APPLY]

1 (Did not work like I thought it would)

2 (Too complicated to use)

3 (Did not believe any changes will result in lower energy bills)

4 (Did not trust in energy professionals installing new measures)

5 (Turned off AV equipment too quickly)

96. (Other [SPECIFY: _____])

98. (Don't know)

99. (Refused)

E2a. Were you home when the Embertec smart power controller was installed?

6 Yes

7 No

98. (Don't Know)

99. (Refused)

E2b. [ASK IF E2a=1 (YES)] Did the installer explain how the Embertec smart power controller worked?

1 Yes

2 No

98. (Don't Know)

99. (Refused)

E3a. [DO NOT ASK IF E1a=2 (NO)] Using a scale from 1 to 5, where 1 means "very dissatisfied" and 5 means "very satisfied", please tell me how satisfied you are with the Embertec smart power controller that was installed under the program. [98 = Don't know/Don't recall, 99 = Refused] [DO NOT ACCEPT A RANGE]

E3b. [ASK IF E3a = 1, 2 or 3] You indicated that you were not satisfied with the Embertec smart power controller that was installed under the program. What was the SINGLE most important reason you were not satisfied with this device? [PROBE FOR SPECIFIC REASON. ACCEPT ONE RESPONSE. DO NOT READ]

- 1 (Did not work like I thought it would)
- 2 (Too complicated to use)
- 3 (Did not notice any changes in energy bills)
- 4 (Turned off AV equipment too quickly)
- 96. (Other [SPECIFY: _____])
- 98. (Don't know)
- 99. (Refused)

Program Awareness and Participation [P Series]

[ASK ALL RESPONDENTS]

P1. Do you still live in the same residence where these installations were made as part of the program?

- 1 Yes [GO TO P2]
- 2 No [CONTINUE] _____
- 98. (Don't Know)
- 99. (Refused) [THANK AND TERMINATE]

[IF P1 = 2 'NO'] Please answer the survey questions based on the house that went through the program.

P2. How did you find out about this program? [DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]

- 1 (Efficiency Nova Scotia staff)
- 2 (Mailing from Efficiency Nova Scotia)
- 3 (ENSC Website)
- 4 (Co-worker, family, or friend)
- 5 (Other participants)
- 96 (Other [SPECIFY _____])
- 98 (Don't know)
- 99. (Refused)

- P3. What was the SINGLE most important reason you agreed to participate in the program?
[ACCEPT ONE RESPONSE] [DO NOT READ]
- 1 (To save on energy/to save on energy costs)
 - 2 (Comfort)
 - 3 (To receive free compact fluorescent bulbs)
 - 4 (To receive LED lights at a discounted price)
 - 5 (To help the environment)
 - 6 (Reduce greenhouse gases)
 - 7 (No cost for services/program was free)
 - 8 (To reduce my water consumption)
 96. (Other) [SPECIFY _____]
 98. (Don't know) [GO TO P5]
 99. (Refused) [GO TO P5]
- P4. Were there any other reasons? [DO NOT READ. ACCEPT MULTIPLE. SAME LIST AS P3]
- P5. Before participating, did you have any concerns about taking part in the program?
- 1 Yes
 - 2 No
 98. (Don't know)
 99. (Refused)
- P6. [IF P5 = 1] What were those concerns? [DO NOT READ. ACCEPT ALL RESPONSES]
- 1 (That I wouldn't be eligible)
 - 2 (That I'd have to pay something)
 - 3 (Didn't believe it was really free)
 - 4 (Wouldn't like what they gave me)
 - 5 (That products offered would cause health risks)
 - 6 (Concern that participation will affect eligibility for other assistance programs – social assistance, heating assistance rebate)
 96. (Other) [SPECIFY _____]
 98. (Don't know)
 99. (Refused)

Satisfaction with the Program [S Series]

[ASK ALL RESPONDENTS]

- S1. Using a scale from 1 to 5, where 1 means “very dissatisfied” and 5 means “very satisfied”, please tell me how satisfied you are with your OVERALL experience with the program. [97 = Not Applicable, 98 = Don't know/Don't recall, 99 = Refused] [DO NOT ACCEPT A RANGE]

S2. [IF DISSATISFIED—S1=1, 2 or 3] You indicated a score of [ANSWER S1] on a 5-point scale for your overall satisfaction with the program. For what reasons were you not satisfied with the program overall? Probe: Any other reasons? [DO NOT READ. PROBE FOR SPECIFIC REASONS. ACCEPT MULTIPLE]

- 1 (The installation took too long)
- 2 (I expected more)
- 3 (Energy bill did not decrease)
- 4 (I don't like the light bulbs I received)
- 5 (I don't like the insulation/wrap upgrade)
- 6 (I don't like the low flow showerhead installed)
- 7 (I don't like the low flow faucet aerators installed)
- 8 (I did not like the installer who visited the home)
- 96 (Other) [SPECIFY _____]
- 98. (Don't know)
- 99. (Refused)

S3. [IF SATISFIED S1=4 or 5] What was the most important reason why you were satisfied with the program overall? PROBE: Anything else? [DO NOT READ. PROBE FOR SPECIFIC REASONS. ACCEPT MULTIPLE.]

- 1 (Lowered energy bill)
- 2 (Good service)
- 3 (Saves energy)
- 4 (Better lights/lighting)
- 5 (Informative/Information received)
- 6 (I liked the installer who visited the home)
- 96. (Other) [SPECIFY _____]
- 98. (Don't know)
- 99. (Refused)

Now I am going to read a list of specific aspects of the program. Using a scale from 1 to 5, where 1 means "very dissatisfied" and 5 means "very satisfied", please tell me how satisfied you are with your experience with each aspect of the program. [DO NOT RANDOMIZE] [97 = Not Applicable, 98 = Don't know/Don't recall, 99 = Refused] [DO NOT ACCEPT A RANGE]

S4.	Overall communication from the program	1	2	3	4	5	97/98/99
S5.	Time required to complete work	1	2	3	4	5	97/98/99
S6.	Energy conservation measures installed	1	2	3	4	5	97/98/99
S7.	Quality of the work completed	1	2	3	4	5	97/98/99

S8. Using a 5-point scale, where '1' is very difficult and '5' is very easy, how would you rate the process to apply to the program? [1-5 scale, 98 = Don't know/Don't recall, 99 = Refused]

S9. [IF S8=1, 2 or 3] What was difficult about applying to the program? [MULTIPLE RESPONSE – RECORD VERBATIM] Probe: Anything else?

96. (Record answer)

97. (Don't know)

98. (Refused)

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before the products were installed in your household? [RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

Participation to the Pilot Project [PP Series]

[ASK PILOT PARTICIPANTS]

PP1a. According to our records, your household received information during the visit from the installer about the benefits of washing your clothes in cold water. The installer would have spoken to you about your clothes washing behavior and encouraged you to set your washing temperature to cold. Do you recall this conversation with the installer?

1 Yes

2 No

98. (Don't know)

99. (Refused) [GO TO B1]

PP1b. [IF PP1a=2 or 98] The installer would have provided you with a brochure that details the facts and benefits associated to washing clothes in cold water. The installer might have also placed a removable sticker on your washing machine with a "Set wash temperature to cold!" reminder. Do you now recall receiving this information from the installer?

1 Yes

2 No [GO TO B1]

98. (Don't know) [GO TO B1]

99. (Refused) [GO TO B1]

PP2a. [IF PP1a=1 or PP1b=1] Did you agree to wash your clothes in cold water?

1 Yes

2 No [GO TO B1]

98. (Don't know) [GO TO B1]

99. (Refused) [GO TO B1]

PP2b. When agreeing to wash your clothes in cold water, you may have been asked to agree to several commitments. Please tell me whether you agreed, disagreed, or were not asked about the following commitments. [ROTATE OPTIONS, RECORD RESPONSE, 1 = AGREED, 2 = DISAGREED, 3 = WAS NOT ASKED, 98 = Don't know, 99 = Refused. ACCEPT ALL APPLICABLE ANSWERS]

- a. Provide a verbal commitment to wash clothes in cold water
- b. Signed a pledge sheet
- c. Provide permission to put your name on the ENSC website
- d. Agree to a follow up call

PP3. [IF PP2a=1] Thinking of your OVERALL experience with this project aimed at encouraging you to wash your clothes in cold water, including any services or energy efficiency advice or tips provided, how satisfied were you overall with this project on a scale from 1 to 10, where 1='not at all satisfied' and 10='very satisfied'? [RECORD NUMBER, DO NOT ACCEPT A RANGE, 98 = Don't know, 99 = Refused]

Behaviour Changes and Washing Habits [B Series]

[ASK ALL PARTICIPANTS]

B1. Did your household receive information during the visit from the installer about energy-efficient products? **DO NOT READ, CODE ONE ONLY**

- 1 Yes
- 2 No
- 98. (Don't know)
- 99. (Refused)

B2. [IF B1=1] Did the information your household received during the visit from the installer change your behavior in terms of how you use energy at home? **DO NOT READ, CODE ONE ONLY**

- 1 Yes
- 2 No
- 98. (Don't know)
- 99. (Refused)

- B3. [IF B2=1] How did your behavior change? PROBE: Anything else? [DO NOT READ. ACCEPT ALL RESPONSES]
- 1 (I turn off my lights now)
 - 2 (I set my heating thermostat lower)
 - 3 (I set my water heater thermostat lower)
 - 4 (I hang my clothes to dry)
 - 5 (I use cold water to wash my clothes)
 - 6 (I use fans instead of air conditioning)
 - 7 (I close doors and windows)
 - 8 (I turn off appliances)
 - 9 (I decided to participate in ENSC's Appliance Retirement program)
 - 10 (I decided to participate in ENSC's Home Energy Assessment program)
 96. (Other) [SPECIFY _____]
 98. (Don't know)
 99. (Refused)
- B4a. Approximately how many loads of clothes washing did your household do last week? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]
- ___ Response
97. (I don't own a washing machine) [GO TO R1]
 98. (Don't Know) [GO TO R1]
 99. (Refused) [GO TO R1]
- B4b. [ASK IF ANSWER TO B4a > 0] Thinking of those [ANSWER TO B4a] loads your household did last week, approximately how many were washed in cold water? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]
- ___ Response ___ 98 Don't Know ___ 99 Refused
- B5. [ASK IF ANSWER TO B4b > 0] How satisfied are you with washing your clothes in cold water on a scale from 1 to 10, where 1='not at all satisfied' and 10='very satisfied'? [RECORD NUMBER, DO NOT ACCEPT A RANGE, 98 = Don't know, 99 = Refused]
- B6. How old is your washing machine? [RECORD IN YEARS, PROBE FOR SPECIFIC ANSWER]
- ___ Response in number of years ___ 0 Less than 1 year ___ 98 Don't Know
- ___ 99 Refused
- ___ Response in year

Recommendations (R Series)

[ASK ALL RESPONDENTS]

R1. Do you have any recommendations that you think would help improve the Residential Direct Installation program? PROBE: Anything else? [DO NOT READ, ACCEPT MULTIPLE]

- 1 (Offer more products/measures to be installed)
- 2 (Offer more information on the products/measures installed)
- 3 (Complete work faster)
- 4 (Improve quality of work)
- 5 (Improve communication)
- 6 (Make participation process shorter)
- 7 (No recommendation)
- 96 (Other [SPECIFY _____])

R2. [IF R1= 1] Which energy efficiency products would you like to have had installed through the Residential Direct Installation program? [DO NOT READ. ACCEPT MULTIPLE]

- 1 (dishwasher)
- 2 (washing machine)
- 3 (dryer)
- 4 (windows/envelope)
- 5 (refrigerator)
- 6 (freezer)
- 7 (ventilation)
- 8 (thermostats)
- 9 (air sealing/weather stripping)
- 10 (toilets)
- 96 Other [SPECIFY _____]
- 98 (Don't know)
- 99 (Refused)

R3. [IF R1= 6] You mentioned that you would like the participation process to be shorter. What part(s) of the participation process took too long? [MULTIPLE RESPONSE – RECORD VERBATIM] Probe: Anything else?

- 96 (Record answer)
- 98 (Don't know)
- 99 (Refused)

Spillover [SO Series]

[ASK ALL RESPONDENTS]

SO1. Now I'd like you to think of the time **since you participated** in the Residential Direct Installation program. Have you installed any additional energy-efficient products or retired any old appliances on your own?

- 1 Yes
- 2 No [GO TO D SERIES]
- 98. (Don't know/Don't recall) [GO TO D SERIES]
- 99. (Refused) [GO TO D SERIES]

SO2. [IF SO1= YES, THEN ASK] I just want to make sure I understand - After you participated in the Residential Direct Installation program, you installed additional energy-efficient products or retired old appliances on your own. Is that correct?

- 1 Yes
- 2 No [GO TO D SERIES]
- 3 (Don't know) [Go To D SERIES]
- 99. (Refused) [GO TO D SERIES]

Now, I will specifically talk about the additional actions you took on your own after participating in the Residential Direct Installation program.

SO3. [IF SO2 = 1 "YES"] Have you benefited from any other financing or rebates from any other Efficiency Nova Scotia programs for these additional energy-efficient products or retirement of appliances?

- 1 Yes [GO TO D SERIES]
- 2 No
- 98. (Don't know [GO TO D SERIES])
- 99. (Refused) [GO TO D SERIES]

SO4a. [IF SO3 = 2 'NO'] What additional energy-efficient products have you installed on your own after participating in the Residential Direct Installation program? [DO NOT READ, ALLOW MULTIPLE] Probe: Any others?

- 1 (CFLs)
- 2 (LEDs)
- 3 (Low flow showerheads)
- 4 (Faucet aerators)
- 5 (Pipe insulation/tank wrap)

- 6 (Smart power controller/smart power bar)
- 7 (Energy Star refrigerator)
- 8 (Energy Star clothes washer)
- 96 (Other [SPECIFY _____])
- 97 (Don't know)
- 98 None

SO4b. [IF SO3 = 2 'NO'] What appliances have you retired on your own after participating in the Residential Direct Installation program? [DO NOT READ, ALLOW MULTIPLE] Probe: Any others?

- 1 (Refrigerators)
- 2 (Freezers)
- 3 (Room AC units)
- 4 (Dehumidifiers)
- 96 (Other [SPECIFY _____])
- 97 (Don't know)
- 98 None

SO5. [IF SO3 = 2 'NO'] How influential was your experience with the Residential Direct Installation program on your decision to install these additional energy-efficient products or retire these appliances on your own? Please, give your answer on a scale of 0 to 10, where 0 indicates that the Residential Direct Installation program "had no influence at all on your decision" and 10 indicates that the program was "extremely influential to your decision." [RECORD RESPONSE 0-10, 98 = Don't know, 99 = REFUSED] [DO NOT ACCEPT A RANGE]

Demographic Characteristics (D Series)

[ASK ALL RESPONDENTS]

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

D1. What type of residence do you live in? [READ RESPONSES 1-7, THEN 96; SELECT ONE RESPONSE]

- 1 Apartment building that has fewer than five stories
- 2 Apartment building that has five to twenty stories
- 3 Row house (Single story apartment building)

- 4 Detached single-family home
- 5 Semi-detached house
- 6 Mobile home or house trailer
- 7 Townhouse or duplex which shared adjacent walls
- 96 Or some other type [SPECIFY: _____]
- 98. (Don't know)
- 97 (Refused)

- D2. How many bedrooms are in your home? [98=DK; Enter zero for a studio apartment with no bedrooms]

- D3. Do you own or rent this home?
 - 1 Own/buying
 - 2 Rent/lease
 - 3 Other (Describe) _____
 - 99. (Refused)

- D4. Do you pay the electric bills for your home?
 - 1 Yes
 - 2 No
 - 96. (Other) [Specify_____]
 - 98. (Don't Know)
 - 99. (Refused)

- D5. Including yourself, how many people live in this residence on a full-time basis?
Number of people: _____
[NOTE: DON'T ALLOW ZERO FOR A RESPONSE]
 - 99. (Refused)

- D6. What is your age group? Are you: [READ]
 - 1 18 to 24
 - 2 25 to 34
 - 3 35 to 44
 - 4 45 to 54
 - 5 55 to 64
 - 6 65 or over
 - 99 (Refused)

- D7. What is the highest grade of schooling completed by the head of your household? [READ IF NECESSARY]
- 1 (Less than high school graduation diploma)
 - 2 (High school graduation diploma and/or some post secondary)
 - 3 (Trades certificate or diploma)
 - 4 (College certificate or diploma)
 - 5 (University degree, certificate or diploma)
 - 97. Other (SPECIFY: _____)
 - 98. (Don't know)
 - 99. (Refused)
- D8. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category. [READ LIST; SELECT ONE RESPONSE]
- 1 Less than \$15,000
 - 2 \$15,000 - \$24,999
 - 3 \$25,000 - \$34,999
 - 4 \$35,000 - \$49,999
 - 5 \$50,000 - \$69,999
 - 6 \$70,000 - \$79,999
 - 7 \$80,000 or more
 - 98. (Don't know)
 - 99. (Refused)
- D9. [DO NOT READ] Gender:
- 1 Male
 - 2 Female

END: THAT IS ALL THE QUESTIONS I HAVE FOR YOU. THANK YOU FOR TAKING THE TIME TO RESPOND TO THIS SURVEY.

APPENDIX V

ANNUAL PARTICIPANT SURVEY RESULTS

E1a. You just mentioned that an Embertec smart power controller for audio-visual equipment was installed in your household as part of the program. Do you still have this device installed in your household?

Embertec Controller Installed	2014
<i>Sample Size</i>	36
Yes	86%
No	14%

E1b. Why did you choose to remove this device from your household?

Reason Embertec Controller No Longer Installed**	2014 (#)
<i>Sample Size*</i>	5
Turned off AV equipment too quickly	3
Did not work like I thought it would	2
Not enough room to put it in	1
*Base: Respondents who removed Embertec Controller **Multiple responses	

E2a. Were you home when the Embertec smart power controller was installed?

Onsite when Embertec Controller Installed	2014
<i>Sample Size</i>	36
Yes	89%
No	11%

E2b. Did the installer explain how the Embertec smart power controller worked?

Explained Embertec Controller	2014
<i>Sample Size*</i>	32
Yes	100%
No	-
*Base: Respondents who were onsite when Embertec controller installed	

E3a. Using a scale from 1 to 5, where 1 means “very dissatisfied” and 5 means “very satisfied”, please tell me how satisfied you are with the Embertec smart power controller that was installed under the program.

Satisfaction with Embertec Controller*	2014
<i>Sample Size**</i>	30
5 - Very satisfied	60%
4	23%
3	13%
2	-
1 - Very dissatisfied	3%
*Base: Respondents who still have Embertec controller installed **Don't know removed from calculations	

E3b. You indicated that you were not satisfied with the Embertec smart power controller that was installed under the program. What was the SINGLE most important reason you were not satisfied with this device?

Reasons for Dissatisfaction	2014 (#)
<i>Sample Size*</i>	5
Turned off AV equipment too quickly	3
Too complicated to use	1
Others	1
*Base: Respondents who were dissatisfied with controller (as indicated by a rating of '1', '2' or '3')	

P2. How did you find out about this program?

Sources of Program Awareness*	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
TOTAL ADVERTISING	29%	19%	26%
Mailings from ENSC	11%	9%	10%
Newspaper	6%	5%	7%
ENSC Website	4%	3%	7%
Radio	8%	3%	2%
Co-worker, family, friend	24%	50%	52%
Mall/in-store booth/display	-	3%	6%
Television	-	6%	5%
ENSC staff/DA	24%	9%	4%
Home show/Trade show	-	2%	3%
Other participants	2%	3%	2%
Participated in other programs or completed an energy audit	16%	2%	1%
Brochure/Pamphlet	2%	1%	-
Others	8%	8%	10%
Don't know	5%	9%	5%
*Multiple responses			

P3. What was the single most important reason you agreed to participate in the program? P4. Were there any other reasons?

Reasons for Participating	2012		2013		2014	
	Most Important Motivation	Other Important Motivations*	Most Important Motivation	Other Important Motivations*	Most Important Motivation	Other Important Motivations*
<i>Sample Size</i>	181	179	159	155	164	163
To save on energy/energy costs	69%	20%	76%	19%	73%	20%
No cost for services/program was free	8%	6%	9%	8%	7%	3%
To help protect the environment	3%	7%	1%	9%	4%	8%
Wanted energy efficient upgrades	-	-	1%	5%	4%	2%
To receive CFLs	7%	6%	3%	1%	2%	4%
To become more informed about energy efficient upgrades	-	-	2%	1%	2%	1%
To receive LED lights at a discounted price	1%	1%	3%	-	1%	2%
To reduce water consumption	1%	2%	-	-	-	3%
Comfort	-	1%	-	-	-	1%
Reduce greenhouse gases	-	4%	-	1%	-	-
Others	10%	8%	4%	3%	7%	7%
None/no other reasons	-	41%	-	55%	-	56%
Don't know	1%	11%	3%	2%	1%	1%
Refused	-	2%	-	-	-	-
*Multiple responses						

P5. Before participating, did you have any concerns about taking part in the program?

Concerns with Program Prior to Taking Part	2012	2013	2014
<i>Sample Size</i>	181	159	164
No	93%	94%	96%
Yes	7%	5%	4%
Don't know	-	1%	-

P6. What were those concerns?

Concerns about the Program*	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size**</i>	13	8	6
That I'd have to pay some fees	4	3	2
Wouldn't save energy/be energy efficient	-	1	2
It could be a scam/Uncomfortable about letting strangers into home	4	1	1
Didn't believe it was really free	4	2	1
That the products offered might pose health risks	1	-	-
Others	3	-	-
Don't know	-	1	-
*Base: Respondents who expressed concerns **Multiple responses			

S1, S4, S5, S6, S7. Using a scale from 1 to 5, where 1 means "very dissatisfied" and 5 means "very satisfied", please tell me how satisfied you are with....

Satisfaction with RDI	2012		2013		2014	
	<i>Sample Size*</i>	<i>%**</i>	<i>Sample Size*</i>	<i>%**</i>	<i>Sample Size*</i>	<i>%**</i>
Time required to complete the work	181	98%	158	96%	164	99%
Quality of the work completed	181	97%	158	95%	162	97%
Overall communication from the program	181	95%	158	91%	160	94%
Program overall	179	96%	159	89%	163	90%
Energy conservation measures installed	175	96%	153	90%	158	85%
*Don't know removed from calculations **Percentage of respondents who gave a rating of 5 or 4 on a scale where 5= "Very satisfied" and 1= "Not at all satisfied"						

S3. What was the most important reason why you were satisfied with the program overall?
Anything else?

Reasons for Satisfaction*	2012	2013	2014
<i>Sample Size**</i>	<i>171</i>	<i>141</i>	<i>147</i>
I liked the installer who visited the home	35%	33%	34%
Lowered energy bill	20%	19%	22%
Good service	28%	9%	18%
Information received/informative	20%	17%	18%
Saves energy	23%	21%	16%
Better lights/lighting	8%	11%	12%
Program was free	8%	10%	8%
Products/services offered through the program	5%	13%	8%
Reasonable timeframe	4%	2%	6%
Reduced water consumption	-	1%	2%
Everything went smooth	4%	2%	1%
Others	5%	13%	8%
Don't know	2%	4%	3%
*Base: Respondents who were satisfied with the program (giving a rating of '5' or '4' on a scale where 5= "Very satisfied" and 1= "Very dissatisfied")			
**Multiple responses			

S2. For what reasons were you not satisfied with the program overall?

Reasons for Dissatisfaction*	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size**</i>	<i>8</i>	<i>18</i>	<i>16</i>
I expected more	-	5	6
I don't like the light bulbs I received	2	6	3
Energy bill did not decrease	2	5	4
I did not like the installer who visited the home	2	1	1
Unsure if program is worthwhile/Waste of tax payers money	-	1	1
I don't like the insulation/wrap upgrade	2	-	1
I don't like the low-flow faucet aerators installed	1	-	1
I don't like the low-flow showerhead installed	1	3	-
Did not like the upgrades/changes made	-	1	-
Others	2	1	4
*Base: Respondents who were dissatisfied with the program (as indicated by a rating of '1', '2' or '3' on a scale where 5= "Very satisfied" and 1= "Very dissatisfied")			
**Multiple responses			

S8. Using a 5-point scale, where '1' is very difficult and '5' is very easy, how would you rate the process to apply to the program?

Program Application Process	2012	2013	2014
<i>Sample Size*</i>	171	155	160
5 - Very easy	81%	74%	80%
4	11%	19%	16%
3	5%	6%	4%
2	2%	1%	1%
1 - Very difficult	2%	-	-
*Don't know removed from calculations			

S9. What was difficult about applying to the program?

Causes for Program Application Difficulty*	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size</i>	14	10	7
Poor advertising/Lack of program awareness	6	3	1
Too much paperwork	-	-	1
Took more time	-	-	1
Lack of information/not informed about application process	4	2	-
Poor communication/hard to contact	-	2	-
Others	2	1	-
Nothing	2	1	2
Don't know/Refused	-	1	2
*Base: Respondents who had difficulty applying to the program (as indicated by a rating of '1', '2' or '3')			

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before the products were installed in your household?

Time Between First Contact with ENSC and Product Installation*	2013	2014
<i>Sample Size</i>	<i>159</i>	<i>164</i>
1-6 days	23%	25%
7-9 days	15%	26%
10-19 days	14%	14%
20-29 days	3%	2%
30 days or more	9%	10%
Don't know	36%	24%
Mean	15.5 Days	13.7 Days
<i>*Mean excludes responses of 'Don't know'</i>		

B1. Did your household receive information during the visit from the installer about energy-efficient products?

B2. Did the information your household received during the visit from the installer change your behavior in terms of how you use energy at home?

Information Received	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Yes	75%	77%	70%
No	18%	11%	21%
Don't know	8%	11%	9%
Information Led to Behavioral Changes*	2012	2013	2014
<i>Sample Size</i>	<i>135</i>	<i>123</i>	<i>114</i>
Yes	49%	53%	51%
No	50%	45%	47%
Don't know	1%	2%	2%
<i>*Base: Respondents who received information</i>			

B3. How did your behavior change?

Behavioral Changes*	2012	2013	2014
<i>Sample Size**</i>	66	65	58
I turn off my lights now	48%	48%	52%
More aware of power usage/saving energy	18%	34%	17%
I turn off appliances	-	8%	14%
Reduce water consumption/Not wasting water	9%	12%	10%
Unplug items not in use	-	-	5%
I use energy-efficient light bulbs	9%	6%	3%
I use cold water to wash my clothes	-	5%	3%
I set my water heater thermostat at lower temperatures	3%	-	3%
Bought energy efficient appliances	-	-	3%
Use appliances more efficiently/Run dishwasher at night	8%	5%	2%
Aware of how to use CFLs properly/let CFLs warm up	12%	3%	2%
I set my heating thermostat at lower temperatures	3%	3%	2%
Improved insulation	-	2%	2%
Use Embertec/audio-visual controller to shut off TV/stereo	-	5%	-
I hang my clothes to dry	-	3%	-
Installed new heating system/heat pump	-	3%	-
I decided to participate in ENSC's Home Energy Assessment program	-	2%	-
I turn off appliances	5%	-	-
I have decided to participate in ENSC Appliance Retirement	2%	-	-
I use less hot water for laundry	9%	-	-
Others	14%	8%	14%
Don't know	-	5%	10%
*Base: Respondents who indicated their behavior changed			
**Multiple responses			

B5. How satisfied are you with washing your clothes in cold water on a scale from 1 to 10, where 1='not at all satisfied' and 10='very satisfied'?

Satisfaction with Washing Clothes in Cold Water	2013		2014	
	<i>Sample Size*</i>	<i>%**</i>	<i>Sample Size*</i>	<i>%**</i>
Satisfied	123	68%	130	63%
*Don't know removed from calculations				
**Percentage of respondents who gave a rating of 10 or 9 on a scale where 10= 'Very satisfied' and 1= 'Not at all satisfied'				

R1. Do you have any recommendations that you think would help improve the Residential Direct Installation program?

Participant Suggestions*	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Offer more products/measures to be installed	6%	9%	10%
Better advertising/program awareness	13%	5%	4%
Offer more information on the products/measures installed	5%	4%	3%
Better/brighter light bulbs	2%	3%	3%
Improve communication	5%	2%	2%
Improve quality of work	1%	1%	1%
Complete work faster	-	-	1%
Rebates for measures already installed/ Compensation for bigger projects	3%	-	-
Issues with faucet aerator	1%	-	-
None/no other recommendations	67%	73%	68%
Others	4%	8%	10%
*Multiple responses			

R2. Which energy efficiency products would you like to have had installed through the Residential Direct Installation program?

Energy Efficiency Products that Respondents Would Have Liked Installed*	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size**</i>	10	6	8
Heat pump/Geothermal	2	-	3
LED light bulbs	-	3	2
Washing machine	-	-	2
Insulation	1	1	1
Refrigerator	-	1	1
Dryer	-	-	1
Thermostats	-	-	1
Freezer	-	-	1
Toilets	-	-	1
Boiler	-	-	1
Audio-visual controller	-	-	1
Solar panels	2	1	-
Windows/Envelope	-	1	-
Doors	-	1	-
Hot water tank wraps	1	-	-
Others	-	1	-
No answer	5	-	-
Don't know	1	-	-
*Base: Respondents who recommended more products/measures to be installed			
**Multiple responses			

D1. What type of residence do you live in?

Type of home	2012	2013	2014
<i>Sample Size</i>	181	159	164
Single-family detached house	90%	90%	85%
Mobile home or house trailer	4%	1%	5%
Semi-detached house	3%	4%	3%
Townhouse or duplex which shares adjacent walls	2%	3%	2%
Apartment building that has fewer than five stories	-	2%	2%
Row house/single story apartment building	-	-	1%
Something else	-	1%	1%
Don't know/Refused	1%	-	1%

D2. How many bedrooms are in your home?

Number of Bedrooms	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
1	1%	3%	2%
2	14%	16%	21%
3	50%	53%	49%
4 or more	35%	28%	27%
Don't know	-	-	1%

D3. Do you own or rent this home?

Home Ownership	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Own	99%	96%	91%
Rent/lease	1%	3%	7%
Refused	-	1%	2%

D4. Do you pay the electric bills for your home?

You Pay Electricity Bills	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Yes	98%	99%	98%
No	2%	1%	1%
Don't know/Refused	1%	1%	1%

D5. Including yourself, how many people live in this residence on a full-time basis?

Household Size	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
1	15%	16%	21%
2	46%	55%	46%
3	18%	12%	13%
4	15%	11%	13%
5	4%	5%	5%
6	2%	1%	1%
Don't know	-	1%	1%

D6. What is your age group?

Age of Respondent	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
18 to 24	-	-	2%
25 to 34	7%	6%	12%
35 to 44	14%	15%	13%
45 to 54	22%	16%	18%
55 to 64	26%	23%	20%
65 or over	31%	39%	34%
Refused	-	1%	2%

D7. What is the highest grade of schooling completed by the head of your household?

Level of Education	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Less than high school graduate certificate	7%	11%	10%
High school graduate certificate and/or some post-secondary education	24%	28%	28%
Trade certificate/diploma	10%	8%	7%
College certificate/diploma	18%	13%	18%
University certificate/diploma	41%	38%	34%
Others	-	-	1%
Refused	1%	3%	2%

D8. Which of the following income categories best describes your total annual household income before taxes in 2013?

Household Income	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Less than \$15,000	1%	6%	5%
\$15,000 - \$24,999	2%	6%	12%
\$25,000 - \$34,999	5%	10%	11%
\$35,000 - \$49,999	16%	14%	13%
\$50,000 - \$69,999	20%	13%	15%
\$70,000 - \$79,999	9%	3%	6%
\$80,000 or more	27%	28%	19%
Don't know/Refused	21%	20%	18%

D9. Gender?

Gender	2012	2013	2014
<i>Sample Size</i>	<i>181</i>	<i>159</i>	<i>164</i>
Male	53%	53%	46%
Female	47%	47%	54%

APPENDIX VI

CBSM PILOT PARTICIPANT SURVEY RESULTS

E1a. You just mentioned that an Embertec smart power controller for audio-visual equipment was installed in your household as part of the program. Do you still have this device installed in your household?

Currently Have Embertec Controller Installed	2014 Pilot Participants
<i>Sample Size*</i>	92
Yes	89%
No	11%
*Base: Respondents who had an Embertec Controller installed through the program	

E1b. Why did you choose to remove this device from your household?

Reason Embertec Controller No Longer Installed**	2014 Pilot Participants (#)
<i>Sample Size*</i>	10
Turned off AV equipment too quickly	4
Did not work like I thought it would	4
Did not like it	2
Too complicated to use	1
Others	1
*Base: Respondents who removed Embertec Controller **Multiple responses	

E2a. Were you home when the Embertec smart power controller was installed?

Onsite when Embertec Controller Installed	2014 Pilot Participants
<i>Sample Size*</i>	92
Yes	91%
No	9%
*Base: Respondents who had an Embertec Controller installed through the program	

E2b. Did the installer explain how the Embertec smart power controller worked?

Explained Embertec Controller	2014 Pilot Participants
<i>Sample Size*</i>	84
Yes	99%
No	1%
*Base: Respondents who were onsite when Embertec controller installed	

E3a. Using a scale from 1 to 5, where 1 means “very dissatisfied” and 5 means “very satisfied”, please tell me how satisfied you are with the Embertec smart power controller that was installed under the program.

Satisfaction with Embertec Controller*	2014 Pilot Participants
<i>Sample Size**</i>	80
5 - Very satisfied	49%
4	26%
3	15%
2	8%
1 - Very dissatisfied	3%
*Base: Respondents who have Embertec controller installed **Don't know removed from calculations	

E3b. You indicated that you were not satisfied with the Embertec smart power controller that was installed under the program. What was the SINGLE most important reason you were not satisfied with this device?

Reasons for Dissatisfaction	2014 Pilot Participants
<i>Sample Size*</i>	20
Turned off AV equipment too quickly	70%
Did not work like I thought it would	15%
Too complicated to use	10%
Others	5%
*Base: Respondents who were dissatisfied with controller (as indicated by a rating of '1', '2' or '3')	

P2. How did you find out about this program?

Sources of Program Awareness*	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
TOTAL ADVERTISING	24%
Mailings from ENSC	16%
Newspaper	6%
ENSC Website	5%
Radio	-
Co-worker, family, friend	54%
ENSC staff/DA	6%
Mall/in-store booth/display	6%
Television	3%
Other participants	3%
Participated in other programs or completed an energy audit	2%
Brochure/Pamphlet	1%
Home show/Trade show	-
Others	10%
Don't know	4%
*Multiple responses	

P3. What was the single most important reason you agreed to participate in the program?

P4. Were there any other reasons?

Reasons for Participating	2014 Pilot Participants	
	Most Important Motivation	Other Important Motivations*
<i>Sample Size</i>	177	175
To save on energy/energy costs	80%	19%
To receive free CFLs	3%	3%
Wanted energy efficient upgrades	3%	3%
No cost for services/program was free	2%	5%
To help protect the environment	2%	7%
To reduce water consumption	1%	3%
To receive LED lights at a discounted price	1%	-
Become informed about energy efficient upgrades	1%	1%
Others	6%	5%
Don't know	1%	1%
None/No other reasons	-	59%
*Multiple responses		

P5. Before participating, did you have any concerns about taking part in the program?

Concerns with Program Prior to Taking Part	2014 Pilot Participants
<i>Sample Size</i>	177
No	97%
Yes	3%

P6. What were those concerns?

Concerns about the Program**	2014 Pilot Participants (#)
<i>Sample Size*</i>	5
That I'd have to pay some fees	2
That the products offered might pose health risks	1
Wouldn't save energy/be more energy efficient	1
Wouldn't like what they gave me	1
It could be a scam/Uncomfortable about letting strangers into home<	-
Didn't believe it was really free	-
Others	1
*Base: Respondents who expressed concerns **Multiple responses	

S1, S4, S5, S6, S7. Using a scale from 1 to 5, where 1 means “very dissatisfied” and 5 means “very satisfied”, please tell me how satisfied you are with...

Satisfaction with RDI*	2014 Pilot Participants	
	<i>Sample Size*</i>	<i>%**</i>
Time required to complete the work	174	98%
Quality of the work completed	176	96%
Program overall	174	94%
Overall communication from the program	175	91%
Energy conservation measures installed	174	89%
*Don't know removed from calculations **Percentage of respondents who gave a rating of 5 or 4 on a scale where 5= 'Very satisfied' and 1= 'Very Dissatisfied'		

S3. What was the most important reason why you were satisfied with the program overall?
Anything else?

Reasons for Satisfaction*	2014 Pilot Participants
<i>Sample Size**</i>	163
I liked the installer who visited the home	29%
Lowered energy bill	27%
Saves energy	18%
Products/services offered through the program	18%
Better lights/lighting	14%
Good service	12%
Information received/informative	12%
Program was free	6%
Reasonable timeframe	6%
Everything went smooth	2%
Reduced water consumption	2%
Don't know	4%
Others	8%
*Base: Respondents who were satisfied with the program (giving a rating of '5' or '4')	
**Multiple responses	

S2. For what reasons were you not satisfied with the program overall?

Reasons for Dissatisfaction*	2014 Pilot Participants (#)
<i>Sample Size**</i>	11
I don't like the light bulbs I received	4
I expected more	3
I did not like the installer who visited the home	3
Energy bill did not decrease	2
Did not like upgrades/changes made	1
I don't like the low flow faucet aerators installed	1
*Base: Respondents who were dissatisfied with the program (as indicated by a rating of '1', '2' or '3')	
**Multiple responses	

S8. Using a 5-point scale, where '1' is very difficult and '5' is very easy, how would you rate the process to apply to the program?

Program Application Process	2014 Pilot Participants
<i>Sample Size*</i>	172
5 - Very easy	83%
4	16%
3	1%
2	1%
1 - Very difficult	1%
*Don't know removed from calculations	

S9. What was difficult about applying to the program?

Causes for Program Application Difficulty*	2014 Pilot Participants (#)
<i>Sample Size</i>	3
Program wasn't what I expected	1
Lack of information/not informed about application process	1
Don't know	1
*Base: Respondents who had difficulty applying to the program (as indicated by a rating of '1', '2' or '3')	

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before the products were installed in your household?

Time Between First Contact with ENSC and Product Installation*	2014 Pilot Participants
<i>Sample Size</i>	177
1-6 days	20%
7-9 days	16%
10-19 days	16%
20-29 days	3%
30 days or more	9%
Don't know	36%
Mean	12.8 days
*Mean excludes responses of 'Don't know'	

PP1a/b. According to our records, your household received information during the visit from the installer about the benefits of washing your clothes in cold water. The installer would have spoken to you about your clothes washing behavior and encouraged you to set your washing temperature to cold. Do you recall this conversation with the installer?

Recall Receiving Information from Installer	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
Yes	87%
No	12%
Don't know/Refused	2%

PP2a. Did you agree to wash your clothes in cold water?

Agree to Wash Clothes with Cold Water	2014 Pilot Participants
<i>Sample Size</i>	<i>154</i>
Yes	95%
No	3%
Don't know/Refused	2%

PP2b. When agreeing to wash your clothes in cold water, you may have been asked to agree to several commitments. Please tell me whether you agreed, disagreed, or were not asked about the following commitments.

Agree to Commitments	2014 Pilot Participants	
	<i>Sample Size*</i>	<i>% Agree**</i>
Provided a verbal commitment to wash clothes in cold water	129	98%
Agreed to follow-up call	104	96%
Signed a pledge sheet	70	90%
Provided permission to put name on ENSC website	75	80%
*Base: Respondents who agreed to wash clothes in cold water **Don't know/Refused removed from calculation		

PP3. Thinking of your OVERALL experience with this project aimed at encouraging you to wash your clothes in cold water, including any services or energy efficiency advice or tips provided, how satisfied were you overall with this project on a scale from 1 to 10, where 1='not at all satisfied' and 10='very satisfied'?

Satisfaction with Pilot Project	2014 Pilot Participants	
	Sample Size*	%**
Overall Experience	146	72%
*Don't know removed from calculations **Percentage of respondents who gave a rating of 10 or 9 on a scale where 10= 'Very satisfied' and 1= 'Not at all satisfied'		

B1. Did your household receive information during the visit from the installer about energy-efficient products?

B2. Did the information your household received during the visit from the installer change your behavior in terms of how you use energy at home?

Information Received	2014 Pilot Participants
Sample Size	177
Yes	71%
No	10%
Don't know	19%
Information Led to Behavioral Changes*	2014 Pilot Participants
Sample Size	125
Yes	68%
No	30%
Don't know	2%
*Base: Respondents who received information	

B3. How did your behavior change?

Behavioral Changes*	2014 Pilot Participants
<i>Sample Size**</i>	85
I turn off my lights now	52%
I use cold water to wash my clothes	35%
Reduce water consumption/Not wasting water	18%
I turn off appliances	12%
More aware of power usage/saving energy	9%
Use appliances more efficiently/Run dishwasher at night	7%
I use energy-efficient light bulbs	6%
Unplug items not in use	6%
I hang my clothes to dry	5%
I set my heating thermostat at lower temperatures	5%
Installed new heating system/heat pump	4%
Bought energy efficient appliances	2%
Improved insulation	2%
I close doors and windows	1%
I decided to participate in ENSC's Home Energy Assessment program	1%
Aware of how to use CFLs properly/let CFLs warm up	1%
I set my water heater thermostat at lower temperatures	1%
Use Embertec/audio-visual controller to shut off TV/stereo	1%
I have decided to participate in ENSC's Appliance Retirement	1%
Others	11%
Don't know	2%
*Base: Respondents who indicated their behavior changed	
**Multiple responses	

B5. How satisfied are you with washing your clothes in cold water on a scale from 1 to 10, where 1='not at all satisfied' and 10='very satisfied'?

Satisfaction with Washing Clothes in Cold Water	2014 Pilot Participants	
	<i>Sample Size*</i>	<i>%**</i>
Satisfied	159	75%
*Don't know removed from calculations		
**Percentage of respondents who gave a rating of 10 or 9 on a scale where 10= 'Very satisfied' and 1= 'Not at all satisfied'		

R1. Do you have any recommendations that you think would help improve the Residential Direct Installation program?

Participant Suggestions*	2014 Pilot Participants
<i>Sample Size</i>	177
Offer more products/measures to be installed	7%
Better/brighter light bulbs	4%
Better advertising/program awareness	3%
Offer more information on the products/measures installed	3%
Improve communication	3%
Improve quality of work	1%
Issues with faucet aerator	1%
None/no other recommendations	72%
Others	11%
*Multiple responses	

R2. Which energy efficiency products would you like to have had installed through the Residential Direct Installation program?

Energy Efficiency Products that Respondents Would Have Liked Installed*	2014 Pilot Participants (#)
<i>Sample Size**</i>	4
Air sealing/Weather stripping	1
Toilets	1
Home energy monitor	1
Dimmable light bulbs/CFLs	1
Others	1
*Base: Respondents who recommended more products/measures to be installed	
**Multiple responses	

D1. What type of residence do you live in?

Type of home	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
Single-family detached house	91%
Townhouse or duplex which shares adjacent walls	3%
Mobile home or house trailer	2%
Semi-detached house	1%
Apartment building that has fewer than five stories	1%
Something else	1%
Don't know	1%

D2. How many bedrooms are in your home?

Number of Bedrooms	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
1	1%
2	15%
3	49%
4 or more	36%

D3. Do you own or rent this home?

Home Ownership	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
Own	93%
Rent/lease	5%
Others	2%
Refused	1%

D4. Do you pay the electric bills for your home?

You Pay Electricity Bills	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
Yes	99%
No	1%
Don't know/refused	1%

D5. Including yourself, how many people live in this residence on a full-time basis?

Household Size	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
1	17%
2	53%
3	12%
4	11%
5	5%
6	2%
Don't know	1%

D6. What is your age group?

Age of Respondent	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
18 to 24	1%
25 to 34	8%
35 to 44	6%
45 to 54	23%
55 to 64	25%
65 or over	36%
Refused	1%

D7. What is the highest grade of schooling completed by the head of your household?

Level of Education	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
Less than high school graduate certificate	14%
High school graduate certificate and/or some post-secondary education	22%
Trade certificate/diploma	5%
College certificate/diploma	19%
University certificate/diploma	37%
Others	1%
Refused	3%

D8. Which of the following income categories best describes your total annual household income before taxes in 2013?

Household Income	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
Less than \$15,000	3%
\$15,000 - \$24,999	7%
\$25,000 - \$34,999	15%
\$35,000 - \$49,999	16%
\$50,000 - \$69,999	17%
\$70,000 - \$79,999	3%
\$80,000 or more	14%
Don't know/Refused	24%

D9. Gender?

Gender	2014 Pilot Participants
<i>Sample Size</i>	<i>177</i>
Male	36%
Female	64%

APPENDIX VII

QUARTERLY PARTICIPANT SURVEY QUESTIONNAIRE

V1. Hello may I please speak with [INSERT NAME]?

1. Yes [GOTO INTRODUCTION]
2. No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

V2. Hello, my name is _____ and I am with CRA (Corporate Research Associates), and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your household recently participated in the Residential Direct Install Program. As part of this program, someone would have come to your house and installed new lighting or domestic water heating energy efficiency products, such as compact fluorescent light bulbs (CFLs) and faucet aerators, at no charge. We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about five minutes. Is this a good time for you?

1. Yes [CONTINUE]
2. No, I don't remember the program / Don't know [PROMPT: "Are you sure? Someone would have come to your house and installed free energy-efficient products for you to save energy and money?" RECODE AS "YES" IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO: Is there someone else in the household who would know about having participated in the Efficiency Nova Scotia program? THANK AND TERMINATE.]
 - a. Yes: [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
 - b. No [THANK & TERMINATE]
3. No, but they came to my previous home CONTINUE
99. Refused [THANK AND TERMINATE]

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"
[SCHEDULED, IF NECESSARY, FOR: _____]

Verification and Recall [V Series]

V3. I am going to read you a list of energy-efficient products that, according to our records, were installed in your house by the program: [READ WHAT IS ON RECORD (MEASURE#0 IN THE DATABASE)]. For each one, can you please verify that this information is correct and that the product was installed? [READ AND ROTATE, CODE ONE RESPONSE FOR EACH APPLICABLE MEASURE]

[NOTE FOR PROGRAMMER: DO NOT PUT THE NUMBER OF EACH MEASURE]

- a. CFL bulbs (CFLs 13W – CFLs 23W – Specialty CFLs)
- b. LED Bulbs (LEDs 8W – LEDs 12W)
- c. LED Nightlights
- d. Low flow showerheads (LFS)
- e. Faucet aerators (Faucet Aerator)
- f. Pipe insulation/Tank Wraps
- g. Embertec smart power controller for audio-visual equipment

3 Yes

4 No, not installed

98 Don't know

99 Refused

V4. [FOR EACH OF V3a TO V3g = NO AND RECORD = YES] Are you sure? According to our records someone would have come to your place and installed ... [READ WHAT IS ON RECORD]

- a. [CFL bulbs (CFL's 13W – CFL's 23W – Specialty CFLs)]
- b. [LED Bulbs (LEDs 8W – LEDs 12W)]
- c. [LED Nightlights]
- d. [Low flow showerheads]
- e. [Faucet aerators]
- f. [Pipe insulation/Tank Wraps]
- g. [Smart power controller]

1 Yes

2 No

98 Don't know

99 Refused [RECORD AS NO]

[THANK AND TERMINATE IF RESPONDENT SAY "NO", "DK" OR "REF" TO ALL APPLICABLE QUESTIONS FROM V3 TO V4]

Satisfaction [S Series]

S2. How did you find out about this program? **[DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]**

1. Media advertising
2. Contacted directly by Efficiency Nova Scotia
3. Through a third party contractor or service provider
4. Efficiency Nova Scotia website
5. Facebook or other social media
6. Word of mouth
97. (Refused)
98. (Don't know)
99. (Other [SPECIFY _____])

S3. Did you have direct contact with Efficiency Nova Scotia employees regarding the Residential Direct Install program? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

1. Yes
2. No
98. (Don't know)
99. (Refused)

IF YES, CONTINUE. OTHERWISE, SKIP TO S24

S4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where "1" is not at all satisfied and "10" is completely satisfied, how satisfied were you with **[READ AND ROTATE. CODE ONE RESPONSE FOR EACH STATEMENT]**

- b. The responsiveness of employees to your requests and enquiries in a timely manner
- e. The length of time prior to your appointment
- g. The value of the program relative to the time and cost involved

___ Response ___ 98 Don't Know ___ 99 Refused

S5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with you?

___ Response ___ 98 Don't Know ___ 99 Refused

S6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

IF YES IN S6, CONTINUE, OTHERWISE SKIP TO S24.

S7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

S9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's **[READ AND ROTATE FACTORS]**? **[CODE ONE RESPONSE FOR EACH FACTOR]**

- a. Service attitude
- b. Knowledge of programs available
- c. Ability to provide advice

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied

VOLUNTEERED

- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

S24. How satisfied were you with the quality of work completed in your home by Efficiency Nova Scotia's service contractor? Were you: **[READ RESPONSES IN ORDER - CODE ONE ONLY]**

1. Completely satisfied
2. Mostly satisfied
3. Mostly dissatisfied, or
4. Completely dissatisfied

VOLUNTEERED

97. (Neither satisfied nor dissatisfied)
98. (Don't know)
99. (Refused)

[IF MOSTLY/COMPLETELY DISSATISFIED IN S.24, CONTINUE, OTHERWISE SKIP TO S26.]

S25. What was the main reason for your dissatisfaction with the quality of work provided? **[RECORD VERBATIM. PLEASE BE AS SPECIFIC AS POSSIBLE]**

___ Response ___ 98 Don't Know ___ 99 Refused

S26. How satisfied were you with the service contractor provided by Efficiency Nova Scotia on each of the following factors? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the **[READ AND ROTATE STATEMENTS. CODE ONE RESPONSE FOR EACH STATEMENT]**?

- a. Service attitudes
- b. Ability to meet deadline as promised
- c. Response to issues or concerns

S27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others? **[CODE ONE ONLY]**

1. Definitely
2. Probably
3. Probably not
4. Definitely not

VOLUNTEERED

97. (Not eligible to any other programs)
98. (Don't know)
99. (Refused)

S28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs? **[CODE ONE ONLY]**

1. Definitely
2. Probably
3. Probably not
4. Definitely not
98. (Don't know)
99. (Refused)

Free-Ridership [FR Series]

INSTRUCTION:

[FOR RESPONDENTS WITH MORE THAN TWO ("YES") MEASURES VERIFIED IN V3 AND V4, CHOOSE TWO MEASURES VERIFIED. [EXCEPT LED NIGHTLIGHTS] THE RESPONDENT WILL ANSWER ACCORDING TO THESE TWO MEASURES THROUGHOUT SECTION FR WHEN IDENTIFIED LIKE SO: [MEASURE 1 or 2].]

SELECTION METHOD FOR THE TWO MEASURES:

- › IF LED BULBS ARE VERIFIED IN V3 AND V4, RESPONDENT WILL AUTOMATICALLY ANSWER ACCORDING TO LED BULBS
- › THEN, CHOOSE ANOTHER MEASURE VERIFIED IN V3 AND V4 AT RANDOM, AMONG THE FOLLOWING:
 - Low flow showerheads (LFS)
 - Faucet aerators (Faucet Aerator)
 - Pipe insulation/Tank Wraps
 - Smart power controller
 - CFLs
- › LED Nightlights ARE EXCLUDED OF THE FREE-RIDERSHIP SECTION. SO NO RESPONDENT WILL ANSWER ABOUT LEDs IN THE FREE-RIDERSHIP SECTION.

The next questions will be about the **[MEASURE 1]** you had installed through the program.

FR1M1. Did you or anyone in your household have specific plans to purchase and install **[MEASURE 1]** prior to learning about the Residential Direct Install Program? **[CODE ONE ONLY]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

FR1aM1. **IF FR1M1=YES, THEN ASK:** I just want to make sure I understand - Before you decided to participate in the Residential Direct Install Program, you had already made the decision to purchase and install **[MEASURE 1]**?

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Residential Direct Install Program.

If you had not participated in the Residential Direct Install Program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely **Would Not** Have Taken the Action,” and a 10 indicating that you “Definitely **Would Have** Taken the Action.” **[AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: “AND NEXT. In the absence of the Program, would you have . . . DO NOT ACCEPT A RANGE – POSE FR2M1 SEQUENCE IN ORDER/DO NOT RANDOMIZE]**

FR2aM1. ... installed exactly the same **[MEASURE 1]** that was installed through the Program?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2cM1. ... installed the **[MEASURE 1]** that was installed through the Program but at a later date?

___ Response ___ 98 Don't Know ___ 99 Refused

IF FR2cM1 > 5, THEN ASK:

[DO NOT ASK IF FR2cM1=98 OR 99]

FR2dM1. You indicated in your previous response that if the Residential Direct Install Program had not been available there was an **[INSERT RESPONSE FROM FR2cM1]** in 10 likelihood that you would have installed the same energy-efficient products but at a later date. Approximately how many months later would you have installed these products? **[DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

1. _____ months later
2. (Never)
3. (At the same time)
98. (Don't know)
99. (Refused)

[IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2dM1 ANSWER IN MONTHS, READ]:

Would it have been within ...

1. The last 6 months?
2. 6 months to less than 1 year later?
3. 1 to less than 2 years later?
4. 2 to less than 3 years later?
5. 3 to less than 4 years later?
6. 4 or more years later?
7. (Never)
98. (Don't Know)
99. (Refused)

FR3M1. If Efficiency Nova Scotia had not installed **[MEASURE 1]** for free, would you have paid the full cost of the **[MEASURE 1]**?

1. Yes
2. No
97. (Depends on the cost)
98. (Don't know)
99. (Refused)

[IF ONLY ONE MEASURE VERIFIED IN V3-V4, SKIP TO FR4]

The next questions will be about the **[MEASURE 2]** you had installed through the program.

FR1M2. Did you or anyone in your household have specific plans to purchase and install **[MEASURE 2]** prior to learning about the Residential Direct Install Program?

- 1. (Yes)
- 2. (No)
- 98. (Don't know)
- 99. (Refused)

FR1aM2. **[IF FR1M2=YES, THEN ASK: I just want to make sure I understand - Before you decided to participate in the Residential Direct Install Program, you had already made the decision to purchase and install [MEASURE 2]?**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Residential Direct Install Program.

If you had not participated in the Residential Direct Install Program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely **Would Not** Have Taken the Action,” and a 10 indicating that you “Definitely **Would Have** Taken the Action.” **[AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: “AND NEXT. In the absence of the Program, would you have . . . DO NOT ACCEPT A RANGE – POSE FR2M2 SEQUENCE IN ORDER/DO NOT RANDOMIZE]**

FR2aM2. ... installed exactly the same **[MEASURE 2]** that was installed through the Program?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2cM2. ... installed the **[MEASURE 2]** that was installed through the Program but at a later date?

___ Response ___ 98 Don't Know ___ 99 Refused

IF FR2cM2 > 5, THEN ASK:

[DO NOT ASK IF FR2cM2=98 OR 99]

FR2dM2. You indicated in your previous response that if the Residential Direct Install Program had not been available there was an **[INSERT RESPONSE FROM FR2cM2]** in 10 likelihood that you would have installed the same energy-efficient products but at a later date. Approximately how many months later would you have installed these products? **[DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

_____ months later

- 1. (Never)
- 2. (At the same time)
- 98. (Don't know)
- 99. (Refused)

[IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2dM2 ANSWER IN MONTHS, READ]:

Would it have been within ...

- 1. The last 6 months
- 2. 6 months to less than 1 year later
- 3. 1 to less than 2 years later
- 4. 2 to less than 3 years later
- 5. 3 to less than 4 years later
- 6. 4 or more years later

VOLUNTEERED

- 7. (Never)
- 98. (Don't Know)
- 99. (Refused)

FR3M2. If Efficiency Nova Scotia had not installed **[MEASURE 2]** for free, would you have paid the full cost of the **[MEASURE 2]**?

- 1. Yes
- 2. No
- 97. (Depends on the cost)
- 98. (Don't know)
- 99. (Refused)

[ASK FR4 ONCE, NOT FOR EACH MEASURE VERIFIED IN V3-V4]

FR4. Next, I'm going to ask you to rate the importance of factors that might have influenced your decision to install energy-efficient products through the Residential Direct Install Program. Using a scale from 0 to 10 where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to implement the energy-efficient products you installed through the Program. **[DO NOT ACCEPT A RANGE]**

Factor (READ AND RANDOMIZE)	Responses
a. The free installation of energy-efficient products offered by the program	___ Response ___ 98 Don't Know ___ 99 Refused ___ 97 Not applicable
b. Information or advice provided by the program advisor during the installation	___ Response ___ 98 Don't Know ___ 99 Refused ___ 97 Not applicable
c. Previous experience with a similar program either from Efficiency Nova Scotia or Nova Scotia Power	___ Response ___ 98 Don't Know ___ 99 Refused ___ 97 Not applicable

Demographic Characteristics (D Series)

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

D5. Including yourself, how many people live in this residence on a full-time basis?

Number of people: _____

[NOTE: DON'T ALLOW ZERO FOR A RESPONSE]

99. (Refused)

D6. In what age category do you fall? Are you: **[READ]**

1. 18 to 24
2. 25 to 34
3. 35 to 44
4. 45 to 54
5. 55 to 64
6. 65 or over
99. (Refused)

D7. What is the highest grade of schooling completed by the head of your household? **[READ IF NECESSARY]**

1. (Less than high school graduation diploma)
2. (High school graduation diploma and/or some post secondary)
3. (Trades certificate or diploma)
4. (College certificate or diploma)
5. (University degree, certificate or diploma)
96. Other (**SPECIFY:** _____)

VOLUNTEERED

98. (Don't know)
99. (Refused)

D8. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category. **[READ LIST; SELECT ONE RESPONSE]**

1. Less than \$15,000
2. \$15,000 - \$24,999
3. \$25,000 - \$34,999
4. \$35,000 - \$49,999
5. \$50,000 - \$69,999
6. \$70,000 - \$79,999
8. \$80,000 or more

VOLUNTEERED

98. (Don't know)
99. (Refused)

D9. **[DO NOT READ]** Gender:

1. Male
2. Female

END: THAT IS ALL THE QUESTIONS I HAVE FOR YOU. THANK YOU FOR TAKING THE TIME TO RESPOND TO THIS SURVEY.

APPENDIX VIII

QUARTERLY PARTICIPANT SURVEY RESULTS

S2. How did you find out about this program?

Sources of Awareness*	2013	2014
<i>Sample Size</i>	<i>124</i>	<i>110</i>
Word of mouth	55%	61%
Contacted directly by ENSC	15%	15%
Media advertising	21%	14%
Facebook or other social media	2%	3%
ENSC website	1%	3%
Through the mail	-	3%
Third party contractor or service provider	4%	2%
Previous experience with ENSC	-	2%
The Internet	1%	1%
Booth at Community Centre/Event	5%	-
Nova Scotia Power bill	2%	-
Others	9%	5%
Don't know	2%	1%
*Multiple Responses		

S3. Did you have direct contact with Efficiency Nova Scotia employees regarding the Residential Direct Install program?

Contact with ENSC	2013	2014
<i>Sample Size</i>	<i>124</i>	<i>110</i>
Yes	72%	72%
No	24%	26%
Don't know	4%	2%

- S4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with...
- S5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia’s overall performance in working with you?

Satisfaction with Overall Performance	2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Responsiveness of employees to requests and enquiries in a timely manner	89	9.6	79	9.6
Length of time prior to your first appointment	87	9.5	79	9.5
ENSC’s overall performance in working with you	89	9.4	78	9.4
Value of RDI relative to the time and cost involved	84	9.4	77	9.4
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of ‘Refused’ and ‘Don’t know’				

- S6. Did you speak directly to any of Efficiency Nova Scotia’s contact centre representatives?

Contact with ENSC Contact Centre	2013	2014
Sample Size	89	79
Yes	81%	73%
No	12%	20%
Don’t know	7%	6%

- S7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

S9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's...

Satisfaction with Overall Performance	2013		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Overall level of service provided	72	100%	58	100%
Service attitude	71	100%	58	100%
Knowledge of programs available	70	99%	57	100%
Ability to provide advice	72	99%	58	96%
*Base: Number of respondents who had contact with ENSC contact center representatives **Percentage completely satisfied/mostly satisfied. "Don't know/Refused" removed from calculations				

S24. How satisfied were you with the quality of work completed in your home by Efficiency Nova Scotia's service contractor?

Satisfaction with Service Contractor	2013	2014
Sample Size*	124	109
Completely satisfied	81%	84%
Mostly satisfied	17%	15%
Mostly dissatisfied	2%	1%
Completely dissatisfied	-	-
Neither satisfied nor dissatisfied	-	-
*Excludes responses of 'Refused' and 'Don't know'		

S25. What was the main reason for your dissatisfaction with the quality of work provided?

Reason for Dissatisfaction with Service Contractor	2013 (#)	2014 (#)
Sample Size*	2	1
Couldn't/didn't install measures that were advertised	1	1
Poor product	1	-
Not enough measures installed	1	-
Lack of advice	1	-
*Multiple Response		

S26. How satisfied were you with the service contractor provided by Efficiency Nova Scotia on each of the following factors? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the...

Satisfaction with Service Contractor	2013		2014	
	Sample Size	Satisfied*	Sample Size	Satisfied*
Ability to meet deadline as promised	122	98%	109	100%
Service attitude	122	99%	109	99%
Response to issues or concerns	120	98%	106	99%
*Percentage completely satisfied/mostly satisfied. "Don't know/Refused" removed from calculations				

S27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others?

Would Recommend RDI to a Family Member or Friend	2013	2014
Sample Size*	124	110
Definitely	94%	91%
Probably	6%	9%
Probably not	1%	-
Definitely not	-	-
**"Don't know/refused" have been removed from calculation		

S28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs?

Would Participate in Other ENSC Programs	2013	2014
Sample Size*	123	107
Definitely	77%	79%
Probably	20%	21%
Probably not	2%	-
Definitely not	-	-
* "Don't know/refused" have been removed from calculation		

FR4. Next, I'm going to ask you to rate the importance of factors that might have influenced your decision to install energy-efficient products through the Residential Direct Install Program. Using a scale from 0 to 10 where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to implement the energy-efficient products you installed through the Program.

Importance of RDI in Influencing Decisions	2013		2014	
	Sample Size*	Mean Score	Sample Size*	Mean Score
Average rating: 10= "Extremely important", 0= "Not important at all"				
The free installation of energy-efficient products offered by the program	121	8.9	110	9.3
Information or advice provided by the program advisor during the installation	122	8.5	109	8.5
Previous experience with a similar program either from Efficiency Nova Scotia or Nova Scotia Power	89	5.3	86	5.4
* "Don't know/Refused" excluded from calculations				

D5. Including yourself, how many people live in this residence on a full-time basis?

Full-time Residents	2013	2014
Sample Size	124	110
1	15%	13%
2	43%	53%
3	16%	14%
4	16%	15%
5 or more	10%	6%
Don't know	-	-
Average*	2.7	2.5
*Don't know/Refused excluded from calculation		

D6. In what age category do you fall? Are you

Respondent Age	2013	2014
<i>Sample Size</i>	<i>124</i>	<i>110</i>
18 to 24	2%	-
25 to 34	13%	15%
35 to 44	14%	15%
45 to 54	21%	18%
55 to 64	33%	24%
65 or older	17%	28%
Refused	-	-

D7. What is the highest grade of schooling completed by the head of your household?

Education	2013	2014
<i>Sample Size</i>	<i>124</i>	<i>110</i>
Less than high school	2%	7%
High school graduate	23%	27%
Trade certificate	7%	4%
College diploma	15%	14%
University diploma	50%	46%
Others	1%	-
Don't know/Refused	2%	2%

D8. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category.

	2013	2014
<i>Sample Size</i>	<i>124</i>	<i>110</i>
Less than \$15,000	-	1%
\$15,000 to \$24,999	4%	5%
\$25,000 to \$34,999	5%	5%
\$35,000 to \$49,999	18%	11%
\$50,000 to \$69,999	19%	16%
\$70,000 to \$79,999	7%	8%
\$80,000 or more	32%	35%
Refused / Don't know	15%	19%

D9. Gender

Gender	2013	2014
<i>Sample Size</i>	<i>124</i>	<i>110</i>
Male	47%	49%
Female	53%	51%

APPENDIX IX

ALGORITHM FOR FREE-RIDERSHIP CALCULATION

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

FR2a. If you had not participated in RDI, what is the likelihood that you would have installed the same energy-efficient products that you installed through RDI? (Scale 0 to 10)	FR2a = Answer x 10%
PA1 Score:	FR2a
FR1. Did you or anyone in your household have specific plans to purchase and install the energy-efficient products prior to talking with anyone about RDI?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%
FR1a. I just want to make sure I understand - Before you decided to participate in RDI, you had already made the decision to purchase and install the energy-efficient products?	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%
FR3. If ENSC had not installed energy-efficient products for free, would you have paid for the full cost of the products? (Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3
FR4. Level of influence (Scale 0 to 10) Factors a, b and c = Program factors	FR4_P = Max(a ; b ; c)
PA3 Score:	(10 – FR4_P) x 10%
FR2c. If you had not participated in the program, what is the likelihood that you would have installed the energy-efficient products but at a later date? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2d Otherwise: PA4 = EMPTY
FR2d. Approximately how many months later would you have installed these products? 1. Less than 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later? 7. (Never) 9. (Don't know / Refused)	IF 1. : FR2d = 100% IF 2. : FR2d = 50% IF 3. : FR2d = 25% IF 4. : FR2d = 0% IF 5. : FR2d = 0% IF 6. : FR2d = 0% IF 7. : FR2d = 0% IF 9. : FR2d = 0%
PA4 Score:	FR2d
Final Free-Ridership	MEAN VALUE OF : (PA1 ; PA2 ; PA3 ; PA4)
Inconsistency Test	IF FR3 ≤ 70% AND IF FR2a > 70%: PA1 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)

APPENDIX X INTERNAL SPILLOVER METHODOLOGY

Internal spillover was measured using a participant survey. Participants were asked whether following their participation in the program, they bought and implemented any additional energy efficiency measures, without benefitting from any rebates offered by ENSC programs. If a participant did admit to having implemented additional measures, they were asked a set of questions designed to identify the additional energy efficiency measures implemented and to quantify their associated savings. Subsequently, another question was asked to quantify the level of influence the program had on the participant's decision to whether implement these additional measures. The value established regarding this level of influence was used to determine the portion of the additional savings attributable to the program.

Then, the level of internal spillover was established by dividing the total quantity of the additional savings attributable to the program by the total quantity of savings achieved by the program for all the survey respondents.

The figure below illustrates the methodology used to calculate the internal spillover level.

SO1. Since the time that you participated in RDI, have you installed any additional energy-efficient products or retired any old appliances on your own?	IF 1. Yes: CONTINUE IF 2. No OR 99 : END
SO2. I just want to make sure I understand - After you participated in the RDI program, you installed additional energy-efficient products or retired old appliances on your own. Is that correct?	IF 1. Yes: CONTINUE IF 2. No OR 99 : END
SO3. Have you benefited from any other financing or rebates from any other Efficiency Nova Scotia programs for these additional energy-efficient products or retirement of appliances?	IF 2. No: CONTINUE IF 1. Yes OR 99 : END
SO4. Which additional energy-efficient products or retired old appliances have you installed on your own after participating in RDI?	SO4 = SUM (kWh associated with each upgrade)
Additional Products and Retirement Savings:	SO4
SO5. How influential was your experience with RDI on your decision to install these additional energy-efficient products or retire these appliances on your own? (Scale 0 to 10)	SO5 = Answer x 10%
Attribution Level:	SO5
Spillover Savings:	SO4 x SO5
Final Spillover Level = $\frac{\text{SUM of (SO2 x SO4) for All Respondents}}{\text{SUM of Program Savings for All Respondents}}$	



ECONOLER



RENTAL PROPERTIES AND CONDOS SERVICE

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION



Final Report



February 26, 2015



ABBREVIATIONS

BES	Business Energy Solutions
CATI	Computer-Assisted Telephone Interviewing
CFL	Compact Fluorescent Lamp
COP	Coefficient of Performance
CRA	Corporate Research Associates
DA	Delivery Agent
DHW	Domestic Hot Water
ENSC	Efficiency Nova Scotia Corporation
LED	Light Emitting Diode
MURB	Multi-Unit Residential Buildings
NTGR	Net-to-Gross Ratio
OPA	Ontario Power Authority
PUC	Pennsylvania Public Utility Commission
RP&C	Rental Properties and Condos Service
TRM	Technical Reference Manual

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VI
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	3
2.1 Presentation of the Team	3
2.2 Methodology Description	3
3 VALIDATED SAVINGS	5
3.1 Gross Savings	5
3.1.1 CFLs	5
3.1.2 LED Lamps	7
3.1.1 LED Nightlights	8
3.1.2 Faucet Aerators	8
3.1.3 Low-flow Showerheads	10
3.1.4 Pipe Insulation	10
3.1.5 Hot Water Tank Wraps	11
3.1.6 Installation Rates	12
3.1.7 Validated Gross Savings	12
3.2 Interactive Effects	15
3.3 Net-to-Gross Ratio	17
3.3.1 Free-ridership	17
3.3.2 NTGR Calculation	17
3.4 Net Savings	17
APPENDIX I PARTICIPANT SURVEY QUESTIONNAIRE	21
APPENDIX II PARTICIPANT SURVEY RESULTS	31

LIST OF TABLES

Table 1: Validated Gross and Net Savings at the Generator	vii
Table 2: Survey Sample Sizes and Margins of Error	4
Table 3: Unitary Savings Values for Each Type of CFL	7
Table 4: Unitary Savings Values for Each Type of LED Lamp	8
Table 5: Tracked Unitary Savings Value for LED Nightlights	8
Table 6: Unitary Savings Value for Faucet Aerators	9
Table 7: Unitary Savings Values for Low-flow Showerheads	10
Table 8: Unitary Savings Values for RSI-1.21 and RSI-0.90 Hot Water Tank Wraps	11
Table 9: Percentage of Products Installed and Installation Rate	12
Table 10: Validated Gross Energy and Peak Demand Savings by Product	13
Table 11: Interactive Effects Calculation for Lighting Products	15
Table 12: Interactive Effects Factor for Pipe Insulation and Hot Water Tank Wraps	16
Table 13: Validated Net Energy and Peak Demand Savings by Product	18
Table 14: Validated Savings at the Generator	20

LIST OF FIGURES

Figure 1: Light Output Equivalency for Incandescent Lamps and CFLs	6

EXECUTIVE SUMMARY

In 2014, the evaluation of Rental Properties and Condos (RP&C) consisted in substantiating the tracked savings of Efficiency Nova Scotia Corporation (ENSC) with the parameters established in the 2013 evaluation. This report presents the validated gross and net savings for the year 2014.

Program Component Overview

Formerly known as Multi-Unit Residential Buildings (MURB), RP&C offers landlords, tenants and condominium owners direct free-of-charge installation of energy-efficient products in both common-space areas and rental units. It should be noted that products installed in common-space areas through RP&C are claimed as part of Business Energy Solutions (BES).

ENSC contracted one delivery agent (DA), the Summerhill Group, to provide installation services. The following products are installed through RP&C:

Common Areas

- › Compact fluorescent lamps (CFLs)
- › Light-emitting diode (LED) lamps
- › LED exit signs
- › Hot water tank wraps
- › Pipe insulation
- › Faucet aerators
- › Low-flow showerheads

Tenant Units

- › CFLs
- › LED lamps
- › LED nightlights
- › Faucet aerators
- › Low-flow showerheads/showerwands
- › Pipe insulation
- › Hot water tank wraps

Key Findings

Econoler reviewed the content of the 2014 RP&C tracking system, which includes a total of 59,168 products installed in 2,895 condos and apartments.

To calculate the savings associated with the products installed through RP&C, the Evaluator validated the content of the tracking system report, and verified that all the key parameters, namely unitary savings, installation rates, interactive effects factors and net-to-gross ratio (NTGR), matched those established in the 2013 evaluation. For products newly added to the RP&C offerings in 2014, the Evaluator established a new unitary savings value based on the assumptions made in the 2013 evaluation report.

In 2014, RP&C generated net energy savings of 2.720 GWh (in tenant units) and peak demand savings of 0.634 MW, as shown in the following table.

Table 1: Validated Gross and Net Savings at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings	3.750 GWh	3.655 GWh	3.277 GWh	0.83	2.720 GWh
Peak Demand Savings	0.874 MW	0.852 MW	0.764 MW	0.83	0.634 MW

1 PROGRAM DESCRIPTION

Formerly known as Multi-Unit Residential Buildings (MURB), Rental Properties and Condos (RP&C) undertaken by Efficiency Nova Scotia Corporation (ENSC) offers landlords, tenants or condominium owners direct free-of-charge installation of energy-efficient products in both common-space areas and rental units.

ENSC contracted one delivery agent (DA), the Summerhill Group, to provide installation services primarily in buildings with 20 or more residential units across Nova Scotia. However, to allow a greater number of apartments and condominiums outside urban areas to benefit from RP&C, property owners with several smaller buildings close to one another are also eligible for this service. The DA not only installs energy-efficient products that generate energy savings, but also assesses the energy-saving opportunities that may be tapped through other ENSC program components.

The following eligible products are installed through RP&C:

Common Areas

- › CFLs
- › LED lamps
- › LED exit signs
- › Hot water tank wraps
- › Pipe insulation
- › Faucet aerators
- › Low-flow showerheads

Tenant Units

- › CFLs
- › LED lamps
- › LED nightlights
- › Faucet aerators
- › Low-flow showerheads/showerwands
- › Pipe insulation
- › Hot water tank wraps

By July 1, 2014, LED lamps were used as the installed measure (instead of CFLs), except in cases where no equivalent LED product was available (CFL installations were performed only while DAs' supplies lasted).

RP&C funding comes from two different sources, depending on the type of product installed: (1) upgrades that reduce electricity use are paid for by ENSC with funds from electricity rate-payers; and (2) upgrades that reduce the use of other fuels are paid for by ENSC with funds from the Province of Nova Scotia.

It should be noted that only savings from products installed in tenant units are attributed to RP&C, which is a component of the Existing Residential program. Savings associated with energy-efficient products installed in common-space areas are claimed under Business Energy Solutions (BES), which is a component of the Direct Installation program.



RP&C aimed to achieve net electricity savings of 3.0 GWh and peak demand savings of 0.7 MW for 2014. Electrical energy savings generated by RP&C are accounted for under the Existing Residential program.

2 METHODOLOGY

This section presents the Econoler team involved in this evaluation and reports on the methodology used to evaluate RP&C.

2.1 Presentation of the Team

To carry out the 2014 evaluation, Econoler collaborated with Corporate Research Associates (CRA). Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all the evaluation activities, as well as preparing and reviewing all the deliverables.
- › CRA performed the telephone survey with participants.

2.2 Methodology Description

In 2014, a full-scale evaluation of RP&C was not carried out. The evaluation of RP&C involved substantiating ENSC's tracked savings with the parameters established in the 2013 evaluation. The Econoler team validated that all the evaluation parameters, namely unitary savings, installation rates, interactive effects factors and net-to-gross ratio (NTGR), matched those established in the 2013 evaluation. For those products newly added to the RP&C offerings in 2014 (10 W dimmable and regular LED A-lamp, 14 W CFL, and 5 W LED chandelier), the Evaluator established a new unitary savings value for each type of product based on the assumptions made in the 2013 evaluation report. The resulting total gross and net energy and peak demand savings were then compiled.

A survey with a total of 19 landlords or property managers was also conducted by CRA staff. The survey was primarily meant to revise the free-ridership level associated with energy-efficient products installed in common-space areas, as part of the BES evaluation. Although a process evaluation was not required for RP&C in 2014, the Evaluator made sure to optimize the survey planned for this evaluation by including satisfaction-related questions in it. The survey questionnaire and results are presented in Appendices I and II respectively.

The survey was conducted in October and November 2014 using computer-assisted telephone interviewing (CATI) technology. The average length of the survey was 9 minutes. The table below shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 telephone surveys.

Table 2: Survey Sample Sizes and Margins of Error

Survey	Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
2014 Participants	51 ¹	19	± 15.4% ²
2013 Participants	139	45	± 10.1%
2012 Participants	256	37	± 12.7%

The margin of error is used to determine the level of precision³ of the measurement, and its associated confidence level indicates the probability for a measure to fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or biases, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

¹ The final 2014 tracking sheet contained 51 different contact names, for whom products were installed in common areas of building(s). The population of RP&C landlord participants in the 2014 survey was 38 (after duplicates were removed and crosschecking against other programs was made) when the survey was conducted.

² Due to the small population size, a census was undertaken rather than a sampling approach. Drawing a random sample of 19 completed projects from a population of 51 would yield a margin of error as noted in the table.

³ Precision refers to how close the measured values are to each other. However, it does not take into consideration how close the measured value is to the true value, which refers to accuracy.

3 VALIDATED SAVINGS

This section presents the gross and net savings for RP&C in 2014.

3.1 Gross Savings

The quantities of products installed under RP&C in 2014 were documented in the tracking system. A total of 59,168 products were installed in 2,895 condos and apartments. For each type of product, ENSC uses a unitary savings value based on the 2013 evaluation results.

The following sections describe how these unitary savings values were established.

3.1.1 CFLs

In the RP&C tracking sheet, the quantity of CFLs installed is recorded by lamp type (e.g., regular, dimmable or speciality) and wattage. The following 7 types of CFL are documented in the 2014 tracking sheet:

- › 13-watt CFLs
- › 14-watt CFLs
- › 23-watt CFLs
- › 14-watt dimmable CFLs
- › 15-watt dimmable CFLs
- › 16-watt dimmable CFLs
- › 14-watt bathroom globe CFLs (specialty)

Displaced Wattage

The displaced wattages were estimated based on: (1) the 2013 on-site visit results; and (2) a comparison of the wattage value of each type of CFL installed through the program with the average equivalent wattage (as represented by the set of light output equivalency values shown in the figure below) of incandescent lamps replaced.

Figure 1: Light Output Equivalency for Incandescent Lamps and CFLs⁴

LIGHT OUTPUT EQUIVALENCY		
INCANDESCENT BULBS (WATTS)	MINIMUM LIGHT OUTPUT (LUMENS)	COMMON ENERGY STAR QUALIFIED LIGHT BULBS (WATTS)
40	450	9 TO 13
60	800	13 TO 15
75	1,100	18 TO 25
100	1,600	23 TO 30
150	2,600	30 TO 52

Hours of Operation

The hours of operation are based on a metering study conducted for Hydro-Québec's residential lighting program to estimate the daily CFL usage.⁵ In 2014, ENSC introduced a new feature in its electronic form to indicate whether lamps were installed inside or outside. As a result, no weighted average of the indoor and outdoor hours of operation was required. For lamps installed indoor (namely all the dimmable, specialty and G25 CFLs), the 2.68 hrs/day value was used, while exterior lighting was estimated to operate 3.6 hrs/day.

⁴ ENERGY STAR, "ENERGY STAR Qualified Light Bulbs – 2006 Partner Resource Guide".

⁵ Econoler, "Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel", presented to Hydro-Québec, Québec, March 30, 2011.

Unitary Savings

Based on the displaced wattage values and the hours of operation described above, the table below presents the unitary savings values used in the tracking sheet for each category of CFL.

Table 3: Unitary Savings Values for Each Type of CFL

Type of CFL	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (hrs/day)	Tracked Unitary Savings Value (kWh/year)
13W CFL (Indoor)	60.0	13.0	47.0	2.68	46.0
14W CFL (Indoor)	60.0	14.0	46.0	2.68	45.0
23W CFL (Indoor)	93.5	23.0	70.5	2.68	69.0
13W CFL (Outdoor)	60.0	13.0	47.0	3.6	61.8
14W CFL (Outdoor)	60.0	14.0	46.0	3.6	60.4
23W CFL (Outdoor)	93.5	23.0	70.5	3.6	92.6
14W Dimmable CFL	60.0	14.0	46.0	2.68	45.0
15W Dimmable CFL	60.0	15.0	45.0	2.68	44.0
16W Dimmable CFL	60.0	16.0	44.0	2.68	43.0
14W Bathroom Globe or G25 CFL	40.0	14.0	26.0	2.68	25.4

3.1.2 LED Lamps

Three types of LED lamps are included in the RP&C tracking sheet: 10-watt A-lamps, 10-watt dimmable A-lamps and 5-watt chandeliers. All these three products were newly added into RP&C in 2014.

Displaced Wattage

ENSC assumes that 10-watt LED A-lamps (dimmable or regular) replace 60-watt incandescent lamps, and that 5-watt LED chandeliers replace 40-watt incandescent lamps. This results in displaced wattages of 50 W and 35 W, respectively.

Hours of Operation

LED chandeliers and dimmable A-lamps are only installed indoors, and therefore, the value of 2.68 hrs/day was applied. For the 10-watt LED A-lamp, the installation location was not tracked. Therefore, the 2014 Atlantic Survey results were used to establish the proportion of LED lamps installed indoors; it was found that this was the case for 88 percent of LED lamps. The average operation hours value for this product was obtained using the following equation:

$$HOU_{LED10W} = 2.68 \frac{hrs}{day} \times 0.88 + 3.6 \frac{hrs}{day} \times (1 - 0.88) = 2.8 \text{ hrs/day}$$

Unitary Savings

Based on the displaced wattage values and the hours of operation described above, the table below presents the unitary savings values used in the tracking sheet for each category of LED lamp.

Table 4: Unitary Savings Values for Each Type of LED Lamp

Type of LED	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (hrs/day)	Tracked Unitary Savings Value (kWh/year)
10W LED A-lamp	60.0	10.0	50.0	2.80	51.1
10W LED dimmable A-lamp	60.0	10.0	50.0	2.68	48.9
5W LED Chandelier (Indoor)	40.0	5.0	35.0	2.68	34.2

3.1.1 LED Nightlights

For the LED nightlights installed through RP&C, ENSC uses a unitary savings value of 29.3 kWh/year. The table below shows the variables used to calculate the unitary savings.

Table 5: Tracked Unitary Savings Value for LED Nightlights

Parameter	Value
Old Wattage (incandescent nightlight)	7.0 W
New Wattage (LED nightlight)	0.3 W
Average Displaced Wattage	6.7 W
Operating Time	12 hrs/day
Unitary Savings	29.3 kWh/year

3.1.2 Faucet Aerators

For all faucet aerators installed through RP&C (whether in the kitchen or the bathroom), ENSC uses an average unitary savings value of 122 kWh/year. This value comes from a custom calculation detailed in 2013 MURB Evaluation Report, which made references to various sources to estimate the total hot water consumption and flow rate reduction due to faucet aerators.

The table below presents the unitary savings value used by ENSC for faucet aerators.

Table 6: Unitary Savings Value for Faucet Aerators

Parameter	Value	Source
Housing Type	Multi-Family	-
Baseline Flow Rate	1.2 gpm	2003 Aquacraft Study ⁶
Low-flow Rate	0.94 gpm	2003 Aquacraft Study
Number of People per Household (RP&C)	1.8	2013 Pennsylvania Public Utility Commission TRM ⁷
Domestic Hot Water (DHW) Used per Person for Total Number of Faucets	8.6 gpd	CBEEDAC ⁸
Specific Heat of Water	1 Btu/lb°F	Convention
Density of Water	62.426 lb/ft ³	Convention
Temperature Rise in Electric Water Heater	79°F	2011 OPA
Days per Year	365	2011 OPA
Unit Conversion No. 1	1 kWh/3413 Btu	Convention
Unit Conversion No. 2	0.1337 ft ³ /1 gal	Convention
Electric Water Heater Efficiency	97%	Pennsylvania Public Utility Commission TRM ⁹
Unitary Savings	122 kWh/year	

⁶ Aquacraft, Inc. Water Engineering and Management, "Residential Indoor Water Conservation Study", July 2003.

⁷ Pennsylvania Public Utility Commission, "Technical Reference Manual," State of Pennsylvania, June 2013, page 45.

⁸ Canadian Building Energy End-Use Data & Analysis Centre, "Domestic Water Heating and Water Heater Energy Consumption in Canada", April 2005, page 29.

⁹ Pennsylvania Public Utility Commission, "Technical Reference Manual," State of Pennsylvania, June 2013, page 174.

3.1.3 Low-flow Showerheads

On the basis of a custom calculation that took into account the reduction in flow rate, the number of people per household and the baseline volume of hot water used per person, ENSC established the unitary savings for low-flow showerheads at 330 kWh/year. The values used and their sources are presented in the following table.

Table 7: Unitary Savings Values for Low-flow Showerheads¹⁰

Parameter	Value	Source
Housing Type	Multi-Family	2013 Pennsylvania Public Utility Commission TRM ¹¹
Baseline Flow Rate	2.5 gpm	2013 Pennsylvania Public Utility Commission TRM
Low-flow Rate	1.5 gpm	RP&C DA
Number of People per Household (RP&C)	1.8	2013 Pennsylvania Public Utility Commission TRM
DHW Used per Person per Shower	6.3 gpd	CBEEDAC ¹²
Specific Heat of Water	1 Btu/lb°F	-
Density of Water	62.426 lb/ft ³	Engineering Toolbox website
Temperature Rise in Electric Water Heater	79°F	2011 OPA
Days per Year	365	2011 OPA
Unit Conversion #1	1 kWh/3413 Btu	
Unit Conversion #2	0.1337 ft ³ /1 gal	
Electric Water Heater Efficiency	97%	Pennsylvania Public Utility Commission TRM
Unitary Savings	330 kWh/year	

3.1.4 Pipe Insulation

In the 2014 tracking sheet, the units of pipe insulation installed are reported in the number of feet of insulation installed.

The unitary savings value used by ENSC for this measure is based on the 2011 Ontario Power Authority (OPA) Prescriptive Measures and Assumptions report. For each foot of insulation installed, the unitary savings value corresponds to 12.7 kWh/year.

¹⁰ Pennsylvania Public Utility Commission, "Technical Reference Manual," State of Pennsylvania, June 2013, pages 45–48.

¹¹ Pennsylvania Public Utility Commission, "Technical Reference Manual," State of Pennsylvania, June 2013, page 174.

¹² Canadian Building Energy End-Use Data & Analysis Centre, "Domestic Water Heating and Water Heater Energy Consumption in Canada", April 2005, page 29.

3.1.5 Hot Water Tank Wraps

Two types of tank wraps are installed under RP&C, and their respective thermal resistance values are 0.90 m²·°C/W and 1.21 m²·°C/W. To calculate the unitary savings value, the equation used by both the OPA and the Pennsylvania Public Utility Commission (PUC) TRMs was applied:

$$\text{Unitary Savings for Tank Wrap} = \frac{(U_{\text{base}}A_{\text{base}} - U_{\text{insul}}A_{\text{insul}}) \times (T_{\text{setpoint}} - T_{\text{ambient}})}{\eta_{\text{Elec}}} \times \text{HOU}$$

Where:

- › U_{base} : Thermal transmittance per area unit of water heater prior to adding tank wrap [W/m²·°C]
- › A_{base} : Surface area of storage tank prior to adding tank wrap [m²]
- › U_{insul} : Thermal transmittance per area unit of water heater after addition of tank wrap [W/m²·°C]
- › A_{insul} : Surface area of storage tank after addition of tank wrap [m²]
- › η_{Elec} : Thermal efficiency of electric heater element [-]
- › T_{setpoint} : Setpoint temperature of the DHW tank [°C]
- › T_{ambient} : Ambient temperature [°C]
- › HOU: Hours of operation [hrs]

The A values were calculated based on products' specifications, and the R values were obtained by using the equation to calculate the thermal resistance of a cylinder.

The main variables in the heat transfer equations, as well as the resulting thermal losses with and without the tank wraps, are presented in Table 8.

Table 8: Unitary Savings Values for RSI-1.21 and RSI-0.90 Hot Water Tank Wraps

Parameter	Value	Source
T_e	21°C	Assumption for standard ambient temperature indoors
T_i	60°C	Natural Resources Canada ¹³
HOU	8,760 hrs/year	Assumption
η_{heater}	97%	Pennsylvania Public Utility Commission ¹⁴
Q_{tank}	40.2 W	Calculation
$Q_{\text{tank+RSI-1.21}}$	27.1 W	Calculation
$Q_{\text{tank+RSI-0.90}}$	29.4 W	Calculation
Unitary Savings for RSI-1.21 Tank Wrap	118 kWh	Calculation
Unitary Savings for RSI-0.90 Tank Wrap	97.5 kWh	Calculation

¹³ Natural Resources Canada. "Water Heaters: Energy Consideration", Office of Energy Efficiency.
<http://oee.nrcan.gc.ca/equipment/heating/514#reducStanbdy> (Consulted on November 26, 2013).

¹⁴ Pennsylvania Public Utility Commission, "Technical Reference Manual," of Pennsylvania, June 2013, page 174.

3.1.6 Installation Rates

The table below shows the installation rates used in the 2014 tracking sheet. These values were obtained from the on-site visits conducted for the 2013 evaluation of MURB.

Table 9: Percentage of Products Installed and Installation Rate

Type of Product	Installation Rate
Regular CFL (13W and 23W)	95%
Dimmable CFL (16W)	100%
LED Nightlight	100%
Faucet Aerator	95%
Low-Flow Showerhead	92%
Low-Flow Showerwand	100%

3.1.7 Validated Gross Savings

The annual gross savings tracked for the products installed in 2014 were validated by the Evaluator and are presented in Table 10. Overall, the gross energy and peak demand savings amount to 3.325 GWh and 0.775 MW at the meter, respectively.

The same table also presents the gross savings at the generator estimated using a line loss factor of 1.099 between the meter and the generator. This line loss factor value corresponds to the weighted average of the line loss value for residential customers (95%) and commercial customers (5%), as it was done in the 2013 evaluation. The 2014 line loss values were provided by Nova Scotia Power for residential customers. As a result, the validated gross energy and peak demand savings at the generator have been established at 3.655 GWh and 0.852 MW, respectively.

Table 10: Validated Gross Energy and Peak Demand Savings by Product

Type of Product	13-Watt CFL	13-Watt CFL Outdoor	14-Watt CFL	14-Watt CFL Outdoor	23-Watt CFL	23-Watt CFL Outdoor	14-Watt Dim. CFL	15-Watt Dim. CFL	16-Watt Dim. CFL	14-Watt G25 CFL	5-Watt LED Chand.
Energy Savings											
Number of Units	8,382	187	7,274	70	138	1	325	189	219	1,799	128
Installation Rate (%)	0.95	0.95	0.95	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00
Number of Units Installed	7,963	178	6,910	67	131	1	325	189	219	1,799	128
Unitary Savings Value (kWh)	46.0	61.8	45.0	60.4	69.0	92.6	45.0	44.0	43.0	25.4	34.2
Total Gross Energy Savings – at Meter (GWh)	0.366	0.011	0.311	0.004	0.009	0.000	0.015	0.008	0.009	0.046	0.004
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Gross Energy Savings – at Generator (GWh)	0.403	0.012	0.342	0.004	0.010	0.000	0.016	0.009	0.010	0.050	0.005
Peak Demand Savings											
Demand-to-energy Ratio	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233
Total Gross Peak Demand Savings – at Meter (MW)	0.085	0.003	0.072	0.001	0.002	0.000	0.003	0.002	0.002	0.011	0.001
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Gross Peak Demand Savings – at Generator (MW)	0.094	0.003	0.080	0.001	0.002	0.000	0.004	0.002	0.002	0.012	0.001

(Continued)

Type of Product	10-Watt LED A- Lamp	10-Watt LED Dim. A-Lamp	LED Nightlight	Low-Flow Faucet Aerator	Low-Flow Shower- head	Low-Flow Shower- wand	Pipe Insulation	Hot Water Tank Wrap (RSI-0.90)	Hot Water Tank Wrap (RSI-1.21)	Total for All Products
Energy Savings										
Number of Units	29,777	5,707	172	1,776	1,205	246	1,216	265	92	59,168
Installation Rate (%)	1.00	1.00	1.00	0.95	0.92	0.92	0.95	1.00	1.00	-
Number of Units Installed	29,777	5,707	172	1,687	1,109	226	1,155	265	92	58,100
Unitary Savings Value (kWh)	51.1	48.9	29.3	122.0	330.0	330.0	12.7	198.0	242.0	-
Total Gross Energy Savings – at Meter (GWh)	1.522	0.279	0.005	0.206	0.366	0.075	0.015	0.052	0.022	3.325
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	-
Total Gross Energy Savings – at Generator (GWh)	1.672	0.307	0.006	0.226	0.402	0.082	0.016	0.058	0.024	3.655
Peak Demand Savings										
Demand-to-energy Ratio	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	0.233	-
Total Gross Peak Demand Savings – at Meter (MW)	0.355	0.065	0.001	0.048	0.085	0.017	0.003	0.012	0.005	0.775
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	-
Total Gross Peak Demand Savings – at Generator (MW)	0.390	0.071	0.001	0.053	0.094	0.019	0.004	0.013	0.006	0.852

3.2 Interactive Effects

Interactive effects occur on a building's space conditioning systems after the implementation of energy efficiency measures, such as lighting upgrades. These upgrades impact the energy consumption of the heating and cooling equipment. In the case of RP&C, replacing incandescent lighting products with CFLs or LEDs causes a reduction in heat released into the space, which in turn increases the heating load during winter and decreases the cooling load during summer.

For lighting products, the evaluation of the interactive effects factor was done based on a study conducted by ADS in 1992 for Hydro-Québec. The work carried out in this study was intended to modify certain parameters used in simulations of an average home in Quebec to determine the impact of these changes on the interactive effects. The simulations were performed with the DOE-2 software¹⁵, focusing on homes heated entirely by electricity. The simulations were carried out to analyze three interactive-effects scenarios: low, moderate and high interactive effects. The scenario with minimum interactive effects was finally selected for the calculation because it reflects the evolution of homes since 1992.

Presented in the table below are the details for calculating the interactive effects factor for indoor CFLs, LED lamps and LED nightlights; this calculation was done in 2013 and has not been changed as part of this evaluation. It reflects the proportions of electrically heated units as entered in the 2013 tracking system. The 2009 provincial statistics regarding the proportion of housing units that use air-conditioning units or systems¹⁶ as space-cooling information was not yet collected in the tracking system. For this, the Evaluator had to rely on the data for the entire province of Nova Scotia.

Table 11: Interactive Effects Calculation for Lighting Products

Parameter	% of Residences	Interactive Effects ¹⁷
Electric heating with air-conditioning	$25\% \times 18\% = 5\%$	-54.4%
Electric heating without air-conditioning	$25\% \times 82\% = 20\%$	-58.0%
No electric heating with air-conditioning	$75\% \times 18\% = 14\%$	3.6%
No electric heating without air-conditioning	$75\% \times 82\% = 61\%$	0.0%
Weighted Interactive Effects Factor	100%	-13.8%

These interactive effects occur only when the products are installed inside the buildings, since the reduction in waste heat released by lighting either increases or decreases the space conditioning loads. Because lighting products in the RP&C tracking system are now identified as being installed indoors or outdoors, those interactive effects were only applied to indoor products. One exception is the 10-watt LED A-lamp, for which indoor and outdoor installation was not tracked. Consequently, by

¹⁵ DOE-2 is a widely used and accepted building energy analysis software tool, developed with U.S. Department of Energy funding.

¹⁶ Statistics Canada (CANSIM), Households having air conditioning, Nova Scotia, 2009.

¹⁷ ADS ASSOCIÉS, "Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – résidence unifamiliale," report presented to Hydro-Québec, 1992.

applying the ratio of indoor installation established at 88 percent in the 2014 Atlantic Survey, the adjusted interactive effect factor was established at -12.1 percent.

For pipe insulation and hot water tank wraps, an interactive effects factor of -100 percent is considered during the heating period in electrically heated houses. This factor is based on the fact that, without insulation, 100 percent of the heat lost through the DHW system is released into the space, contributing to the heating load. Conversely, during the cooling period, interactive effects are assumed at +100 percent in locations that use air-conditioning, based on the same logic. To adjust the potential interactive effects on the air-conditioning systems, the Evaluator used an average coefficient of performance (COP) of 2.5 and established the interactive effects factor at +40 percent. Considering the heating and cooling degree-days for the region of Halifax,¹⁸ the Evaluator used an eight-month heating period and a two-month cooling period in the interactive effects calculations. The table below presents the details for these calculations. As with lighting products, the table shows the proportions of Nova Scotia residences heated electrically and using air-conditioning, which resulted in a weighted interactive effects factor of -15.5 percent.

Table 12: Interactive Effects Factor for Pipe Insulation and Hot Water Tank Wraps

Parameters	% of Residences ¹⁹	Interactive Effects During Heating Period	Interactive Effects During Cooling Period
Electric heating with air-conditioning	5%	$-100\% \times 8/12 = -67\%$	$+40\% \times 2/12 = +7\%$
Electric heating without air-conditioning	20%	$-100\% \times 8/12 = -67\%$	$0\% \times 2/12 = 0\%$
No electric heating with air-conditioning	14%	$0\% \times 8/12 = 0\%$	$+40\% \times 2/12 = +7\%$
No electric heating without air-conditioning	61%	$0\% \times 8/12 = 0\%$	$0\% \times 2/12 = 0\%$
Weighted Interactive Effects Factor	100%	-16.8%	+1.3%
		-15.5%	

The interactive effects are considered negligible for all other products installed under RP&C.

¹⁸ RETScreen International, "Normalized climate data for the Halifax International Airport", Natural Resources Canada, 1997–2010.

¹⁹ From DA information and Statistics Canada.

3.3 Net-to-Gross Ratio

The NTGR evaluation is based on a self-report approach which relies on a series of questions designed to measure the influence of RP&C on end-users' decision to install eligible energy-efficient products. This section presents the methodology used to calculate the NTGR, which is based on one distortion effect: free-ridership.

3.3.1 Free-ridership

The free-ridership level is directly applied to the savings generated by the products installed in the individual tenant units. The free-ridership level has to be measured through interviews with tenants during the on-site visits, rather than using the participant survey with landlords and building owners.

In 2013, interviews were conducted with tenants during the on-site visits. Since no on-site visits were done in 2014, last year's free-ridership results of 17 percent were applied again in 2014.

3.3.2 NTGR Calculation

The NTGR was calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership})$$

Using the free-ridership established in 2013, the NTGR value has been estimated at 0.83.

3.4 Net Savings

The net savings were estimated using the interactive effects factors and the NTGR presented above. The equation below was used to calculate the net savings.

$$\text{Net savings} = \text{Gross Evaluation Savings} \times (1 + \text{Interactive Effects Factor}) \times NTGR$$

This equation was used to calculate both peak demand savings and energy savings.

The validated net energy savings for RP&C in 2014 are estimated at 2.475 GWh at the meter and at 2.720 GWh at the generator, while the peak demand savings are of 0.577 MW at the meter and of 0.634 at the generator. The detailed results are presented in the following table.

Table 13: Validated Net Energy and Peak Demand Savings by Product

Type of Product	13-Watt CFL	13-Watt CFL Outdoor	14-Watt CFL	14-Watt CFL Outdoor	23-Watt CFL	23-Watt CFL Outdoor	14-Watt Dim. CFL	15-Watt Dim. CFL	16-Watt Dim. CFL	14-Watt G25 CFL	5-Watt LED Chand.
Energy Savings											
Total Gross Energy Savings – at Meter (GWh)	0.366	0.011	0.311	0.004	0.009	0.000	0.015	0.008	0.009	0.046	0.004
Interactive Effects Factor	-13.8%	0.0%	-13.8%	0.0%	-13.8%	0.0%	-13.8%	-13.8%	-13.8%	-13.8%	-13.8%
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Total Net Energy Savings – at Meter (GWh)	0.262	0.009	0.222	0.003	0.006	0.000	0.010	0.006	0.007	0.033	0.003
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Net Energy Savings – at Generator (GWh)	0.288	0.010	0.244	0.004	0.007	0.000	0.011	0.007	0.007	0.036	0.003
Peak Demand Savings											
Total Gross Peak Demand Savings – at Meter (GWh)	0.085	0.003	0.072	0.001	0.002	0.000	0.003	0.002	0.002	0.011	0.001
Interactive Effects Factor	-13.8%	0.0%	-13.8%	0.0%	-13.8%	0.0%	-13.8%	-13.8%	-13.8%	-13.8%	-13.8%
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Total Net Peak Demand Savings – at Meter (GWh)	0.061	0.002	0.052	0.001	0.002	0.000	0.002	0.001	0.002	0.008	0.001
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Net Peak Demand Savings – at Generator (GWh)	0.067	0.002	0.057	0.001	0.002	0.000	0.003	0.002	0.002	0.008	0.001

(Continued)

Type of Product	10-Watt LED A- Lamp	10-Watt LED Dim. A-Lamp	LED Nightlight	Low-Flow Faucet Aerator	Low-Flow Shower- head	Low-Flow Shower- wand	Pipe Insulation	Hot Water Tank Wrap (RSI-0.90)	Hot Water Tank Wrap (RSI-1.21)	Total for All Products
Energy Savings										
Total Gross Energy Savings – at Meter (GWh)	1.522	0.279	0.005	0.206	0.366	0.075	0.015	0.052	0.022	3.325
Interactive Effects Factor	-12.1%	-13.8%	-13.8%	0.0%	0.0%	0.0%	-15.5%	-15.5%	-15.5%	-
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-
Total Net Energy Savings – at Meter (GWh)	1.110	0.200	0.004	0.171	0.304	0.062	0.010	0.037	0.016	2.475
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	-
Total Net Energy Savings – at Generator (GWh)	1.220	0.219	0.004	0.188	0.334	0.068	0.011	0.040	0.017	2.720
Peak Demand Savings										
Total Gross Peak Demand Savings – at Meter (GWh)	0.355	0.065	0.001	0.048	0.085	0.017	0.003	0.012	0.005	0.775
Interactive Effects Factor	-12.1%	-13.8%	-13.8%	0.0%	0.0%	0.0%	-15.5%	-15.5%	-15.5%	-
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-
Total Net Peak Demand Savings – at Meter (GWh)	0.259	0.047	0.001	0.040	0.071	0.014	0.002	0.009	0.004	0.577
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	-
Total Net Peak Demand Savings – at Generator (GWh)	0.284	0.051	0.001	0.044	0.078	0.016	0.003	0.009	0.004	0.634

The table below summarizes the validated energy and peak demand savings calculated in the 2014 tracking sheet. To confirm these savings, the Evaluator validated the data and information documented in the tracking system report, and verified whether all the key parameters used in the gross and net savings calculations were the same as those established in the 2013 evaluation.

Table 14: Validated Savings at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings	3.750 GWh	3.655 GWh	3.277 GWh	0.83	2.720 GWh
Peak Demand Savings	0.874 MW	0.852 MW	0.764 MW	0.83	0.634 MW

APPENDIX I PARTICIPANT SURVEY QUESTIONNAIRE

Could I speak with [INSERT NAME]?

1. Yes [GO TO INTRODUCTION]
2. No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

[INTRODUCTION]

Hello, my name is _____ and I am with CRA, Corporate Research Associates, a Halifax-based survey research company, and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you recently participated in Efficiency Nova Scotia Corporation's Rental Properties and Condos program, formerly known as the Multi-Unit Residential Program. We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program.

In the Rental Properties and Condos Program, someone would have come to your building(s) to install energy conservation measures in common spaces and individual residential units at no charge. Do you recall participating in this program?

1. Yes [CONTINUE]
2. No [PROMPT: "Is there someone else in your organization who would know about having participated in the Rental Properties and Condos Program?"]

 __Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
 __No [THANK & TERMINATE]
3. Don't know [PROMPT: "Is there someone else in your organization who would know about having participated in the Rental Properties and Condos Program?"]

 __Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
 __No [THANK & TERMINATE]
4. Refused [THANK AND TERMINATE]

The survey will take about ten minutes. Is this a good time for you?

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"]

[SCHEDULED, IF NECESSARY, FOR: _____]

Verification and Recall [V series]**[ASK IF MEASURES IN COMMON AREAS=YES, IF NOT SKIP TO S SERIES]**

V3. I am going to read you a list of measures that, according to our records, were installed in the common area of your building(s) by the Program: [READ WHAT IS ON RECORD (MEASURE≠0 IN THE DATABASE)]. For each one, can you please verify that this information is correct and that the measure was installed? [1=YES, INSTALLED, 2=NO, NOT INSTALLED, 98=DON'T KNOW, 99=REFUSED]

NOTE FOR PROGRAMMER: DO NOT PUT THE NUMBER OF EACH MEASURE

- a) CFL bulbs
- b) LED bulbs
- c) LED Exit Signs
- d) Pipe insulation/Tank wraps
- e) Low-flow showerheads or showerwands
- f) Faucet aerators

V4. [FOR EACH OF V3a to V3e = NO and RECORD = YES] Are you sure? According to our records someone would have come to your building(s) and installed ... [READ WHAT IS ON RECORD] [1=YES → RECORD AS YES] [2=NO, 98=DON'T KNOW, 99=REFUSED → RECORD AS NO]

- V4a. [CFL bulbs]
- V4b. [LED bulbs]
- V4c. [LED Exit Signs]
- V4d. [Pipe insulation/Tank wraps]
- V4e. Low-flow showerheads or showerwands
- V4f. Faucet aerators

Satisfaction with the Program [S series]**[ASK ALL RESPONDENTS]**

CS1. How did your company first learn of the programs offered by Efficiency Nova Scotia? **[DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]**

- 1 Media advertising
- 2 Someone at Efficiency Nova Scotia contacted the business
- 3 Through a third party contractor
- 4 The business contacted Efficiency Nova Scotia about the program.
- 5 Word of mouth
- 6 Efficiency Nova Scotia website

- 7 Facebook or other social media
- 8 Participation in another Efficiency Nova Scotia program
- 97. (Other [SPECIFY _____])
- 98. Cannot recall

CS2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent? **CODE ONE ONLY**

- 1 Directly with Efficiency Nova Scotia
- 2 Third-party contractor or agent **SKIP TO CS6**
- 3 Both

CS4. Now I will read you a list of factors, and this time I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where "1" is not at all satisfied and "10" is completely satisfied, how satisfied were you with **READ AND ROTATE**

CODE ONE RESPONSE FOR EACH FACTOR

- a. The technical expertise of employees related to the program
- b. The responsiveness of employees to your requests and enquiries in a timely manner
- e. The length of time between your application and the product installation visit
- g. The value of the program relative to the time and cost involved
- j. The ability to provide estimates of the savings or return on investment associated with the program.

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with your company?

___ Response ___ 98 Don't Know ___ 99 Refused

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

- 1 Yes
- 2 No
- 98. (Don't know)
- 99. (Refused)

IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO CS28.

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

- 1 Completely satisfied
- 2 Mostly satisfied
- 3 Mostly dissatisfied
- 4 Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's... **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**

- a. Service attitude
- b. Knowledge of programs available
- c. Ability to provide advice
- 1 Completely satisfied
- 2 Mostly satisfied
- 3 Mostly dissatisfied
- 4 Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98 (Don't know)
- 99 (Refused)

CS28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia? **CODE ONE ONLY**

- 1 Definitely
- 2 Probably
- 3 Probably not
- 4 Definitely not
- 7. [VOLUNTEERED] Not eligible for any other programs
- 8. [VOLUNTEERED] Don't know/No answer

CS29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others?

CODE ONE ONLY

- 1 Definitely
- 2 Probably
- 3 Probably not
- 4 Definitely not
- 8. [VOLUNTEERED] Don't know/No answer

CS32. Based on your personal experience would you definitely, probably, probably not, or definitely not recommend this third-party contractor to others?

CODE ONE ONLY

- 1 Definitely
- 2 Probably
- 3 Probably not
- 4 Definitely not
- 8. [VOLUNTEERED] Don't know/No answer

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before the first products were installed in your building(s)? [RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

Free-Ridership [FR series]

[ASK IF MEASURES IN COMMON AREAS=YES, IF NOT SKIP TO D SERIES]

INSTRUCTION

(FOR RESPONDENTS WITH MORE THAN TWO ("YES") MEASURES VERIFIED IN V3 AND V4, CHOOSE TWO MEASURES VERIFIED AT RANDOM AMONG THE FOLLOWING.

- › CFL bulbs
- › LED bulbs
- › LED Exit Signs
- › Pipe insulation/Tank Wraps

THE RESPONDENT WILL ANSWER ACCORDING TO THESE TWO MEASURES THROUGHOUT SECTION FR WHEN IDENTIFIED LIKE SO: [MEASURE 1 or 2].)

(NOTE: IF THERE ARE ONLY TWO MEASURES VERIFIED IN V3 AND V4, RESPONDENT WILL AUTOMATICALLY ANSWER ACCORDING TO THESE TWO MEASURES. IF THERE IS ONLY ONE

MEASURE VERIFIED IN V3 AND V4, RESPONDENT WILL ANSWER ABOUT THIS UNIQUE MEASURE ONLY.)

The next questions will be about the [MEASURE 1] you had installed through the program.

FR1M1. Did you have any specific plans to install [MEASURE 1] in the common areas of your building(s) prior to talking with anyone about the Rental Properties and Condos Program?

1 Yes

2 No

98. (Don't know)

99. (Refused)

FR1aM1. **IF FR1M1=YES, THEN ASK:** I just want to make sure I understand - Before you decided to participate in the Rental Properties and Condos Program, you had already made the decision to install [MEASURE 1] throughout the common areas of the building(s)?

1. Yes

2. No

98. (Don't know)

99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Rental Properties and Condos Program.

If you had not participated in the Rental Properties and Condos Program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely **Would Not** Have Taken the Action," and a 10 indicating that you "Definitely **Would Have** Taken the Action." AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: "AND NEXT. In the absence of the Program, would you have . . . DO NOT ACCEPT A RANGE – POSE FR2M1 SEQUENCE IN ORDER/DO NOT RANDOMIZE

FR2aM1. ...installed the [MEASURE 1] that was installed through the Program?

___ Response

___ 98 Don't Know

___ 99 Refused

FR2bM1. ...installed standard equipment instead of energy-efficient [MEASURE 1]?

___ Response

___ 98 Don't Know

___ 99 Refused

FR2cM1. ...installed the [MEASURE 1] that was installed through the Program *but at a later date*?

___ Response

___ 98 Don't Know

___ 99 Refused

IF FR2CM1 > 5, THEN ASK:

[DO NOT ASK IF FR2cM1=98 OR 99]

FR2dM1. You indicated in your previous response that if the Rental Properties and Condos program had not been available there was an [FR2cM1] in 10 likelihood that you would have installed the same energy-efficient products *but at a later date*. Approximately how many months later would you have installed these products? **DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE**

1. _____ months later
2. (Never)
3. (At the same time)
98. (Don't know)
99. (Refused)

IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2dM1 ANSWER IN MONTHS, READ:

Would it have been ...

- 1 Less than 6 months?
- 2 Within 6 months to less than 1 year later?
- 3 1 to less than 2 years later?
- 4 2 to less than 3 years later?
- 5 3 to less than 4 years later?
- 6 4 or more years later?
- 7 (Never)
98. (Don't Know)
99. (Refused)

FR3M1. If Efficiency Nova Scotia had not installed [MEASURE 1] for free, would you have paid the full cost of the [MEASURE 1]?

- 1 Yes
- 2 No
97. (Depends on the cost)
98. (Don't know)
99. (Refused)

[IF ONLY ONE MEASURE VERIFIED IN V3-V4, SKIP TO FR4]

The next questions will be about the [MEASURE 2] you had installed through the program.

FR1M2. Did you have any specific plans to install [MEASURE 2] in the common area of your building(s) prior to talking with anyone about the Rental Properties and Condos Program?

- 1 (Yes)
- 2 (No)
- 98. (Don't know)
- 99. (Refused)

FR1aM2. **IF FR1M2=YES, THEN ASK:** I just want to make sure I understand - **Before** you decided to participate in the Rental Properties and Condos Program, you had already made the decision to install [MEASURE 2] throughout the common areas of the building(s)?

- 1 Yes
- 2 No
- 98. (Don't know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Rental Properties and Condos Program.

If you had not participated in the Rental Properties and Condos Program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely **Would Not** Have Taken the Action," and a 10 indicating that you "Definitely **Would Have** Taken the Action." AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: "AND NEXT. In the absence of the Program, would you have ... DO NOT ACCEPT A RANGE – POSE FR2M2 SEQUENCE IN ORDER/DO NOT RANDOMIZE

FR2aM2. ...installed the [MEASURE 2] that was installed through the Program?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2bM2. ...installed standard equipment instead of energy-efficient [MEASURE 2]?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2cM2. ...installed the [MEASURE 2] that was installed through the Program *but at a later date*?

___ Response ___ 98 Don't Know ___ 99 Refused

IF FR2cM2 > 5, then ask:

[DO NOT ASK IF FR2cM2=98 OR 99]

FR2dM2. You indicated in your previous response that if the Rental Properties and Condos program had not been available there was an [FR2cM2] in 10 likelihood that you would have installed the same energy-efficient products but at a later date. Approximately how many

months later would you have installed these products? DO NOT READ RESPONSES -
PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE

- 1 _____ months later
- 2 (Never)
- 3 (At the same time)
- 98. (Don't know)
- 99. (Refused)

IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2dM2 ANSWER IN MONTHS, READ:

Would it have been ...

- 1 Less than 6 months?
- 2 Within 6 months to less than 1 year later?
- 3 1 to less than 2 years later?
- 4 2 to less than 3 years later?
- 5 3 to less than 4 years later?
- 6 4 or more years later?
- 7 (Never)
- 98. (Don't Know)
- 99. (Refused)

FR3M2. If Efficiency Nova Scotia had not installed [MEASURE 2] for free, would you have paid the full cost of the [MEASURE 2]?

- 1 Yes
- 2 No
- 97. (Depends on the cost)
- 98. (Don't know)
- 99. (Refused)

[ASK FR4 ONCE, NOT FOR EACH MEASURE VERIFIED IN V3-V4]

FR4. Next, I'm going to ask you to rate the importance of the Program as well as other factors that might have influenced your decision to install energy efficient measures through the Rental Properties and Condos program. Using a scale from 0 to 10 where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to install the energy-efficient products you installed through the Program. DO NOT ACCEPT A RANGE

Factor (READ AND RANDOMIZE)	Responses		
a. The free installation of energy-efficient products offered by the program	___ Response	___ 98 Don't Know	___ 99 Refused
b. Information or advice provided by program staff throughout the upgrade process	___ Response	___ 98 Don't Know	___ 99 Refused
c. Previous experience with a similar program either from Efficiency Nova Scotia, Nova Scotia Power or Conserve Nova Scotia	___ Response	___ 98 Don't Know	___ 99 Refused

Demographics [D series]

[ASK ALL RESPONDENTS]

These final questions are asked for statistical purposes only. The information collected is strictly confidential. If you have more than one building, please answer according to one of them.

D2. How many apartments are in your building? [98=DK]

D4. Do tenants or does the landlord pay the electric bills for this building?

1 Tenants

2 Landlord

3 Some tenants pay, while in other cases the landlord pays

98. (Don't Know)

99. (Refused)

D7. How many other rental property and condo buildings do you own? [98=DK]

[READ: THAT IS ALL THE QUESTIONS I HAVE FOR YOU. THANK AND TERMINATE.]

APPENDIX II

PARTICIPANT SURVEY RESULTS

CS1. How did your company first learn of the programs offered by Efficiency Nova Scotia?

Sources of Awareness*	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	37	45	19
Contacted directly by ENSC	19%	18%	3
ENSC website	5%	11%	2
Building management	24%	40%	1
Media advertising	5%	9%	1
Business contacted ENSC about the program	-	-	1
Bill Insert	-	-	1
Participated in another ENSC Program	-	-	1
Internet	-	-	1
Through a third party contractor or service provider	-	7%	-
Word of mouth	16%	-	-
Investment Property Owners Association	8%	-	-
Mailing from ENSC	5%	-	-
Others	14%	11%	2
Don't know/Can't recall	3%	7%	6
*Multiple responses			

Results for this table are based on information provided in the sample file.

Characteristics of Participation	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	37	45	19
Did not have products installed in common areas	76%	67%	5
Did have products installed in common areas	24%	33%	14

FR4. Next, I'm going to ask you to rate the importance of the Program as well as other factors that might have influenced your decision to install energy efficient measures through the Rental Properties and Condos program. Using a scale from 0 to 10 where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to install the energy-efficient products you installed through the Program.

Importance of Factors in Influencing Decision-making	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size*</i>	9	15	14
Mean (0 = Not at all important; 10 = Extremely important)**			
Free installation of energy-efficient products offered by the program	9.3	9.1	9.6
Information or advice provided by program staff throughout the upgrade process	8.4	8.3	9.3
Previous experience with a similar program either from ENSC, Nova Scotia Power or Conserve Nova Scotia	8.3	6.2	9.2
*Base: Respondents who had products installed in common areas of building **Mean excludes responses of 'Refused' and 'Don't know'			

CS2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent?

Contact with ENSC	2012 (%)	2013* (%)	2014 (#)
<i>Sample Size</i>	30	37	19
Directly with ENSC	47%	35%	11
Third-party contractor or agent	50%	49%	5
Both	3%	16%	3
Don't know	-	-	-
*Base is not full sample size because of programming error			

CS4. Now I will read you a list of factors, and this time I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with...

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia’s overall performance in working with your company?

Satisfaction with ENSC	Sample Size*	2012 Satisfied**	Sample Size*	2013 Satisfied**	Sample Size*	2014 Satisfied**
Mean (1=Not at all satisfied; 10=Completely satisfied)**						
The responsiveness of employees to requests and inquiries in a timely manner	15	8.2	18	8.8	13	9.5
The length of time between the application and product installation visit	n/a	n/a	18	8.8	12	9.3
The ability to provide estimates of the savings or return on investment associated with the program	13	7.4	14	8.6	11	9.2
Overall experience in working with ENSC	14	8.8	19	8.7	4	9.1
The value of the program relative to the time and cost involved	14	7.6	17	8.5	13	9.0
The technical expertise of employees related to the program	15	8.5	19	8.9	13	8.7
*Base: Number of respondents who dealt with ENSC directly. Base is not the full sample size because of programming error. **Mean excludes responses of ‘Refused’ and ‘Don’t know’.						

CS6. Did you speak directly to any of Efficiency Nova Scotia’s contact centre representatives?

Contact with ENSC Contact Centre Staff	2014 (#)
Sample Size	19
Yes	14
No	2
Don’t know	3

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's...:

Satisfaction with ENSC Contact Centre Staff	2014	
	Sample size*	Satisfied** (#)
Overall level of service provided by ENSC contact centre staff	14	14
Knowledge of programs available	14	14
Service attitude	14	14
Ability to provide advice	14	14
*Base: Number of respondents who had contact with ENSC staff **Number of respondents who gave a rating of completely satisfied or mostly satisfied; Don't know removed from calculations		

CS28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia?

Would Participate in Other ENSC Programs	2012 (%)	2013** (%)	2014 (#)
Sample Size*	29	36	19
Definitely	76%	61%	18
Probably	17%	33%	1
Probably not	7%	3%	-
Definitely not	-	3%	-
*Don't know/refused have been removed from calculation **Base is not full sample size because of programming error			

CS29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others?

Would Recommend to Other Businesses	2012 (%)	2013** (%)	2014 (#)
<i>Sample Size*</i>	30	36	19
Definitely	80%	75%	18
Probably	13%	17%	1
Probably not	7%	6%	-
Definitely not	-	3%	-
*Don't know/refused have been removed from calculation **Base is not full sample size because of programming error			

CS32. Based on your personal experience would you definitely, probably, probably not, or definitely not recommend this third-party contractor to others?

Would Recommend Third-party Contractor	2013** (%)	2014 (#)
<i>Sample Size</i>	23*	7
Definitely	65%	7
Probably	26%	-
Probably not	9%	-
Definitely not	-	-
*Base: respondents who dealt with third-party contractor. The base is not full sample size because of programming error. **Don't know/refused have been removed from calculation		

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before the first products were installed in your building(s)?

Length of Time to Have Products Installed	2014 (#)
<i>Sample Size*</i>	13
1-6 days	2
7-9 days	7
10-19 days	-
20-29 days	1
30 days or more	3
Average	29 days
*Don't know/refused have been removed	

D2. How many apartments are in your building?

Number of Apartments in Building	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	37	45	19
1-5	8%	2%	1
6-10	5%	9%	-
11-49	35%	38%	3
50 or more	49%	47%	15
Don't know	3%	4%	-

D7. How many other rental property and condo buildings do you own?

Number of Multi-Residential Buildings Owned*	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	37	45	19
1	35%	31%	3
2-3	22%	2%	-
4 or more	19%	36%	14
Other	24%	31%	-
Don't know	-	-	2
*Calculations are based on the total number of buildings owned by participant.			

D4. Do tenants or does the landlord pay the electric bills for this building?

Pay Electric Bills	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	37	45	19
Tenants	76%	64%	12
Some tenants pay, while in other cases, the landlord pays	14%	16%	4
Landlord	8%	16%	3
Don't know/Refused	3%	4%	-



ECONOLER

SOLAR

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ECONOLER

ABBREVIATIONS

DHW	Domestic Hot Water
ENSC	Efficiency Nova Scotia Corporation
NTGR	Net-to-Gross Ratio

DEFINITIONS

Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Tracked savings	Gross savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VI
1 PROGRAM DESCRIPTION.....	1
2 VALIDATED SAVINGS	2
2.1 Gross Savings	2
2.1.1 Adjustment Ratios.....	4
2.1.2 Validated Gross Savings.....	5
2.2 Net-to-Gross Ratio	6
2.3 Net Savings.....	6

LIST OF TABLES

Table 1: Validated Gross and Net Savings at the Generator	vi
Table 2: Values of Variables for Solar DHW Systems	3
Table 3: Values of Variables for Solar Space Heating Systems	4
Table 4: Validated Gross Savings	5
Table 5: Validated Net Savings	6

EXECUTIVE SUMMARY

The evaluation of Solar in 2014 validated the tracked savings of Efficiency Nova Scotia Corporation (ENSC) and applied the parameters evaluated in 2013. This report presents the validated gross and net savings for the year 2014.

Program Component Overview

Solar encourages homeowners to adopt a solar heating system (domestic hot water [DHW] and/or space heating) in their homes across Nova Scotia. Solar heating systems use the sun's thermal energy to heat water and/or space to offset part of the home heating needs met by existing traditional equipment.

Key Findings

Econoler reviewed the content of the 2014 Solar tracking sheet. The program had a total of 33 participants for 2014.

ENSC calculates the participant energy savings based on tailored RETScreen analyses using information found in the application form and/or standardized variables. To the gross savings tracked by ENSC, Econoler applied an adjustment factor established with the RETScreen simulation reviews carried out during the 2013 evaluation of Solar. In order to obtain the net savings, a 0.65 net-to-gross ratio (NTGR) was applied to the gross savings. This NTGR was determined by considering the free-ridership measured in the 2013 annual survey.

Based on those parameters, the net electric energy savings were estimated at 0.0617 GWh for 2014. The peak demand savings were estimated to be nil for 2014.

Table 1: Validated Gross and Net Savings at the Generator

	Tracked Gross Savings	Gross Savings with Adjustment Ratio	NTGR	Net Savings
Energy Savings	0.0925 GWh	0.0950 GWh	0.65	0.0617 GWh

1 PROGRAM DESCRIPTION

The Efficiency Nova Scotia Corporation (ENSC) Solar program component encourages homeowners to adopt a solar heating system (domestic hot water [DHW] and/or space heating) in their homes across Nova Scotia. Solar heating systems use the sun's thermal energy to heat water and/or space to offset part of the home heating needs met by existing traditional equipment. Solar participants offsetting domestic water heating only or both domestic water and space heating can choose either the rebate option or the zero-interest financing option to complete the work.

Solar aimed to achieve net electricity savings of 0.2 GWh and peak demand savings of 0.1 MW for 2014. Electrical energy savings generated by Solar are accounted for under the Existing Residential program.

2 VALIDATED SAVINGS

In 2014, a full-scale evaluation of Solar was not carried out. The evaluation of Solar involved validated ENSC's tracked savings and applied the parameters established in the 2013 evaluation. This section presents the gross and net savings for Solar in 2014.

2.1 Gross Savings

The tracking sheet provided for 2014 contained a total of 33 projects offsetting electric energy consumption, including 30 systems used for DHW and three for air space heating. Based on the 2013 evaluation, systems combining solar DHW and space heating were classified into the DHW system category.

ENSC calculates the participant energy savings based on tailored RETScreen analyses using information found in the application form and/or standardized variables. The preferred approach to calculating savings is to use specific variables, but when such variables are unknown, ENSC uses standard values.

Domestic Hot Water Heating

ENSC uses the following conditions to establish the model variables for solar DHW systems.

Table 2: Values of Variables for Solar DHW Systems

Variables	Values
Number of Occupants	Number of occupants claimed on application
Daily Water Use	60 L/day* per person (RETScreen calculates this)
Slope	Actual value if available; otherwise default value = 45 degrees
Azimuth	Actual value if available; otherwise default value = 0 degree
Solar Water Heater	RETScreen data for actual collector type or manufacturer's performance specifications for systems not listed in RETScreen ¹
Misc. Losses from Collectors	5%
Storage	Yes
Storage Capacity	50 L/m ²
Heat Exchanger	Yes
Heat Exchanger Efficiency	80%
Misc. Losses from Storage and Heat Exchanger	5%
Pump Power	0 W/m ² for PV pumps and 10 W/m ² for non-PV systems
Seasonal Efficiency	88% for electric and 76% for non-electric systems

By applying the variables listed above and the information provided by the participant on the application form, a RETScreen model is created. The annual savings are calculated using the difference in electricity consumption figures between the base and proposed case. Savings for systems combining solar DHW and space heating were calculated by applying all solar heating production to the DHW system.

¹ ENSC used flat-plate collectors from Thermo Dynamics Ltd. and evacuated tube solar collectors from Apricus when the proposed system was not available in the RETScreen product database as these were the most commonly installed in 2013.

Air Space Heating Systems

ENSC uses the following conditions as the model variables for solar space heating systems.

Table 3: Values of Variables for Solar Space Heating Systems

Variables	Values
Number of Occupants	Number of occupants claimed on application
Indoor Temperature (°C)	Actual, otherwise default value = 21
Air Temperature – maximum (°C)	Actual, otherwise default value = 35
R-value – wall (ft ² -°F(BTU/h)	Actual, otherwise default value = 20
Design Airflow Rate (cfm)	Actual, otherwise default value = 150
Operating Days per Week – weekdays	Actual, otherwise default value = 5
Operating Hours per Day – weekdays	Actual, otherwise default value = 8
Operating Days per Week – weekends	Actual, otherwise default value = 2
Operating Hours per Day – weekends	Actual, otherwise default value = 8
Slope	Actual, otherwise default value = 90 degrees
Azimuth	Actual, otherwise default value = 0 degree
Solar Air Heater	RETScreen data for actual collector type or manufacturer's performance specifications for systems not listed in RETScreen ²
Misc. Losses from Collectors	5%
Solar Collector Shading – season of use	0%
Incremental Fan Power	0 W/m ² for PV fans and 10 W/m ² for non-PV fans
Seasonal Efficiency	100% for electric and 76% for non-electric systems

By applying the variables listed above and the information provided by the participant on the application form, a RETScreen model is created. The annual savings are calculated using the difference in electricity consumption figures between the base and proposed case.

2.1.1 Adjustment Ratios

During the 2013 impact evaluation, the Econoler team evaluated the savings values calculated by ENSC for solar DHW systems by reviewing the RETScreen simulation and conducting sites visit for 11 projects. The information collected on site enabled the Econoler team to verify the variables used by ENSC and to create updated RETScreen models to reflect the reality observed on site. For all selected projects, the tracked savings values were recalculated with the updated RETScreen models

² ENSC used CanSolair collectors when the proposed system was not available in the RETScreen product database as these were the most commonly installed in 2013.

and a 1.028 adjustment ratio was determined. As in the 2013 impact evaluation, this adjustment ratio is applied to the gross savings tracked by ENSC in 2014 for the DHW category.

The unitary savings value used for air space heating systems was also reviewed during the 2013 evaluation. To do so, the Econoler team developed its own RETScreen simulation for one project. The project was part of the sample selected for the site visits. Using the information collected on site, the simulation developed by the Econoler team yielded a unitary savings value almost identical to the one tracked by ENSC. Based on these findings, the Econoler team recommended that no change be made to the tracked savings values. A 1.000 adjustment ratio is therefore used for air space heating systems.

2.1.2 Validated Gross Savings

The gross annual savings for all categories of equipment installed through Solar are presented in Table 4. The results are based on the calculated RETScreen savings found in the tracking sheet and the adjustment factors established with the RETScreen simulation reviews carried out by the Econoler team during the 2013 evaluation of Solar.

Overall, the validated gross savings amount to 0.0864 GWh at the meter. The gross savings at generator level are also estimated, using a 1.100 line loss factor between the meter and the generator. This line loss factor value was provided by Nova Scotia Power for residential customers. As a result, the validated energy savings are 0.0950 GWh at the generator.

Peak demand savings for Solar are assumed to be nil for 2014.

Table 4: Validated Gross Savings

Measure Category	DHW	Air Space Heating	Total
Program Tracking Sheet			
Number of Projects	30	3	33
Tracked Energy Savings (GWh)	0.0806	0.0035	0.0841
Validated Energy Savings			
Adjustment Ratio	1.028	1.000	-
Total Gross Energy Savings – at meter (GWh)	0.0829	0.0035	0.0864
Line Loss Factor	1.100	1.100	1.100
Total Gross Energy Savings – at generator (GWh)	0.0911	0.0039	0.0950

2.2 Net-to-Gross Ratio

The net-to-gross ratio (NTGR) evaluation is based on a self-report approach which relies on a series of questions designed to measure the influence of Solar on the participants' decision to install solar heating systems.

In the case of Solar, the NTGR calculation includes the assessment of free-ridership, which can occur when participants would have still implemented the specific solar measures to reduce their electric space or DHW heating load in the absence of the program. This distortion effect was established through a telephone survey conducted during the 2013 evaluation. The 35-percent value obtained through this survey is used for this year's evaluation since no participant survey was conducted for Solar in 2014.

The NTGR is calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership}).$$

Using the free-ridership established for Solar, the NTGR value is estimated at 0.65.

2.3 Net Savings

The net savings were estimated using the NTGR presented above. The equation below was used to calculate the net energy savings.

$$\text{Net Savings} = \text{Gross Evaluation Savings} \times NTGR$$

The 2014 validated net energy savings for Solar are estimated at 0.0561 GWh at the meter and 0.0617 GWh at the generator. The detailed results are presented in the following table.

Table 5: Validated Net Savings

Category of Measure	DHW	Air Space Heating	Total
Energy Savings			
Total Gross Energy Savings – at meter (GWh)	0.0829	0.0035	0.0864
NTGR	0.65	0.65	0.65
Total Net Energy Savings – at meter (GWh)	0.0539	0.0023	0.0561
Line Loss Factor	1.100	1.100	1.100
Total Net Energy Savings – at generator (GWh)	0.0592	0.0025	0.0617



ECONOLER



LED HOLIDAY LIGHT EXCHANGE

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ECONOLER

ABBREVIATIONS

ENSC	Efficiency Nova Scotia Corporation
LED	Light-Emitting Diode
LHLE	LED Holiday Light Exchange
NTGR	Net-to-Gross Ratio
OPA	Ontario Power Authority
PG&E	Pacific Gas and Electric Company
TRM	Technical Reference Manual

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Diversity factor	The ratio of the sum of the individual maximum demands of the various subsystems to the maximum demand of the whole system.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Percentage of savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.

Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VII
1 PROGRAM DESCRIPTION	1
2 IMPACT EVALUATION.....	2
2.1 Gross Savings.....	2
2.1.1 Tracked Unitary Savings Value	3
2.1.2 Revised Unitary Savings Value	3
2.1.3 Diversity Factor.....	8
2.1.4 Total Gross Savings	9
2.2 Interactive Effects	10
2.3 Net-to-Gross Ratio	11
2.4 Net Savings.....	11

LIST OF TABLES

Table 1: Comparison of Tracked and Evaluated Savings at the Generator	viii
Table 2: ENSC Unitary Savings Estimate for Each Set of LED Lights Exchanged.....	3
Table 3: Proportion of Old Incandescent Sets and Average Quantity of Lamps per Category	4
Table 4: Literature Review of Old Incandescent Sets	5
Table 5: Estimated Wattage Values for Old Incandescent Sets	6
Table 6: Revised Unitary Savings Estimate for Each Set of LED Lights Exchanged	8
Table 7: Evaluation Results – Total Gross Energy Savings	9
Table 8: Interactive Effects Factor for LHLE	11
Table 9: Evaluation Results – Total Net Savings.....	12
Table 10: Comparison of Tracked and Evaluated Savings at the Generator.....	12

EXECUTIVE SUMMARY

This report presents the results of the 2014 impact evaluation of the Light-Emitting Diode (LED) Holiday Light Exchange (LHLE), which is a component of the Residential Efficient Product Rebates program.

Program Component Overview

LHLE provides individuals across Nova Scotia with the opportunity to receive one set of LED holiday lights in exchange for two sets of old traditional holiday lights in order to reduce electrical energy consumption and peak demand. LHLE is primarily a community outreach and awareness activity. The exchanges are made through local tree-lighting events held all across the province during the months of November and December. In 2014, a total of 117 events were held.

A first impact evaluation was conducted in 2011, covering the years 2007 to 2011. The evaluation demonstrated net energy savings of 1.447 GWh resulting from the distribution of 46,399 LED holiday light sets during the period. The impact evaluation then established net energy savings of 0.349 GWh and 0.303 GWh in 2012 and 2013 respectively. This decrease was in line with the reduced distribution of LED holiday light sets, which went from 9,703 in 2012 to 7,826 in 2013.

Key Findings

The 2014 impact evaluation of LHLE calculated the net energy savings resulting from the LED holiday light sets distributed in 2014. To calculate these savings, Econoler reviewed the parameters used by Efficiency Nova Scotia Corporation (ENSC) to estimate gross savings, used an in-field survey to update the assumption on the return of incandescent sets and took into consideration the interactive effects regarding LED holiday lights. Due to the special nature of this program, the free-ridership and spillover effects were not measured and the net-to-gross ratio (NTGR) is assumed to be 1.

In 2014, 6,343 LED holiday light sets were distributed through LHLE, confirming the trend in the previous years. The evaluation revealed that LHLE generated net energy savings of 0.192 GWh and net peak demand savings of 0.414 MW at the generator in 2014.

Table 1: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings				
Tracked Savings from ENSC	0.246 GWh	0.246 GWh	1.00	0.246 GWh
Evaluation Results	0.202 GWh	0.192 GWh	1.00	0.192 GWh
Peak Demand Savings				
Tracked Savings from ENSC	1.228 MW	1.228 MW	1.00	1.228 MW
Evaluation Results	0.435 MW	0.414 MW	1.00	0.414 MW

The net energy savings evaluated for LHLE are lower than those tracked by ENSC. This result can be explained by the reduction of the unitary savings value from 35.2 kWh to 29 kWh due to a change in the proportion of incandescent sets replaced and a reduction of the average wattage. These assumptions are based on the in-field survey conducted in 2014 by ENSC. Econoler considered it to be reliable and in line with the literature review of other jurisdictions. In addition, an interactive effect factor of -5.0 percent is used but was not considered in the tracked savings.

Based on these assumptions, the net peak demand savings evaluated were 66 percent lower than those tracked by ENSC because the diversity factor is estimated at 50 percent by Econoler, based on the probability that the LED holiday lights were turned on during the peak electricity demand. The unitary demand savings value per set exchanged decreased from 176 W to 125 W due to the revised unitary savings and the addition of the interactive effect factor.

1 PROGRAM DESCRIPTION

The Light-Emitting Diode (LED) Holiday Light Exchange (LHLE) is aimed at promoting the use of energy-efficient LED lights for holiday lighting. LHLE is mainly a community outreach and awareness activity. Through local tree-lighting events held annually in November and December across Nova Scotia, Efficiency Nova Scotia Corporation (ENSC) provides individuals with the opportunity to receive one set of LED lights in exchange for two sets of incandescent holiday lights. There is a limit of one set of LED holiday lights per person.

LHLE has been running every fall since 2005. After Nova Scotia Power withdrew from the program in 2012, ENSC is the only entity responsible for delivering LHLE. Since 2007, 70,271 LED holiday light sets have been exchanged through LHLE.

A first impact evaluation was conducted in 2011, covering the years 2007 to 2011. The evaluation demonstrated net energy savings of 1.447 GWh resulting from the distribution of 46,399 LED holiday light sets during the period. The impact evaluation then established net energy savings of 0.349 GWh and 0.303 GWh in 2012 and 2013 respectively. This decrease was in line with the reduced distribution of LED holiday light sets, which went from 9,703 in 2012 to 7,826 in 2013.

This report evaluates the electricity savings generated by LHLE in 2014. The impact evaluation is based on a review of the parameters used in the unitary savings calculations of ENSC. Because of the short period targeted by LHLE and the level of associated savings it generated, ENSC has not planned any specific process evaluation activities for this evaluation.

2 IMPACT EVALUATION

The purpose of the impact evaluation is to determine the gross and net savings of LHLE in 2014. To this end, Econoler reviewed the unitary savings calculations of ENSC by comparing them with those made by other jurisdictions. Some assumptions were also updated based on an in-field survey conducted by ENSC in 2014. Subsequently, the gross energy savings were calculated from this revised unitary savings value and the gross peak demand savings were calculated using a diversity factor. Finally, the net savings were evaluated by applying the interactive effects generated by the replacement of traditional incandescent lights with LED lights.

2.1 Gross Savings

The quantity of LED sets exchanged during LHLE events was captured in a tracking sheet. A total of 6,343 sets were distributed at 117 events in 2014. ENSC then used an average unitary savings value to estimate the total energy and peak demand savings generated by the program.

2.1.1 Tracked Unitary Savings Value

The average unitary savings value estimated for each set of LED lights exchanged is 35.2 kWh, and the unitary demand savings value is estimated at 176 W by ENSC. These values have been used to estimate the gross energy and peak demand savings generated by the LHLE since 2007. They are based on the assumptions presented in the table below.

Table 2: ENSC Unitary Savings Estimate for Each Set of LED Lights Exchanged

Parameters	Values
Proportion of Old Large Incandescent Sets Returned (25 lamps per set)	40%
Proportion of Old Mini Incandescent Sets Returned (100 lamps per set)	40%
Proportion of Old Mini Incandescent Sets Returned (50 lamps per set)	20%
Wattage of Old Large Incandescent Sets (25 lamps per set)	$7 \text{ W/lamp} \times 25 \text{ lamps/set} = 175 \text{ W/set}$
Wattage of Old Mini Incandescent Sets (100 lamps per set)	$0.4 \text{ W/lamp} \times 100 \text{ lamps/set} = 40 \text{ W/set}$
Wattage of Old Mini Incandescent Sets (50 lamps per set)	$0.4 \text{ W/lamp} \times 50 \text{ lamps/set} = 20 \text{ W/set}$
Average Old Wattage (incandescent sets)	$(40\% \times 175 \text{ W}) + (40\% \times 40 \text{ W}) + (20\% \times 20 \text{ W}) = 90 \text{ W/set}$
Wattage of New LED Sets (25 lamps per set)	$0.08 \text{ W/lamp} \times 25 \text{ lamps/set} = 2 \text{ W/set}$
Average Displaced Wattage (per exchange)	$(90 \text{ W} - 2 \text{ W}) = 88 \text{ W}$
Annual Usage	$5 \text{ h/day} \times 40 \text{ days/yr} = 200 \text{ h/yr}$
Number of New LED Sets Used to Replace the Two Old Sets Returned	2
Unitary Energy Savings Value (per exchange)	$2 \text{ sets} \times 88 \text{ W} \times 200 \text{ h/yr} = 35.2 \text{ kWh/yr}$
Unitary Demand Savings Value (per exchange)	$2 \text{ sets} \times 88 \text{ W} = 176 \text{ W}$

2.1.2 Revised Unitary Savings Value

Following a recommendation from the past evaluation, ENSC conducted an in-field survey in 2014 to determine the number of sets returned, as well as the type and the quantity of lamps in each returned set. The average unitary savings value estimated for each set of LED lights exchanged was updated to 29 kWh and the unitary demand savings value was estimated at 125 W. The following section describes the methodology to obtain these updated values.

Number of Sets Replaced

Through LHLE, ENSC offers one set of LED lights in exchange for two sets of traditional incandescent lights—there is a limit of one set of LED holiday lights per person. Consequently, ENSC calculates the unitary savings value associated with each LED set exchanged based on the assumption that, ultimately, customers would probably replace both returned sets with new LED sets.

This assumption is conservative from two perspectives:

- › It assumes that only two sets of old incandescent lights are returned for every LED set exchanged. However, in practice, the in-field teams have seen many customers bring in multiple sets of old incandescent lights for only one LED set.
- › It also assumes that each set of old incandescent lights that have been returned will ultimately be replaced even if the customer may choose to use the new set provided by ENSC only.

It is also possible that a customer buys additional sets of holiday lights. In some cases, the old incandescent sets returned were longer and contained more lights. Econoler nonetheless considers ENSC's assumptions to be conservative.

Proportion of Sets Replaced

The in-field survey carried out in 2014 highlights major differences in the proportion of each incandescent set category and in the average number of lamps per set compared to assumptions used in the previous evaluations. The results are presented in the table below:

Table 3: Proportion of Old Incandescent Sets and Average Quantity of Lamps per Category

Category of Incandescent Set	Number of Sets Returned	Proportion of Each Category	Average Quantity of Lamps per Set
Long Large Incandescent Bulb	62	20%	35
Long Mini Incandescent Bulb	222	75%	50
Short Mini Incandescent Bulb	15	5%	20
Total	299	100%	-

The survey was conducted during one event and results could be slightly different in other regions of Nova Scotia. Nonetheless, a sample size of 299 sets represents 2.4 percent of all the incandescent sets returned in 2014. The margin of error is used to determine the level of precision¹ of the measurement, and its associated confidence level indicates the probability that a measure will fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take

¹ *Precision* refers to how close the measured values are to each other. It does not, however, take into consideration how close the measured value is to the true value, which would be defined as *accuracy*.

random sampling errors into account; they do not reflect non-sampling error or bias, such as data entry errors. With a ± 4.7 percent margin of error at 90 percent confidence interval, the survey is consistent enough to provide reliable findings.

The results of a previous survey conducted by ENSC in early January 2013 with 69 respondents who had participated in LHLE in December 2012 showed that no participant declared having returned sets with 100 lamps. Moreover, the results of the in-field survey are in the same range as that of the literature review conducted among other jurisdictions, as shown in the table below.

Table 4: Literature Review of Old Incandescent Sets

Type of Light	Proportion of Each Category	Quantity of Lamps per Set	Source
Large Incandescent	50 %	50 lamps/set	Pennsylvania Public Utility Commission Technical Reference Manual (TRM) ²
Mini Incandescent	50 %	50 lamps/set	
Large Incandescent	50 %	25 lamps/set	Ontario Power Authority Report ³
Mini Incandescent	50 %	25 lamps/set	
Large Incandescent	10 %	25 lamps/set	California Municipal Utilities Association Energy Efficiency Technical Reference Manual ⁴
Mini Incandescent	90 %	50 lamps/set	

Based on the two surveys conducted by ENSC and the review studies from other jurisdictions, the Evaluator elected to rely on the findings of the in-field survey conducted in 2014.

² Pennsylvania Public Utility Commission, *Technical Reference Manual*, available at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/technical_reference_manual.aspx> (Last accessed January 14, 2015).

³ Ontario Power Authority, *2010 Prescriptive Measures and Assumptions and 2014 Prescriptive Measures and Assumptions*, available at <<http://www.powerauthority.on.ca/opa-conservation/conservation-information-hub/evaluation-measurement-verification/measures-assumptions-lists>> (Last accessed January 14, 2015).

⁴ California Municipal Utilities Association, *Energy Efficiency Technical Reference Manual and TRM205_LED-holiday-lights-spreadsheet*, available at <<http://cmua.org/energy-efficiency-technical-reference-manual>> (Last accessed January 14, 2015).

Displaced Wattage

Based on former in-field observations, ENSC established the percentages of old sets that were returned among three different types of incandescent light sets. The lamp wattages used for the different types of old sets that were returned (7 watts per large incandescent bulb and 0.4 watt per mini incandescent bulb) were validated through a review of the various studies presented in the table below.

Table 5: Estimated Wattage Values for Old Incandescent Sets

Type of Light	Estimated Wattage	Source
Large Incandescent	7.00 W	Pacific Gas and Electric Company Test Results ⁵
Mini Incandescent	0.45 W	
Large Incandescent	5 W and 7 W	BC Hydro, Impact Evaluation – Seasonal LEDs ⁶
Mini Incandescent	0.40 W	
Large Incandescent	5 W	Ontario Power Authority Report ⁷
Mini Incandescent	0.5 W	
Large Incandescent	6 W and 7 W	TRM of the Pennsylvania Public Utility Commission ⁸
Mini Incandescent	0.48 W	
Large Incandescent	5 W and 7 W	TRM of the California Municipal Utilities Association ⁹
Mini Incandescent	0.5 W	

In 2014, one study was added to this table—the Technical Reference Manual (TRM) of the California Municipal Utilities Association. In comparison with the findings of this new study and those reviewed in 2012, it appears that the wattage values used by ENSC for large and mini incandescent bulbs are still appropriate.

The wattage used for the replacement set of LED lights provided by ENSC corresponds to the actual wattage value of the C-6 LED lights offered through LHLE.

⁵ Pacific Gas and Electric Company, *A Better Way to Light Up the Holidays*, available at <<http://www.pge.com/myhome/saveenergymoney/savingstips/seasonaltips/winter/led/index.shtml>>, (Last accessed January 14, 2015).

⁶ Sampson Research, *Market & Impact Evaluation of BC Hydro's Seasonal LED Initiative - Executive Summary*, available at <www.bchydro.com/content/dam/hydro/medialib/internet/documents/info/pdf/rates_regulation_post_decision_filings_directive_66.pdf> (Last accessed January 14, 2015).

⁷ Ontario Power Authority, *2010 Prescriptive Measures and Assumption and 2014 Prescriptive Measures and Assumptions*, available at <<http://www.powerauthority.on.ca/opa-conservation/conservation-information-hub/evaluation-measurement-verification/measures-assumptions-lists>> (Last accessed January 14, 2015).

⁸ Pennsylvania Public Utility Commission, *Technical Reference Manual*, available at <http://www.puc.pa.gov/filing_resources/issues_laws_regulations/act_129_information/technical_reference_manual.aspx> (Last accessed January 14, 2015).

⁹ California Municipal Utilities Association, *Energy Efficiency Technical Reference Manual: and TRM205_LED-holiday-lights-spreadsheet*, available at <<http://cmua.org/energy-efficiency-technical-reference-manual>> (Last accessed January 14, 2015).

Annual Usage

ENSC used an annual usage assumption of 40 days per year, which represents an average value of all the studies mentioned below. While BC Hydro¹⁰ and the Ontario Power Authority (OPA) assume an annual usage of 31 days, which corresponds to the entire month of December, other jurisdictions such as the U.S. Department of Energy¹¹, Pacific Gas and Electric Company (PG&E)¹² and the University of Maine¹³ assume an annual usage of 40 to 45 days to estimate the savings associated with the usage of LED holiday lighting. Econoler considers this assumption acceptable.

For the daily usage of 5 hours per day used by ENSC, this value was already revised during the 2013 evaluation based on ENSC's January 2013 survey results. The average daily usage declared by the participants was indeed slightly higher than what ENSC is currently tracking, i.e., 5.8 hours per day instead of 5 hours per day. As with the 2013 evaluation report, Econoler changed the daily usage of 5 hours per day to 5.8 hours per day and based its calculations on ENSC's annual usage assumption of 40 days per year.

¹⁰ BC Hydro, *Make Your Holiday Season Bright and Energy Efficient!*, available at : <https://www.bchydro.com/content/dam/hydro/medialib/internet/documents/Power_Smart_FACT_sheets/FACTS_Holiday_Lighting.pdf> (Last accessed January 14, 2015).

¹¹ U.S. Department of Energy, *LED Products, Energy Savers*, available at <<http://energy.gov/energysaver/articles/led-lighting>> (Last accessed January 14, 2015).

¹² Pacific Gas and Electric Company, *A Better Way to Light Up the Holidays*, available at <<http://www.pge.com/myhome/saveenergymoney/savingstips/seasonaltips/winter/led/index.shtml>>, (Last accessed January 14, 2015).

¹³ The University of Maine, *LED Alternatives Offer Efficient Holiday Lighting*, available at <<http://umaine.edu/ext-energy/blog/2010/11/29/led-alternatives-offer-efficient-holiday-lighting>>, (Last accessed January 19, 2015).

Unitary Savings Value

The updated assumptions are presented in the table below.

Table 6: Revised Unitary Savings Estimate for Each Set of LED Lights Exchanged

Parameters	Values
Proportion of Old Large Incandescent Sets Returned (35 lamps per set)	20%
Proportion of Old Mini Incandescent Sets Returned (50 lamps per set)	75%
Proportion of Old Mini Incandescent Sets Returned (20 lamps per set)	5%
Wattage of Old Large Incandescent Sets (35 lamps per set)	$7 \text{ W/lamp} \times 35 \text{ lamps/set} = 245 \text{ W/set}$
Wattage of Old Mini Incandescent Sets (50 lamps per set)	$0.4 \text{ W/lamp} \times 50 \text{ lamps/set} = 20 \text{ W/set}$
Wattage of Old Mini Incandescent Sets (20 lamps per set)	$0.4 \text{ W/lamp} \times 20 \text{ lamps/set} = 8 \text{ W/set}$
Average Old Wattage (incandescent sets)	$(20\% \times 245 \text{ W}) + (75\% \times 20 \text{ W}) + (5\% \times 8 \text{ W}) = 64.4 \text{ W/set}$
Wattage of New LED Sets (25 lamps per set)	$0.08 \text{ W/lamp} \times 25 \text{ lamps/set} = 2 \text{ W/set}$
Average Displaced Wattage (per exchange)	$(64.4 \text{ W} - 2 \text{ W}) = 62.4 \text{ W}$
Annual Usage	$5.8 \text{ h/day} \times 40 \text{ days/yr} = 232 \text{ h/yr}$
Number of New LED Sets Used to Replace the Two Old Sets Returned	2
Unitary Energy Savings Value (per exchange)	$2 \text{ sets} \times 62.4 \text{ W} \times 232 \text{ h/yr} = 29 \text{ kWh/yr}$
Unitary Demand savings value (per exchange)	$2 \text{ sets} \times 62.4 \text{ W} = 125 \text{ W}$

2.1.3 Diversity Factor

In the tracking sheet, ENSC estimated gross peak demand savings by using a diversity factor of 100 percent. As with the 2011, 2012 and 2013 evaluations, Econoler revised this assumption, considering that the probability that the LED holiday lights would be turned on during the peak electricity demand period is not 100 percent certain.

Indeed, the peak electricity demand for Nova Scotia Power is expected to occur between 5 p.m. and 7 p.m. on a weekday in December, January or February. To evaluate the probability that the LED holiday lights are turned on at the time of the peak electricity demand for Nova Scotia Power, Econoler considered two probabilities: (1) that the LED holiday lights are turned on between 5 p.m. and 7 p.m., and (2) that the LED holiday lights are turned on the day of the peak load, which occurs on a weekday in December, January or February.

Since the evaluation revealed that the LED holiday lights could be on for about 5.8 hours a day, usually in the evening, there was a high probability that the LED holiday lights were turned on between

5 p.m. and 7 p.m. This probability was therefore estimated at 100 percent. Furthermore, ENSC assumes that the LED holiday lights are used on average 40 days per year throughout the entire month of December and the first nine days of January. Based on this assumption, Econoler evaluated the probability that the LED holiday lights were turned on the day of the peak load. Nova Scotia Power's historical peak load data¹⁴ shows that, in approximately 50 percent of cases, peak load occurred during the month of December. Therefore, as with the last LHLE evaluations, a diversity factor of 50 percent is used in the peak demand savings calculations.

2.1.4 Total Gross Savings

The gross savings of LHLE for 2014 were calculated by multiplying the unitary savings value of 29 kWh established during this evaluation with the number of LED sets exchanged through LHLE in the fall of 2014.

For 2014, the total gross energy and peak demand savings amount to 0.184 GWh and 0.396 MW respectively at the meter. Between the meter and the generator, the line loss factor for residential rate categories is estimated by Nova Scotia Power at 1.100. By applying this value, the total gross energy and peak demand savings are estimated at 0.202 GWh and 0.435 MW respectively at the generator level.

Table 7: Evaluation Results – Total Gross Energy Savings

Energy Savings	
Number of LED Sets – from tracking sheet	6,343
Unitary Energy Savings Value (kWh)	29
Total Gross Energy Savings – at meter (GWh)	0.184
Line Loss Factor	1.100
Total Gross Energy Savings – at generator (GWh)	0.202
Peak Demand Savings	
Number of LED Sets – from tracking sheet	6,343
Unitary Demand Savings value (W)	125
Diversity Factor	50%
Total Gross Peak Demand Savings – at meter (MW)	0.396
Line Loss Factor	1.100
Total Gross Peak Demand Savings – at generator (MW)	0.435

¹⁴ Nova Scotia Power, Open access same time information system, *Hourly Total Net Nova Scotia Load*, available at <<http://oasis.nspower.ca/en/home/oasis/monthly-reports/hourly-total-net-nova-scotia-load.aspx>> (Last accessed January 14, 2015).

2.2 Interactive Effects

Interactive effects occur in a home when implemented energy efficiency measures have an impact on the energy consumption of other elements, such as heating and cooling. In the case of LHLE, replacement of old traditional holiday lights with LED holiday lights inside a house can cause an increase in the heating load during their use. In fact, LED lights release less heat than old incandescent lights they traditionally replace.

The interactive effects of LED holiday lights on electric heating are estimated at -100 percent when they are installed inside a house. This assumption is based on the fact that holiday lighting is installed and used during winter (the heating season) in common-type rooms at medium height with no air-conditioning unit being used. Therefore, 100 percent of the energy released from the holiday lights is used for the heating load. Similar discussions took place a few years ago with Hydro-Québec as part of its holiday lighting program and it was agreed to disregard the energy savings associated with LED holiday lighting installed in electrically heated houses. Only external holiday lighting was promoted and considered for energy savings.

The table below presents the calculation details for the interactive effects factor by showing the percentage of homes in Nova Scotia that use electricity as a main heating source and the percentage of homes where seasonal LED lights were installed inside the house. According to a survey conducted in 2011 by ENSC, 33 percent of households in Nova Scotia use electricity as a main heating source for their home.¹⁵ To determine the indoor/outdoor installation ratio, Econoler assumed that the sets of LED lights that replaced large incandescent lights and 25 percent of mini incandescent lights had been installed outside. Those sets represented 40 percent of the sets exchanged. The remaining sets, which replaced mini incandescent lights, were considered to be used as indoor holiday decoration. Moreover, the large incandescent light sets which accounted for 20 percent of all the sets generated 80 percent of the overall savings. Twenty-five percent of the mini incandescent bulbs installed outside accounted for 5 percent of the overall savings. The indoor remaining mini incandescent sets accounted for 15 percent of the overall savings. Thus, the percentage accounted for by each category of incandescent set in the weighted savings has had an impact on the interactive effect factor.

The survey conducted in January 2013 with 2012 LHLE participants included a question to validate where the LED lights distributed through the program had been installed—indoors or outdoors. It was, however, impossible to draw any conclusions from the results obtained since half of the respondents selected both choices although only one set of LED holiday lights was exchanged per individual. Econoler therefore recommends improving this question and the available answers if a similar survey is conducted in the future.

¹⁵ ENSC from 2011 socket study.

Table 8: Interactive Effects Factor for LHLE

Parameters	% of Residences	Interactive Effects
Using Electric Heating – indoor seasonal LED lights	$33\% \times 15\% = 5\%$	-100%
Using Electric Heating – outdoor seasonal LED lights	$33\% \times 85\% = 28\%$	0%
Not Using Electric Heating – indoor seasonal LED lights	$67\% \times 15\% = 10\%$	0%
Not Using Electric Heating – outdoor seasonal LED lights	$67\% \times 85\% = 57\%$	0%
Weighted Interactive Effects Factor	100%	-5.0%

The interactive effects factor calculated for 2014 is -5 percent.

2.3 Net-to-Gross Ratio

Due to the special nature of this program, the short target period and the fact that it requires special involvement from the participant, the distortion effects of the LHLE are assumed to be negligible. Consequently, the net-to-gross ratio (NTGR) is assumed to be 1.

2.4 Net Savings

Since the NTGR for LHLE is assumed to be 1, the net savings were calculated using the interactive effects only.

$$\text{Net Savings} = \text{Gross Evaluation Savings} \times (1 + \text{Interactive effects factor})$$

The net energy savings calculated for 2014 are shown in the table below. Overall, the total net energy and peak demand savings amount to 0.175 GWh and 0.376 MW respectively at the meter, and 0.192 GWh and 0.414 MW respectively at the generator.

Table 9: Evaluation Results – Total Net Savings

Energy Savings	
Total Gross Energy Savings – at meter (GWh)	0.184
Interactive Effects Factor	-5.0%
NTGR	1.00
Total Net Energy Savings – at meter (GWh)	0.175
Line Loss Factor	1.100
Total Net Energy Savings – at generator (GWh)	0.192
Peak Demand Savings	
Total Gross Peak Demand Savings – at meter (MW)	0.396
Interactive Effects Factor	-5.0%
NTGR	1.00
Total Net Peak Demand Savings – at meter (MW)	0.376
Line Loss Factor	1.100
Total Net Peak Demand Savings – at generator (MW)	0.414

As shown below, the gross and net savings resulting from this evaluation were compared to the gross and net savings estimates in the 2014 tracking sheet.

Table 10: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings				
Tracked Savings from ENSC	0.246 GWh	0.246 GWh	1.00	0.246 GWh
Evaluation Results	0.202 GWh	0.192 GWh	1.00	0.192 GWh
Peak Demand Savings				
Tracked Savings from ENSC	1.228 GWh	1.228 GWh	1.00	1.228 GWh
Evaluation Results	0.435 GWh	0.414 GWh	1.00	0.414 GWh

Although the daily usage was assumed to be higher for 2014, the net energy savings evaluated for LHLE are lower than those tracked by ENSC. This result can be explained by the reduction of the unitary savings value from 35.2 kWh to 29 kWh due to a change in the proportion of incandescent sets replaced and a reduction of the average wattage. These assumptions are based on the in-field survey

conducted in 2014 by ENSC, which is considered reliable and in line with the literature review of other jurisdictions. In addition, an interactive effect factor of -5 percent is used, though it was not considered in the tracked savings.

Based on these assumptions, the net peak demand savings evaluated were lower than those tracked by ENSC by 66 percent because the diversity factor is estimated at 50 percent by Econoler, based on the consideration of the probability that the LED holiday lights were turned on during the peak electricity demand. The unitary demand savings value per set exchanged decreased from 176 W to 125 W, and the addition of the interactive effect factor contributed to this result for peak demand savings.





HOME ENERGY REPORT

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

CATI	Computer-assisted Telephone Interviewing
CBSM	Community-based Social Marketing
CSA	Canadian Standard Association
CRA	Corporate Research Associates
DA	Delivery Agent
DSM	Demand-side Management
EER	Energy Efficiency Ratio
ENSC	Efficiency Nova Scotia Corporation
HER	Home Energy Report
MEF	Modified Energy Factor
PM	Program Manager
OPA	Ontario Power Authority
RCT	Randomized Controlled Trial
RDI	Residential Direct Install

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	vi
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	2
2.1 Presentation of the Team	2
2.2 Evaluation Activities	2
2.2.1 Interview with Program Manager	2
2.2.2 Interviews with Opower	3
2.2.3 Survey	3
2.2.4 Billing Analysis Review	4
2.2.5 Unitary Savings Review	4
3 PROCESS EVALUATION	5
3.1 Program Design	5
3.2 Program Documentation	5
3.3 Tracking System	6
4 MARKET EVALUATION	8
4.1 Participant Perspectives	8
4.1.1 Energy Efficiency Appliance Purchases and Behaviours	8
4.1.2 Usage of HER Report	9
4.1.3 Awareness of and Satisfaction with HER	11
5 IMPACT EVALUATION FOR PAPER-BASED COMPONENT	13
5.1 Methodology Review	13
5.2 Net Savings	15
6 IMPACT EVALUATION FOR WEB-BASED COMPONENT	17
6.1 Unitary Savings Values	17
6.1.1 Energy-efficient Dishwasher	17
6.1.2 Energy-efficient Room Air-conditioner	18
6.1.3 Insulate Windows with Heat-shrink Film	19
6.1.4 Reduce Shower Time	22
6.1.5 Turn Off the Computer at Night	24
6.1.6 Wash Clothes in Cold Water	25
6.1.7 Hang Laundry to Dry	28
6.2 Gross Savings	29
6.3 Net-to-gross Ratio	31
6.3.1 Free-ridership	31
6.3.2 NTGR Calculation	31
6.4 Net Savings	32
7 OVERALL HER RESULTS	34
CONCLUSION	35
APPENDIX I 2014 RECOMMENDATIONS	36
APPENDIX II PARTICIPANT SURVEY QUESTIONNAIRE	38
APPENDIX III PARTICIPANT SURVEY RESULTS	55

LIST OF TABLES

Table 1: Survey Sample Size and Margin of Error.....	3
Table 2: Energy-efficient Behaviours Adopted.....	8
Table 3: HER Report.....	9
Table 4: Importance of HER in Influencing Decisions.....	9
Table 5: Likelihood of Purchasing/Undertaking Activity without HER.....	10
Table 6: Sources of Awareness.....	11
Table 7: Willingness to Recommend Programs.....	12
Table 8: Comparison of the Treatment Group and the Control Group.....	14
Table 9: Paper-based Component Evaluation Results – Total Net Energy Savings.....	16
Table 10: Paper-based Component Evaluation Results – Total Net Peak Demand Savings.....	16
Table 11: Heating Degree Days below 15°C in Representative Cities in Nova Scotia.....	20
Table 12: Technical Data of the Typical Window with Heat-shrink Film.....	21
Table 13: Average Wind Speeds.....	22
Table 14: Revised Unitary Savings Value for Low-flow Showerheads.....	23
Table 15: Average Power Use of the “Off Mode”.....	24
Table 16: Average Number of Laundry Loads per Week.....	25
Table 17: Water-heating Sources for Clothes Washers.....	27
Table 18: Average Water Usage of Clothes Washers per Year of Purchase.....	27
Table 19: Web-based Component Evaluation Results for 2013 – Total Gross Energy Savings.....	30
Table 20: Web-based Component Evaluation Results for 2014 – Total Gross Energy Savings.....	30
Table 21: Net-to-gross Ratios.....	32
Table 22: Web-based Component Evaluation Results for 2013 – Total Net Energy Savings.....	33
Table 23: Web-based Component Evaluation Results for 2014 – Total Net Energy Savings.....	33
Table 24: Total Evaluated Savings at the Generator for HER.....	34

LIST OF FIGURES

Figure 1: Methodological Model.....	2

EXECUTIVE SUMMARY

This report presents the results of the 2014 process, market and impact evaluation of Home Energy Report (HER), also known as the Energy Savings Actions program. The 2014 evaluation was based on the data and information collected from the interviews with the Program Manager (PM) and Opower, an annual telephone survey with a total of 340 participants in the web-based component of HER, a billing analysis review and a unitary savings review.

Program Component Overview

The purpose of HER is to enable participating households to compare their energy usage with similar neighbouring homes by mailing to participating households periodic reports illustrating their energy usage patterns and providing personalized energy efficiency tips to help them reduce their energy consumption.

In April 2013, Opower, the delivery agent (DA), selected a total of 98,000 households to receive their mail-out energy reports. A web portal was made available to these participants, and then to all Nova Scotians by October 2013.

HER aimed to achieve net electrical energy savings of 15.4 GWh and net electrical demand savings of 3.6 MW for 2014.

Key Findings

Since its inception in 2013, a total of 93,119 participants have taken part in the paper-based component of HER, and 10,669 participants have taken part in the web-based component. In terms of net energy savings for 2014, the HER paper-based component achieved 25.336 GWh and the web-based component achieved 0.100 GWh. Hence, HER's total net energy savings amounted to 25.437 GWh in 2014. In addition, 2.892 MW of peak demand savings was achieved in 2014.

Influence of HER on Behavioural Changes

Participants in the web-based component of HER were first asked a number of survey questions about energy efficiency behaviours to find out whether they had adopted one or more of them in the 12 months prior to the survey. These energy efficiency behaviours included purchasing energy-efficient appliances, such as air-conditioners, clothes washers and refrigerators, reducing their shower time, turning off their computers at night, hanging their laundry to dry, installing heat-shrink film and washing clothes in cold water. When asked about the level of influence HER had on their decisions to adopt these energy efficiency behaviours, participants generally provided low ratings, varying from 1.6 to 4.3 on a scale from 1 to 10, where 1 means that HER had no influence at all on their behaviour and 10 means that HER was extremely influential on their behaviour. Therefore, the majority of respondents mentioned it would have been likely for them to undertake these energy efficiency behaviours without HER.

That said, when comparing specific behaviours prior to and after participation in HER, it was found that there had been changes in behaviour following participation in HER. For example, on average, participants hung their laundry to dry more often, did more loads of laundry in cold water, turned off their computers at night more often and reduced their shower time.

Satisfaction

Close to 80 percent of web-based participants said they were satisfied with HER. Participants provided high satisfaction ratings to specific aspects of HER including the appearance and the clarity of the report, the ease of creating and updating the account, and the usefulness of tips provided. The most important reasons for participants' dissatisfaction were that they felt the report was not accurate and that they did not like the comparisons made with other houses in the area. A smaller proportion of the participants also mentioned that there was not enough information in the report and they did not find the tips relevant, and that energy consumption did not decrease after they started to follow the tips. Therefore, it is not surprising that the participants' main recommendations on improvement called for providing more detailed information in the report, particularly more information based on the specifics of the house, and improving the energy consumption comparisons with neighbouring houses.

Energy Savings

To calculate the net savings of HER in 2014, the Econoler team first reviewed the methodology used by Opower for calculating the paper-based component savings. The energy savings achieved by the paper-based component are considered net savings, since they have already included the program's influence on participants' decisions, by using a control group comparison. As for the web-based component, the Econoler team defined the unitary savings values for seven specific tips provided on the web portal. The web-based participant survey was used to estimate how many participants put the suggested tips into practice and questions were asked to determine the level of influence that HER had on participants' decisions to implement the suggested tips. These questions regarding the level of HER's influence were part of the self-declared approach used to calculate net energy savings for the web-based component.

The evaluation has revealed that HER generated net energy savings of 34.711 GWh and demand savings of 3.938 MW at the generator for the first 21 months of its implementation (from April 2013 through December 2014).

Recommendations

Overall, the Econoler team finds that the paper-based component of HER has succeeded in achieving the expected results in terms of changing participants' electricity consumption behaviour. The impact of the web-based component, however, has been more difficult to evaluate; the evaluation has not established a significant amount of savings associated with this component. In addition to the general recommendations presented for all ENSC program components in the overall executive summary of the 2014 demand-side management (DSM) programs, the team makes specific recommendations

throughout the report aimed at optimizing HER. The most important recommendations are summarized as follows:

- 2014 HER-R1. Explain in greater detail the characteristics of HER in the program documentation.** Designed to influence and change participants' electricity use behaviour, HER is different from other program components undertaken by ENSC. The specific and particular challenges and characteristics of this component should be clearly made known to program staff and the Evaluator. The program manual and the evaluation plan should be used to document and present all this information. Therefore, the Evaluator recommends that the program manual and the evaluation plan explain in greater detail the following elements of HER:
- › The number of selected participants. The program manual explains how participating households were selected, but the number does not correspond to the number of those finally selected by Opower.
 - › The process for selecting the tips recommended to participants.
 - › All the program documents available or developed when designing HER. It is of crucial importance that Opower help develop a comprehensive evaluation plan by listing all the data available, including methodologies, databases, and any data-collection tools available or program documents so that the Evaluator knows how to evaluate the program and what other data to be collected.
- 2014 HER-R2. Review the raw and treated databases from Opower.** Some confidentiality issues could not be solved within the evaluation timeframe and it was impossible for the Evaluator to review the raw data that Opower received and the treated data upon which it had applied the adjustments. For this evaluation, the Evaluator reviewed the adjustment methodology provided by Opower and considered the logic underlying this methodology to be sound. However, it is recommended that both databases be reviewed to validate whether the adjustments were applied as defined in the methodology. This review should be conducted in the next evaluation now that the confidentiality issues have been solved.
- 2014 HER-R3. Conduct a billing analysis to compare the pre-participation electricity consumption of the treatment and control groups.** Socio-demographic data were analyzed and statistical tests were conducted to validate whether the control group selected was comparable to the treatment group (participants). An additional interesting test could be to analyze past electricity consumption from both groups. This analysis would help determine whether the savings observed through the billing analysis are attributable to HER and not to any other trend that could be observed with the treatment group, but not with the control group. An analysis of the electricity consumption trend for a five-year period should be conducted as part of the next evaluation.

1 PROGRAM DESCRIPTION

Home Energy Report (HER) helps Nova Scotian households reduce their energy consumption by changing their behaviours. More specifically, HER compares participating households' energy usage with similar neighbouring homes by mailing them periodic reports illustrating their energy usage patterns and providing personalized energy efficiency tips to help them reduce their energy consumption.

HER delivery is based on a tripartite agreement among Efficiency Nova Scotia Corporation (ENSC), Opower (the delivery agent (DA)), and Nova Scotia Power.

HER was first launched in 2013 as a three-year pilot. By April 2013, Opower selected a total of 98,000 households to receive their mail-out energy reports. A web portal was made available to these participants, and then to all Nova Scotians by October 2013.

ENSC receives two-thirds of the funds for HER from electricity rate-payers and the remaining one-third from Nova Scotian tax-payers. Rate-payer funds are used for electricity savings while tax-payer funds are used to provide services to non-electrically heated and low-income households.

HER aimed to achieve net electrical energy savings of 15.4 GWh and net electrical demand savings of 3.6 MW for 2014. Savings generated by HER are accounted for under the Energy Savings Actions program.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and the activities carried out for the HER evaluation.

2.1 Presentation of the Team

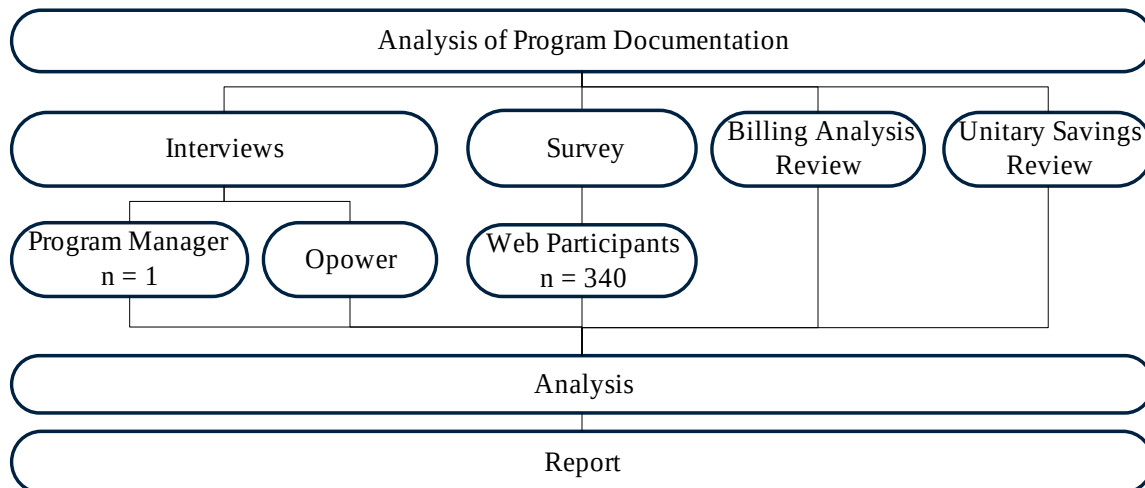
To carry out the 2014 evaluation, Econoler collaborated with Corporate Research Associates (CRA). Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all the deliverables.
- › CRA performed the telephone survey with participants in HER's web-based component and also analyzed and reported on the data collected from this activity.

2.2 Evaluation Activities

Figure 1 illustrates the research strategy and data collection activities used for the 2014 evaluation.

Figure 1: Methodological Model



Each step of this methodological model is further described in the following sub-sections.

2.2.1 Interview with Program Manager

The Econoler team conducted one interview with the PM in September 2014 to gain a basic understanding of the program's mechanisms and delivery. Based on the information obtained from this interview, a list of questions and topics to be included in the data collection tools was prepared.

2.2.2 Interviews with Opower

During the evaluation process, Econoler conducted various interviews with Opower to collect information required to conduct the impact evaluation and, more precisely, to better understand the program design, the selection of participants in the treatment group and the control group, and the billing analysis conducted by Opower to track the program savings.

2.2.3 Survey

In November 2014, CRA staff conducted a survey, using computer-assisted telephone interviewing (CATI) technology, with a total of 340 participants in HER's web-based component. The average length of the survey was 11.5 minutes.

The survey was meant to collect feedback on the following aspects of HER:

- › Behavioural changes
- › Energy efficiency tips implemented
- › Participation motivations
- › Participation in other ENSC programs
- › Satisfaction with the program
- › Recommendations for improvement

The questionnaire and complete survey results are presented in Appendix II and Appendix III respectively. The table below shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level.

Table 1: Survey Sample Size and Margin of Error

Annual Survey	Population	<i>Sample Size (n)</i>	Margin of Error at 90% Confidence Interval
2014 Participants	10,669 ¹	340	±4.5%

The margin of error is used to determine the level of precision² of the measurement, and its associated confidence level indicates the probability for a measure to fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or biases, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

¹ The population of participants for the survey included paper-based participants who also logged into the web portal.

² Precision refers to how close the measured values are to each other. However, it does not take into consideration how close the measured value is to the true value, which refers to accuracy.

2.2.4 Billing Analysis Review

Econoler reviewed the methodology used by Opower to establish the energy savings of the paper-based participants by making an analysis of the billing data of the treatment group and the control group. First, Econoler reviewed the selection process for placing participants into the treatment group and the control group and then looked at the process used to determine the energy savings based on a regression analysis.

2.2.5 Unitary Savings Review

Econoler established the unitary savings values for seven tips selected to quantify the savings associated with the web-based component. To choose the most recent and accurate data sources for establishing the unitary savings value for each tip, the team conducted a literature review of technical reference manuals, studies and public evaluation reports. When no reliable or representative source was found in the literature, engineering calculations were used to estimate savings.

3 PROCESS EVALUATION

This section presents the findings from the process evaluation of HER, which has been carried out on the basis of the information gathered from the documentation and an interview with the PM.

3.1 Program Design

Participants in the paper-based component are provided with paper reports that illustrate their energy usage patterns, compare their energy usage to an anonymous group of similar neighbouring homes and offer tips on how to reduce energy use. HER also has a web portal where new participants can consult a library of energy efficiency tips and also compare their energy usage to an anonymous group of similar neighbouring homes, but they are not provided with full reports like those received by participants in the paper-based component. The program objective is to encourage participants in both the paper-based and web-based components to change their behaviours and reduce their energy consumption. Comparing participants' energy usage and patterns to similar homes is used as a motivating factor for them to change their behaviours.

Participants can take various actions after receiving their paper reports or after browsing the library of tips online. Participants are very likely to change their behaviours and start adopting energy-wise habits right after seeing these energy efficiency tips provided. However, behavioural changes are subject to erosion over time, hence affecting sustainability. Other types of action recommended through HER, such as buying energy-efficient products, will result in more persistence than behavioural changes. In other words, a portion of the savings observed in a given evaluation period can be lost after a certain period, while other savings will stay throughout the entire useful life of the product installed.

3.2 Program Documentation

As part of the evaluation, the Evaluator analyzed the program documentation and worked together with the PM to improve and revise the content of certain program documents. A number of changes have already been made by the PM to the program documents. However, upon completing the process evaluation, the Evaluator made new findings, as summarized below.

Firstly, the Evaluator is of the opinion that certain characteristics of HER should be explained in greater detail in the program manual, including:

- › The number of selected participants should be updated. The Evaluator discovered during the verification process that the information provided in the program manual does not correspond to the final selection made by Opower.
- › The program manual mentions that Opower follows a set of criteria when creating both the treatment and the control groups. The Evaluator recommends that ENSC consider adding the

age of the home to this set of criteria to indicate the particular building code according to which a house was built.

- › The process for selecting the tips should be described in the program manual.

The Evaluator also thinks that certain changes should be made in the next version of the evaluation plan by giving consideration to the following:

- › The calculation of gross savings does not apply to HER and should therefore be removed from the evaluation plan.
- › The evaluation plan should mention all the program documents available or developed when designing HER. Opower may have more data than that presented in the evaluation plan. It is of crucial importance that Opower help develop a comprehensive evaluation plan by listing all the data available, including methodologies, databases, and any data-collection tools available or program documents so that the Evaluator knows how to evaluate the program and what other data to be collected.

The Evaluator was provided with an example of a home energy report to better understand how HER works and the content of the report itself. The Evaluator is satisfied with the overall quality of the report and its content. The bar chart used for tracking changes in energy consumption is a good visual tool and its evolution over time is a good indicator of the results of any effort undertaken by the participant to reduce consumption. The Evaluator noticed that some of the tips provided refer to other ENSC programs. This is a good way of promoting other programs and increasing overall awareness about energy efficiency.

In addition, the Evaluator has reviewed the complete tip library and has the following recommendation to make:

- › The latest version of the tip library has 92 pages. To allow for easier navigation throughout the tip library, the Evaluator suggests creating and placing an index at the beginning of the library to group similar tips under a number of more general topic areas, thereby making it easier for the reader to locate particular groups of tips in the library. For instance, several tips regarding heating, lighting, and hot water can be grouped under the topic area of “electricity end-use”. To better organize the tip library, another option is to divide the tips into two categories: behavioural change and resource acquisition.

3.3 Tracking System

Opower is in charge of tracking the savings of the paper-based component and submits savings summary reports to ENSC every month. ENSC has created its own internal tracking system using some of the data provided in these monthly reports. Since the web-based component’s savings are not tracked, it has no tracking documents.

Each monthly summary report provided by Opower for the paper-based component includes a summary of the electricity savings established for each month based on a billing analysis. Other information, such as the number of opt-outs in a given month, is also provided in the reports. In addition, the reports include statistics on the web-based component (the number of accounts created, the total number of visitors, the average time on site, average page views and the percentage of new visits).

Opower also provides the Evaluator with a database of the customers who logged in. This database includes information such as the account number, a treatment status (which identifies whether the paper-based participant is included in the treatment or the control group), the name and site address of the participant and the login duration. The phone numbers of the web-based participants were essential to conducting the telephone survey planned as part of this evaluation; unfortunately, these phone numbers were not available.

In addition to this database of customers, Opower produces a summary of tip actions. The tip actions file includes the tip name and the type of action with their associated number of customers who chose that action. However, the database and the tip actions file could not be compared to see which participant selected which tip.

4 MARKET EVALUATION

This section presents the findings of the 2014 HER market evaluation from the web-based participants' perspectives. The survey included paper-based participants who also logged into the web portal. Questions were specifically asked to focus on their interaction with the web portal and the information provided by it.

4.1 Participant Perspectives

A participant survey was conducted as part of the HER evaluation. In addition to the questions designed for impact evaluation purposes, survey participants were asked questions related to behaviour change, awareness and satisfaction.

4.1.1 Energy Efficiency Appliance Purchases and Behaviours

Nearly four in ten participants (38%) purchased an energy-efficient appliance in the last year, with most of these being clothes washers (31%), dishwashers (25%), and refrigerators (24%). Meanwhile, participants adopted various energy-efficient behaviours, with 80 percent of them changing their behaviour in some way. The table below details the specific behaviours adopted by respondents.

Table 2: Energy-efficient Behaviours Adopted

Energy-efficient Behaviours Adopted **	2014
<i>Sample Size*</i>	313
Turn off lights when not needed	72%
Wash clothes in cold water	57%
Turn off computer at night	53%
Hang laundry to dry	50%
Use a ceiling fan rather than air-conditioning	44%
Reduce shower time	43%
Turn off water heater when away	31%
Reduce refrigerator's temperature set point	17%
Adjust the television display by reducing the brightness and contrast	17%
Insulate windows with heat-shrink film	8%
Use a home power monitor to have real-time feedback on electricity consumption	6%
*Base: All respondents except those who purchased an energy-efficient appliance and those who did not take steps to reduce home energy use. **Percentage saying "yes".	

4.1.2 Usage of HER Report

Three-quarters of the participants recalled signing up for HER on the ENSC website (74%). The remaining survey questions, with the exception of demographics-related questions, were posed only to this group (n=250). Energy cost savings was the primary reason identified for signing up for HER (46%), followed by improving home energy use efficiency rankings compared with other houses (24%). Participants are generally interested in the information provided by HER, with the majority reading at least some of the website's content, as highlighted in the table below.

Table 3: HER Report

Uses of the HER Report	2014
Sample Size*	250
Read the website content thoroughly	38%
Read some of the website's content	34%
Skim some of the website's content	13%
Glance at the pictures, graphs or headlines	6%
Others	5%
Don't know/refused	4%
*Base: Respondents who recalled signing up for HER	

When asked about the level of influence HER had on respondents' decisions to undertake various energy-efficient activities, influence ratings were generally low, as highlighted in the table below.

Table 4: Importance of HER in Influencing Decisions

Importance of HER		2014	
Base	Question	Sample Size	Mean Score*
Average rating: 10= "Extremely influential", 0= "No influence at all"			
Respondents who purchased air-conditioners	HER influence on purchase decision of energy-efficient air-conditioner	14	4.3
Respondents who reduced shower time	HER influence on decision to reduce shower time	97	3.5
Respondents who purchased dishwashers	HER influence on purchase decision of energy-efficient dishwasher	24	3.1
Respondents who turned off computer at night	HER influence on decision to turn off computer at night	119	2.5
Respondents who hung laundry to dry	HER influence on decision to hang laundry to dry	110	2.3
Respondents who installed shrink wrap film	HER influence on decision to install shrink wrap film	18	1.8
Respondents who washed clothes in cold water	HER influence on decision to wash in cold water	118	1.6
**"Don't know/refused" responses have been removed from calculation.			

The majority of respondents reported it would have been likely for them to adopt the specific energy-efficient behaviour without HER, as highlighted in the table below.

Table 5: Likelihood of Purchasing/Undertaking Activity without HER

Influence of HER		2014	
Base	Question	Sample Size	Definitely/ Probably*
Respondents who purchased air-conditioners	Likelihood of purchasing energy-efficient air-conditioner without HER	14	86%
Respondents who reduced shower time	Likelihood of reducing shower time without HER	97	75%
Respondents who purchased dishwashers	Likelihood of purchasing energy-efficient dishwasher without HER	25	100%
Respondents who turned off computer at night	Likelihood of turning off computer at night without HER	121	81%
Respondents who hung laundry to dry	Likelihood of hanging laundry to dry without HER	109	94%
Respondents who installed shrink wrap film	Likelihood of insulating windows without HER	18	94%
Respondents who washed clothes in cold water	Likelihood of washing clothes in cold water without HER	118	94%
**"Don't know/refused" responses have been removed from calculation.			

While the respondents were not likely to attribute their behaviour changes to HER's influences, it is evident that there have been changes in their behaviours following their participation in HER. For example, respondents who hung clothes to dry did so to an average of 4.3 loads in a typical week. Prior to their participation in HER, these respondents hung an average of 2.7 loads of laundry to dry per week, whereas following their participation in HER, the average increased to 3.2.

Similarly, there was a slight change in the number of loads of laundry washed in cold water following their participation in HER. Specifically, an average of 4.4 loads of laundry were done in a typical week by those who reported washing clothes in cold water, and an average of 3.3 loads were washed in cold water prior to HER, and 3.7 loads after HER.

Finally, there was an increase in turning off computers at night and a reduction in shower time following participation in HER. Prior to their participation in HER, respondents turned off their computers at night on average 4.9 times per week, while following HER, respondents turned off their computers at night on average 6.4 times per week. Shower time was reduced from an average of 10 minutes prior to HER to 6.6 minutes following participation in HER.

4.1.3 Awareness of and Satisfaction with HER

Respondents found out about HER in a number of ways, including media advertising, through the mail and word of mouth. The following table details sources of awareness of HER.

Table 6: Sources of Awareness

Sources of Awareness*	2014 (%)
<i>Sample Size</i>	250
Media advertising	26%
Through the mail/Bill insert	21%
Word of mouth	14%
Internet (general)	6%
Contacted directly by ENSC	6%
ENSC website	5%
Facebook or other social media	3%
Booth at community centre/event	2%
Through Nova Scotia Power	2%
Email/Email from ENSC	2%
Air Miles promotion	1%
Through the HER report received in the mail	1%
Through third-party contractor or service provider	1%
Others	6%
Don't know	12%
*Multiple responses	

The level of satisfaction with HER was high, with 79 percent of participants reporting satisfaction. High levels of satisfaction were reported regarding specific aspects of HER, including the appearance of the report (98%), the clarity of the report (93%), the ease of creating and updating the account (88%), and the usefulness of the tips provided (84%). Those who were not satisfied indicated that the report was not accurate (38%), they did not like the comparisons made with other houses in the area (25%), there was not enough information (15%), they did not find the tips relevant (10%), and energy consumption did not decrease after they started to follow the tips (10%).

Only a minority of HER participants spoke with ENSC contact centre representatives (26%). Among this minority of participants, there were high levels of satisfaction with various aspects of service, including the service attitude (92%), knowledge of programs available (89%), the overall level of service provided (84%), and the ability to provide advice (82%).

The majority of HER participants are likely to recommend the programs offered by ENSC to others, and a similar number would participate in other ENSC programs, as highlighted in the table below. Although the majority of participants did not offer any recommendations to improve HER, a small number mentioned the need for more detailed information (6%), improving house comparisons (5%), the need for more information based on the specifics about the house, such as how it is heated (4%), or improving the content of the report (4%).

Table 7: Willingness to Recommend Programs

	2014	
	Would Recommend ENSC Programs to Others	Would Participate in Other ENSC Programs
<i>Sample Size*</i>	247	244
Definitely	53%	51%
Probably	39%	43%
Probably not	5%	4%
Definitely not	3%	1%
**“Don’t know/refused” responses have been removed from calculation.		

5 IMPACT EVALUATION FOR PAPER-BASED COMPONENT

The objective of the 2014 impact evaluation of HER's paper-based component was to determine the net energy savings. Both electrical energy and demand savings were estimated by analyzing the savings calculation methodology of Opower. Since the methodology used establishes savings that can be accepted as "net", no free-ridership effect is considered for this component.

The following sub-sections present the activities conducted as part of the impact evaluation, and the resulting net energy and demand savings for HER's paper-based component.

5.1 Methodology Review

The approach to the impact evaluation involved reviewing the billing analyses performed by Opower. The savings are established by comparing the consumption of a group of participants (treatment group) to that of a group with similar attributes (control group).

Selection of Participants

First, Econoler reviewed the process used to build the two groups. A smaller group was selected by Opower to represent a random sample of the Nova Scotian population, while the other bigger group represented high electricity users, who were expected to achieve higher potential savings. The objective of this approach was to ensure the highest possible savings for the first program year (as represented by the high electricity users) and to estimate the amount of savings to be expected if the program is expanded to cover the whole provincial population (as represented by the random sample).

Hence, Opower first randomly selected 20,000 eligible households across Nova Scotia Power's entire customer base. Then, it used a randomized controlled trial (RCT) to place 10,000 of these households into the treatment group and the other 10,000 households into the control group. As a result, the treatment group and the control group were expected to be comparable to each other in terms of their usage, social and demographic characteristics, appliance characteristics, etc. In addition, Opower made an analysis by looking at the following criteria to ensure that both groups shared similar attributes:

- › Average annual usage for the previous year
- › Summer usage
- › Winter usage
- › Tenure of occupancy
- › Square footage
- › Heat type
- › AC type
- › Single/Multi family home
- › Has email

After selecting the random sample, Opower selected the high electricity users. It selected the 110,000 biggest users from the eligible population and used an RCT to place 88,000 households into the treatment group and 23,000 households into the control group. Afterwards, it made an analysis of both groups' attributes against the same set of criteria as listed above to ensure that the two groups were similar and comparable. A summary of the attributes analysis is presented in the following table.

Table 8: Comparison of the Treatment Group and the Control Group

Parameter	High-user Group Results			Random Group Results		
	Mean		T-statistic	Mean		T-statistic
	Treatment	Control		Treatment	Control	
Avg. Daily kWh	38.73	38.79	-0.55	28.30	28.15	0.62
Avg. Daily Summer kWh	28.44	28.32	1.32	21.90	21.82	0.48
Avg. Daily Winter kWh	54.66	54.94	-1.39	38.39	38.10	0.69
Tenure	6,161.31	6,163.97	-0.1	6,335.92	6,349.93	-0.25
Type of Dwelling	Chi squared: 3.82			Chi squared: 0.81		
Heat Type	Chi squared: 0.0			Chi squared: 0.0		

As shown in Table 8, the t-statistic was never above 2 or below -2, which means that the treatment group and the control group were not significantly different from each other, although small differences (statistically insignificant) between these two groups were observed. Furthermore, after conducting its own analysis on the average daily, summer and winter consumption levels, Econoler has come to the same conclusion.

Moreover, to increase the accuracy of the analysis, some adjustments were made, including the following:

- › Removing estimated readings: Since estimated meter readings were corrected on the following true-up reading, these estimated readings were combined with their true-up readings to remove any error from the estimated ones.
- › Prorating readings: Meter readings were prorated into calendar months.
- › Removing outliers: Only the readings with extreme values were dropped for customers and not all the readings for a customer were dropped. Data was dropped if:
 - Any meter reading with duration longer than 90 days
 - Electricity meter reading with a usage less than 2 kWh/day or greater than 300 kWh/day

The initial methodology would have involved analyzing the raw database received by Opower and the subsequent treated database, once all the adjustments previously mentioned had been made. However, the confidentiality issues among the parties involved (Nova Scotia Power, Opower, ENSC, Service Nova Scotia and Econoler) made it impossible for the Evaluator to receive said databases within the timeframe of this evaluation.

After making a careful analysis of the methodology and the statistical results, the Evaluator considers that the participants were properly selected. Nonetheless, further analysis of the treatment and control groups should be conducted in 2015, since all the confidentiality issues were solved in early 2015 and the entire databases (raw and treated) have been transferred to the Evaluator.

Billing Analysis

Opower estimated the savings using a panel data regression model, which involved following and comparing the same individuals over time, as well as comparing different individuals at a given point in time through regression models. A literature review showed that compared to other models, panel regression analysis increases the efficiency and precision of the estimates by using repeated measures on each program participant and by accounting for time-invariant unobservable variables³.

Furthermore, Opower used a “post-only” panel data estimator model, which used one year of pre-treatment data to construct control variables capturing the principal parameters of a household’s energy usage. This method is more effective in correcting small, statistically insignificant differences between the treatment group and the control group in pre-treatment and can result in a more accurate post-treatment savings estimate.

To validate the savings calculated, Econoler conducted its own regression modeling using Opower’s net database covering six months (three winter months and three summer months). For a given month, a simple regression was used to predict the actual consumption for that month, using the “PRE” consumption related to the same season as that of the month being analyzed and the variable identified as “treatment”.

For each of the six months, Econoler re-established the savings value within a range smaller than the 95 percent confidence interval, as compared to Opower’s value. Econoler considers that the Opower approach is acceptable and that the monthly savings reported to ENSC can be directly used to calculate the total annual net savings.

5.2 Net Savings

This section presents the net savings associated with HER’s paper-based component.

Energy Savings

Opower makes a billing analysis every month to determine the amount of savings achieved by the participants for that month. The results of these billing analyses are presented to ENSC in a monthly report, detailing the energy savings and the average savings percentage achieved. Since HER was evaluated for the first time in 2014, the savings calculation has covered all the monthly savings results from April 2013 (when HER was launched) to the end of 2014. During that period, the savings

³ The Brattle Group, *Measurement and Verification Principles for Behaviour-Based Efficiency Programs*, May 2011, Sanem Sergici, Ph. D., Ahmad Faruqui, Ph.D.

percentage achieved ranged from 0 percent to 2 percent, with an average of 1.3 percent. The annual net savings for the paper-based component are presented in Table 9. Overall, the total net energy savings amounted to 31.362 GWh at the meter.

The net savings at the generator are also estimated in Table 9, using a line loss factor of 1.100 between the meter and the generator. This value was provided by Nova Scotia Power for residential customers. As a result, the net energy savings at the generator have been established at 34.498 GWh.

Table 9: Paper-based Component Evaluation Results – Total Net Energy Savings

Energy Savings	2013	2014	Total
Number of Participants	93,119		93,119
Total Net Energy Savings – at Meter (GWh)	8.329	23.033	31.362
Line Loss Factor	1.100	1.100	1.100
Total Net Energy Savings – at Generator (GWh)	9.162	25.336	34.498

Peak Demand Savings

The information provided by Opower's billing analysis did not allow calculating the peak demand savings associated with the paper-based participants. However, the paper-based component report's observations regarding the measures taken and the behaviour changes suggest that a certain level of peak demand savings should be looked at and determined.

The Evaluator conducted some secondary research to identify similar programs in other jurisdictions and find out how the peak demand savings were estimated. Only one program evaluation that included demand savings was found (the evaluation of the Home Performance Program in Ohio). Conducted by ADM Associates, this evaluation assumed that demand reductions achieved by the program have a flat hourly profile⁴. Based on this assumption, peak demand savings can be determined by dividing the annual energy savings by 8,760. Using this approach, the net peak demand savings at the meter and at the generator have been established (as summarized below in Table 10) using the line loss factor for the energy savings described previously. Overall, the net peak demand savings amount to 3.580 MW at the meter and 3.938 MW at the generator.

Table 10: Paper-based Component Evaluation Results – Total Net Peak Demand Savings

Peak Demand Savings	2013	2014	Total
Number of Participants	93,119		93,119
Total Net Peak Demand Savings – at meter (MW)	0.951	2.629	3.580
Line Loss Factor	1.100	1.100	1.100
Total Net Peak Demand Savings – at generator (MW)	1.046	2.892	3.938

⁴ ADM Associates, "Home Performance Program Evaluation, Measurement, and Verification Report", 2013.

6 IMPACT EVALUATION FOR WEB-BASED COMPONENT

The Econoler team conducted a survey with customers who signed up on the HER web portal to look at specific tips that they could have implemented because of the report.

When selecting the list of tips to include in the survey, the Evaluator first checked whether the measure was already covered by another ENSC program, to avoid the possibility of double-counting the savings as regular participation or spillovers. Then, the Evaluator filtered out the tips whose amounts of electricity savings were too small. Finally, the Evaluator also excluded those tips that very few people could implement them, and thus had low overall saving potential; these tips were mostly related to pool maintenance and specific heating systems.

Based on these criteria, the Evaluator included the following list of tips in the survey:

- › Energy-efficient dishwasher
- › Energy-efficient room air-conditioner
- › Insulate windows with heat-shrink film
- › Shave a minute off shower time
- › Turn off the computer at night
- › Wash clothes with cold water
- › Hang laundry to dry

The following sub-sections present the unitary savings value calculated for each of the above tips.

6.1 Unitary Savings Values

The unitary savings values were calculated using engineering formulas, as well as the data obtained from the literature and the survey with participants of the web-based component. The implementation ratio associated with each tip was also calculated based on the survey results.

6.1.1 Energy-efficient Dishwasher

The average consumption of all available ENERGY STAR model in 2014 is 269 kWh/year⁵, while the US Federal Standard is 307 kWh/year⁵. Therefore, the average annual savings are established at 38 kWh/year.

In the survey, participants were asked if they had bought an energy-efficient appliance in the preceding 12 months; if they had, they were asked to specify how they knew this appliance was

⁵ ENERGY STAR, *ENERGY STAR Certified Residential Dishwashers database*,
<<http://www.energystar.gov/productfinder/product/certified-residential-dishwashers/results>> (Last accessed October 24, 2014)

energy-efficient. The survey results showed that a total of 32 participants each bought an energy-efficient dishwasher instead of a standard one, which translates into an implementation ratio of 9.4 percent.

6.1.2 Energy-efficient Room Air-conditioner

In 2014, for Appliance Retirement, the Evaluator reviewed the estimated annual energy consumption and the unitary savings value for retired room air-conditioners. The average annual usage was 310.6 hours as most participants used air-conditioners during the summer months when they needed them. The average capacity of the retired units collected last year was 7,185 Btu/h. It is assumed that the web-based population of HER required the same capacity and their usage pattern stayed the same.

Since 1995, room air-conditioners have been required to have an energy efficiency ratio (EER) of at least 8⁶. Today, window-mounting models are available with EER ratings between 12.0 and 8.0, and units intended for through-the-wall applications have EERs between 9.5 and 8.0⁷. It was therefore assumed that standard units had an EER of 8.

Using these parameters and the following equation, the annual-consumption average has been established at 279 kWh for standard room air-conditioners:

$$\text{Consumption of Retired AC unit} = \frac{7,185 \text{ Btu/hr}}{8.0 \frac{\text{Btu}}{\text{W} \cdot \text{hr}} \times \frac{1,000 \text{ W}}{\text{kW}}} \times 310.6 \frac{\text{hr}}{\text{year}} = 279 \text{ kWh}$$

Because the number of surveyed participants that implemented this tip was too small, no conclusion could be drawn regarding the type of equipment purchased. It is assumed that the units met the ENERGY STAR minimum level of energy efficiency, which is now EER 11.2 for units with a capacity below 8,000 Btu/hr⁸. This assumption is supported by the fact that the majority of participants declared that they had each bought a new high-efficiency model.

The same capacity and hours-of-operation values as those for retired room air-conditioners have been used, resulting in an annual energy consumption value of 199 kWh. Therefore, the average annual savings have been established at 80 kWh/year.

In the survey, participants were asked if they had bought an energy-efficient appliance in the preceding 12 months; if they had, they were asked to specify how they knew this appliance was energy-efficient. The survey results showed that a total of 16 participants each bought an

⁶ NRCAN's Office of Energy Efficiency. *Air Conditioning Your Home*, 2003, p. 15 available at: <http://publications.gc.ca/collections/Collection/M91-23-7-2003E.pdf>

⁷ Natural Resources Canada, *Air Conditioning Your Home*, <http://www.nrcan.gc.ca/energy/publications/efficiency/residential/air-conditioning/6051#room> (Last accessed November 07, 2014)

⁸ Energy Star. *Room Air Conditioners Key Product Criteria* https://www.energystar.gov/index.cfm?c=roomac.pr_crit_room_ac (Last accessed October 24, 2014)

energy-efficient air-conditioner instead of a standard one, which translates into an implementation ratio of 4.7 percent.

6.1.3 Insulate Windows with Heat-shrink Film

The methodology used to estimate the average savings per square meter of window due to the installation of heat-shrink film on windows is based on EC128 technical information⁹. The methodology has been reviewed and adjusted to improve its accuracy, while trying to respect the theory and simplify the proposed method.

The objective is to calculate the energy ratio required to compensate the energy losses through the leaks in kWh/m² for a typical window on which the heat-shrink film was installed by the program participants and then determine an average energy ratio based on the statistical data gathered from the participant survey.

Methodology for Determining the Energy Ratio

The energy required to heat the air escaping through window cracks is calculated using the following formula. By inputting the reduction of air flow from the cracks in the formula (instead of the airflow Q), it is possible to calculate the energy savings resulting from installing a heat-shrink film.

$$E = C_p \times Q \times HDD \times 24 \quad (1)$$

Where:

E: Energy saved in kWh

C_p = 0.001208 in kJ/(l.°C) specific heat capacity of air

Q: Reduction of air flow entering through the cracks in l/s

HDD: heating degree days in °C

24: Constant (24 hrs/day)

Then, by dividing the energy E by the window area, the energy ratio reduction attributable to the heat-shrink film in Nova Scotia can be estimated.

Heating Degree Days

A previous project undertaken by the Evaluator showed that the thermal balance point of a residential building usually ranged from 13°C to 17°C. So, the Evaluator recommends calculating the heating degree days with 15°C as a reference temperature. Environment Canada provides climate normal station data between 1981 and 2010 for numerous Canadian cities, including many in Nova Scotia¹⁰.

⁹ Standards and Guidelines Energy Conservation, Technical Information EC 128, Don Hampton, 1980.

¹⁰ http://climate.weather.gc.ca/climate_normals/index_e.html

So, the degree days below 15°C from the normal station data of Environment Canada are used to determine the savings associated with heat-shrink film installed on windows.

Three major cities or areas in Nova Scotia have been selected to represent an average climate throughout the province: Halifax, Sydney and Truro. The degree days of these cities are presented in Table 11.

Table 11: Heating Degree Days below 15°C in Representative Cities in Nova Scotia

	Halifax	Truro	Sydney	Nova Scotia Average
Heating Degree Days (15°C.day)	3,071.8	3,536.9	3,573.1	3,393.9

The difference between the Nova Scotia average and the cities' degree days is less than 10 percent for each city, which means that this Nova Scotia degree-days average can be applied to the whole province.

Airflow Entering through the Cracks

The EC128 code defines the airflow entering through cracks in a building using the following equation:

$$Q = k \times A \times (\Delta p)^n \quad (2)$$

Where:

Q: Air flow entering through the cracks in l/s

k: Average air flow due to differential pressure between the exterior and the interior of the building for an area of 1 m² in l/(s.Pa.m²)

A: Area of the cracks in m²

Δp^n : Average pressure due to wind on a wall in Pa

This equation is used to define the heat-shrink film's usefulness in reducing the air flow entering through the cracks.

The EC128 technical information defines three values for the factor k, depending on the ratio of building volume in liters divided by the window area in m². The Evaluator calculated the ratio based on data gathered in HOT2000 files of HEA program and obtained a value between 10,000 and 20,000, which corresponds to a Type 2 building. For this type of building, the recommended value in the EC128 for the factor k is $400 \frac{\text{L}}{\text{s.Pa.m}^2}$.

The area of the cracks is defined for a typical window using effective air leakage area of building components from Chapter 25 of the 1997 ASHRAE Fundamental Handbook. The effective air leakage area of the window is determined in cm² per linear meter of crack (lmc) or frame (lmf), depending on the window type. For the purpose of this evaluation, since the window on which the heat-shrink film is

installed may have quite a few leaks, it is assumed that the length of the cracks is proportional to the perimeter of the frame.

The effective air leakage area of a window with a heat-shrink film is estimated at 0.018 cm²/Imf.

Based on its knowledge of Nova Scotia's residential building stock accumulated from numerous audits and energy simulations in HOT2000 conducted for ENSC and other institutions, the Evaluator has defined a typical window on which the heat-shrink film is installed. The technical data of this window are presented in Table 12.

Table 12: Technical Data of the Typical Window with Heat-shrink Film

Window Type	Average Frame Perimeter	Average Window Area	Average Effective Air Leakage Area	Air Leakage Reduction due to Heat-shrink Film
Casement, Wood Frame, Double Pane, Narrow Space	8.79 [m]	3.35 [m ²]	0.24 [cm ² /Imc]	0.222 [cm ² /Imc]

Finally, based on the statistical data provided by the survey, the average number of windows on which heat-shrink film was installed in each residential building was established at 3.9. Therefore, the area of cracks reduction to be used to calculate the airflow reduction in Equation (2) mentioned above is A = 0.000761 m².

The average pressure due to wind on a wall is calculated using the following equation:

$$(\Delta_p)^n = (0.0134 \times v^2)^{0.65} \quad (3)$$

v : Average wind speed during heating period in km/h

0.65: Dimensionless constant¹¹

0.0134: Constant value in kg/m³.¹²

¹¹ Walker and al. (1997), Ashrae Fundamental 2009, 16.15.

¹² This value has been calculated according to the Bernoulli equation, and the wind modification equation of ASHRAE fundamental 2009, 24.3 eq. 4 (given the fact that a meteorological station is situated in a flat area without obstacles and the buildings are usually situated in areas with higher urban density). The Cp coefficient applied to the Bernoulli equation from ASHRAE Fundamental 2009 illustrates the fact that the wind can enter into a crack through different angles.

Environment Canada provides climate station data collected between 1981 and 2010 for the average wind speeds at four airports in Nova Scotia: Halifax, Greenwood, Sydney and Yarmouth. The annual average wind speeds have been calculated for the heating period between January through May and September through December, as shown in the following table.

Table 13: Average Wind Speeds

Month	Jan.	Feb.	Mar.	Apr.	May	Sep.	Oct.	Nov.	Dec.	Annual Average
Halifax	17.7	18.3	18.5	18.3	16.5	14.4	16.0	17.5	18.3	17.3
Greenwood	16.5	16.1	16.3	15.9	14	11.7	13.5	15.2	16.4	15.1
Sydney	19.8	19.7	19.6	18.7	16.8	15.4	17.0	18.2	19.8	18.3
Yarmouth	20.7	20.4	19.9	19.3	16.8	14.8	17.2	19.0	20.6	18.7

The average wind speed during the heating period is 17.4 km/h. So, $(\Delta p)^n$ is equal to 2.48 Pa. The air flow reduction attributable to the heat-shrink film for the typical window is calculated as follows:

$$Q = k \times A \times (\Delta p)^n = 400 \times 0.000761 \times 2.48 = 0.75 \text{ l/s}$$

Energy Calculation

The average participant's energy savings associated with a typical window equipped with heat-shrink film in a residential building in Nova Scotia are calculated as follows:

$$\text{Energy kWh} = Cp \times Q \times HDD \times 24 = 0.001208 \times 0.75 \times 3,393.9 \times 24 = 74.2$$

In the survey, participants were asked whether they insulated their windows with heat-shrink film in the preceding 12 months. Twenty-five participants had implemented this tip, which translates into an implementation ratio of 7.4 percent.

6.1.4 Reduce Shower Time

The Econoler team calculated the unitary savings value by conducting a literature review to validate the assumptions used by the Ontario Power Authority (OPA) and by using the results from the survey. The OPA provides assumptions for the average temperature rise for domestic hot water. The value of 73 percent domestic hot water in showerhead flow was obtained from the CBEEDAC¹³ and the average showerhead flow rate (2.4 gpm) was obtained from a study of the 2014 Residential Direct Install (RDI) participants.

In the survey, participants were asked to specify the typical duration of their shower in minutes respectively for the period prior to their signing up online for HER and the period after their sign-up.

¹³ Canadian Building Energy End-Use Data & Analysis Centre, *Domestic Water Heating and Water Heater Energy Consumption in Canada*, April 2005, page 29.

The average participant shortened shower time from 10 minutes to 6.6 minutes, which can be translated into a decrease of 6 gpd of hot water use per person per day.

Table 14 lists the variables used to establish this unitary savings value.

Table 14: Revised Unitary Savings Value for Low-flow Showerheads¹⁴

Parameter	Unitary Savings (kWh/year)	Source
Number of People Whose Behavioural Change is Accounted for	1	
Flow Rate of the Showerhead (F)	2.4 gpm	2014 RDI Database
Average Shower Time Before Participating in HER (T_{bef})	10 min	2014 HER Survey
Average Shower Time After Participating in HER (T_{aft})	6.6 min	2014 HER Survey
Proportion of Hot Water in Showerhead Flow (p)	73%	CBEEDAC
Average Reduction in Hot Water Use (gpd)	6	Calculation
Specific Heat of Water (Cp)	1 Btu/lb°F	Convention
Density of Water (ρ)	62.426 lb/ft ³	Convention
Temperature Rise in Electric Water Heater (ΔT)	79°F	2011 OPA
Days per Year	365	2011 OPA
Unit Conversion #1 (UC1)	1 kWh/3,413 Btu	Convention
Unit Conversion #2 (UC2)	0.1337 ft ³ /gal	Convention
Electric Water Heater Efficiency (η)	97%	Pennsylvania Public Utility Commission TRM ¹⁵
Unitary Savings	433X kWh/year	

The following algorithm has been used to calculate this unitary savings value:

$$\Delta kWh = \frac{(T_{bef} - T_{aft}) \times F \times p \times Cp \times \rho \times \Delta T \times \frac{Days}{yr} \times UC1 \times UC2}{\eta}$$

$$\Delta kWh = \frac{(10 - 6.6) \times 2.4 \times 73\% \times 1 \times 62.426 \times 79 \times 365 \times \left(\frac{1}{3412}\right) \times 0.1337}{97\%}$$

$$\Delta kWh = 433 \text{ kWh per year}$$

¹⁴ Pennsylvania Public Utility Commission, *Technical Reference Manual*, State of Pennsylvania, June 2013, pages 45–48.

¹⁵ Pennsylvania Public Utility Commission, *Technical Reference Manual*, "State of Pennsylvania," June 2013, page 174.

An adjustment factor has to be applied to this number to reflect the share of electric water heating in Nova Scotia, which is 27 percent based on NRCAN's data.¹⁶

$$\Delta kWh\ electric = 117\ kWh\ per\ year$$

The survey showed that 135 participants had implemented this tip, which translates into an implementation ratio of 39.7 percent.

6.1.5 Turn Off the Computer at Night

It is a common knowledge that many households never turn off their computers when they are not used. Turning them off will yield energy savings. The following table shows the average off-mode and sleep-mode power consumption levels for both the basic desktop and the efficient desktop.

Table 15: Average Power Use of the “Off Mode”¹⁷

Mode	Basic Desktop	Efficient Desktop
Off	2.0 W	1.1 W
Sleep	4.0 W	2.4 W

In the survey, participants were asked to specify:

- › The number of times they turned off their computers at night each week for the period prior to their signing up online for HER and the period following their sign-up
- › Whether they had a laptop or a desktop
- › Whether the power-saving mode on their computers was in use; the wait time (in minutes) it took for their computers to go into the power-saving mode.

Based on the survey results and on the OPA Prescriptive Measures and Assumptions, Econoler has established the following averages:

- › The “off-mode power use average”: 1.7 W
- › The “sleep-mode power use average”: 3.5 W
- › The average increase in the number of days per week with the computer turned off: 1.5 days.

¹⁶ Natural Resources Canada, *Comprehensive Energy Use Database: Residential Sector – Nova Scotia – Table 10: Water Heating Secondary Energy Use and GHG Emissions by Energy Source*,
<http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=10&page=4&CFID=31970021&CFTOKEN=fed6e0b3f51f8fc8-C05E90B0-B973-A582-25DA340381F0B679> (Last accessed December 3, 2014)

¹⁷ Ontario Power Authority (OPA), *2011 Prescriptive Measures and Assumptions*, Release Version 1, December 2010.

OPA also assigns a weighting of 55 percent to the time during which the computer is in the off-mode each day. The potential savings associated with turning off the computer instead of leaving it in the sleep-mode is represented in the following equation:

$$kWh = (1.7 W) \times 1.5 \frac{\text{days}}{\text{week}} \times 24 \frac{\text{hours}}{\text{days}} \times 52 \text{ weeks} \times 55\% = 1.75 kWh$$

The survey showed that 80 participants with desktop computers had implemented this tip, which translates into an implementation ratio of 23.5 percent.

6.1.6 Wash Clothes in Cold Water

To establish the average annual savings value per participant, the following method was used:

- › For both the control group and the treatment group: establishing their number of laundry loads done per week and their number of loads done in warm water, using the results of the annual phone survey
- › Estimating the energy required for water heating for each load of laundry done in warm water.

In the survey, participants were asked to specify the number of loads of clothes their households washed per week and the number of loads washed per week using cold water for the period prior to their signing up online for HER and the period after their sign-up. The following table shows the average numbers of laundry loads and cold-water laundry loads done per week per household.

Table 16: Average Number of Laundry Loads per Week

Tip Application	Total Loads per Week	Cold water Loads per Week	Proportion of Loads Done in Warm Water
Before	4.4	3.3	1.1
After	4.4	3.7	0.7

As shown in Table 16, participants' number of warm-water laundry loads had decreased by nine percent. Engineering calculations were made to evaluate the annual electricity consumption for water-heating for clothes washers. The nine percent of reduction can then be applied to this value to estimate the unitary savings value per participant.

Water-heating Energy Usage per Load

Econoler used the total energy consumption value for a clothes washer from the 2013 Instant Savings evaluation report; this value was established based on the average Modified Energy Factor (MEF) of all the non-compact non-ENERGY STAR clothes washers in the Energy Efficiency Ratings directory.¹⁸

¹⁸ Natural Resources Canada, *Energy Efficiency Ratings : Search – Clothes Washers*, < <http://oee.nrcan.gc.ca/pml-imp/index.cfm?action=app.search-recherche&appliance=CLOTHESWASHERS>> (Last accessed November 24, 2014)

By applying an MEF of 40.5 L/kWh/cycle and a capacity of 124.9 L, a consumption value of 3.08 kWh per load was established. This value represents the total energy used throughout the entire clothes-washing process, including the movement of the washing machine, water-heating and heat required to remove the remaining moisture in the wash load.

According to Hydro-Québec's efficient appliances program evaluation report¹⁹, the proportion of the total energy use for water-heating amounts to 24.8 percent. Therefore, the water-heating energy consumption can be established at 0.76 kWh per load.

However, a comprehensive survey on household energy usage conducted by Hydro-Québec²⁰ in the province of Quebec showed that Quebecers used on average 33 percent less energy to heat water for clothes-washing than what is assumed in the Canadian Standard Association (CSA) test procedure. The Evaluator considers that there is no evidence showing that laundry behaviours in Nova Scotia are significantly different from those in Quebec. Therefore, this same factor value and the CSA-defined MEF have been applied to estimate the energy use, resulting in an adjusted water-heating energy consumption value of 0.51 kWh.

¹⁹ Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, p. 18, available at < http://www.regie-energie.qc.ca/audiences/Suivis/Suivi-R-3644-2007-ProcedurePGEE/HQD_RapportEvaluationPGEE_Electro_02fev2012.pdf >

²⁰ Ad Hoc Recherche, *Rapport d'évaluation, Programme : Produits Mieux Consommer – Électroménagers Energy Star (Années 2008 et 2009)*, p. 19, available at < http://www.regie-energie.qc.ca/audiences/Suivis/Suivi-R-3644-2007-ProcedurePGEE/HQD_RapportEvaluationPGEE_Electro_02fev2012.pdf >

Water-heating Electricity per Load

The percentage of hot water produced with electricity was then determined. First, the percentage of the washing machines with their own electrical resistance to heat water was obtained from the ENERGY STAR database for the five most popular models sold through Instant Savings in 2013. This same percentage was applied to standard clothes washers, because the information was not available for standard washers. For washing machines with an internal heater, it is assumed that 100 percent of the water-heating is done with electricity. For clothes washers using a DHW tank as their heating source, the proportion of electric DHW tanks (as obtained from the Instant Savings tracking sheet) was used to calculate the overall proportion of electricity-heated water. This value is 37 percent (14 percent of internal electric heater + 23 percent of electric DHW tanks), as shown in the table below.

Table 17: Water-heating Sources for Clothes Washers²¹

Source of Hot Water for Clothes Washers	Clothes Washer Water-heating	DHW Tank Type	Proportion	Clothes Washer Energy Source
Internal Electric Heater	14%	-	-	14%
DHW Tank	86%	Electric	27%	23%
		Non-electric	73%	63%

By multiplying this ratio of 37 percent by the total energy use for water-heating per laundry load (0.51 kWh), the electricity use for water-heating per laundry load has been established at 0.19 kWh.

Adjustment for the Age of Clothes Washers

Because the MEF and capacity were first extracted from currently available data on new clothes washers in 2013, an adjustment had to be made to account for the increased energy efficiency of clothes washers over time. To do so, the average water-usage data was obtained from Natural Resources Canada²² for each year in the period of 2005 through 2010 (the last year with available data), as shown in the table below.

Table 18: Average Water Usage of Clothes Washers per Year of Purchase

	2005	2006	2007	2008	2009	2010
Liters per cycle	1.45	1.25	1.16	1.14	1.09	0.82

²¹ Natural Resources Canada, *Comprehensive Energy Use Database: Residential Sector – Nova Scotia – Table 10: Water Heating Secondary Energy Use and GHG Emissions by Energy Source*,

<<http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=10&page=4&CFID=31970021&CFTOKEN=fed6e0b3f51f8fc8-C05E90B0-B973-A582-25DA340381F0B679>> (Last accessed December 3, 2014)

²² Natural Resources Canada, *Energy Consumption of Major Household Appliances Shipped in Canada, Trends for 1990-2010*, <<http://www.nrcan.gc.ca/sites/oe.nrcan.gc.ca/files/pdf/publications/statistics/cama12/cama12.pdf>> (Last accessed December 3, 2014)

Based on the values in Table 18, the average increase of water consumption per additional year of clothes washer use has been established at 12 percent. The survey conducted with RDI Community Based Social Marketing (CBSM) Pilot participants showed that these participants' clothes washers were seven years old on average; therefore, the volume of water used by these washers has been estimated to be 2.2 times that of clothes washers purchased in 2013. Since water-heating energy use is directly proportional to the amount of water used by the washer, by multiplying the electricity use per load value (0.19 kWh) by this factor (2.2 times), the average water-heating energy use for old washers is estimated at 0.42 kWh/load.

Unitary Savings Value

As previously discussed, CBSM Pilot participants achieved an average warm-water-usage reduction of 9 percent in comparison to the control group. This reduction percentage, multiplied by the water heating electricity use per load, the average number of laundry loads/week and the number of weeks/year, results in an annual unitary savings value of 8.6 kWh/participant, as represented in the following equation:

$$\text{Annual unitary savings} = 0.42 \frac{\text{kWh}}{\text{load}} \times 9\% \times \frac{4.4 \text{ loads}}{\text{week}} \times 52 \frac{\text{weeks}}{\text{year}} = 8.6 \text{ kWh/year}$$

The survey showed that 178 participants implemented this tip, which translates into an implementation ratio of 52.4 percent.

6.1.7 Hang Laundry to Dry

To calculate the unitary savings value associated with this behaviour, the energy consumption of the clothes dryer was estimated for each laundry load.

Using the results of the 2014 annual survey for RDI, the average age of clothes washers was established at seven years. The Evaluator considers that a similar average age can be assumed for clothes dryers, since both types of appliances are normally purchased at the same time. Therefore, the average annual energy consumption value of the clothes dryer made in 2007 was used, namely 912 kWh/year (based on 416 operations per year).²³ This has resulted in a unitary energy consumption value of 2.214 kWh/load.

²³ Natural Resources Canada, *Energy Consumption of Major Household Appliances Shipped in Canada, Summary Report, Trends for 1900-2007*, December 2009, p. 43.

Survey participants were asked to specify the number of laundry loads their household did per week and the number of laundry loads that were hung to dry in a typical week prior to their signing up online for the HER and after their sign-up. The survey results showed that participants increased their loads hung to dry by 0.5 load on average. Therefore, the following equations were used to calculate the unitary savings value associated with the 0.5 increased hang-to-dry laundry load per week.

$$\text{Clothes dryer consumption per load} = \frac{912 \frac{\text{kWh}}{\text{year}}}{416 \frac{\text{loads}}{\text{year}}} = 2.214 \frac{\text{kWh}}{\text{load}}$$

$$\text{Unitary savings value} = 2.214 \frac{\text{kWh}}{\text{load}} \times 21 \frac{\text{loads}}{\text{year}} = 46.5 \frac{\text{kWh}}{\text{year}}$$

The Evaluator accounted for the proportion of electric clothes dryers in Nova Scotia to calculate electricity savings. Based on data from 2011, there were fewer than 100 natural gas clothes dryers in Nova Scotia, in contrast to over 322,000 electric clothes dryers²⁴. Therefore, it was considered that 100 percent of the savings were in electricity.

The survey showed that 157 participants implemented this tip, which translates into an implementation ratio of 46.2 percent.

6.2 Gross Savings

This section presents the gross savings associated with HER's web-based component.

Gross Energy Savings

The annual gross savings for each category of products installed through the program are presented in Table 19 for 2013 and in Table 20 for 2014. They were calculated using the number of unique visitors to the web portal (paper-based participants who also connected to the web portal were removed to ensure that savings were not double counted), the revised unitary savings values and the implementation ratios presented in the previous sections. Overall, the total gross energy savings amounted to 0.444 GWh at the meter.

The gross savings at the generator are also estimated in the following tables, using a line loss factor of 1.100 between the meter and the generator. This value was provided by Nova Scotia Power for residential customers. As a result, the gross energy savings at the generator have been established at 0.488 GWh.

²⁴ Natural Resources Canada, *Comprehensive Energy Use Database: Residential Sector – Nova Scotia – Table 31: Appliance Stock by Appliance Type and Energy Source*, <
<http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=31&page=4&CFID=34383841&CFTOKEN=79ae388119c57de9-F668F1E3-B327-DE62-173697CB9049C418>> (Last accessed December 3, 2014)

Table 19: Web-based Component Evaluation Results for 2013 – Total Gross Energy Savings

Category of Product	Energy-efficient Dishwasher	Energy-efficient Room Air-conditioner	Insulate Windows with Heat-shrink Film	Reducing Shower Time	Turn off the Computer at Night	Wash Clothes with Cold Water	Hang Laundry to Dry	Total
Tracking Sheet								
Number of Participants	2,739							
Evaluated Energy Savings								
Implementation Ratio	0.094	0.047	0.074	0.397	0.235	0.524	0.462	-
Unitary Savings Value (kWh)	38.00	80.00	74.20	117.00	1.75	8.60	46.50	-
Total Gross Energy Savings – at Meter (GWh)	0.010	0.010	0.015	0.127	0.001	0.012	0.059	0.235
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Gross Energy Savings – at Generator (GWh)	0.011	0.011	0.017	0.140	0.001	0.014	0.065	0.258

Table 20: Web-based Component Evaluation Results for 2014 – Total Gross Energy Savings

Category of Product	Energy-efficient Dishwasher	Energy-efficient Room Air-conditioner	Insulate Windows with Heat-shrink Film	Reducing Shower Time	Turn off the Computer at Night	Wash Clothes with Cold Water	Hang Laundry to Dry	Total
Tracking Sheet								
Number of Participants	2,441							
Evaluated Energy Savings								
Implementation Ratio	0.094	0.047	0.074	0.397	0.235	0.524	0.462	-
Unitary Savings Value (kWh)	38.00	80.00	74.20	117.00	1.75	8.60	46.50	-
Total Gross Energy Savings – at Meter (GWh)	0.009	0.009	0.013	0.113	0.001	0.011	0.052	0.209
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	-
Total Gross Energy Savings – at Generator (GWh)	0.010	0.010	0.015	0.125	0.001	0.012	0.058	0.230

Gross Peak Demand Savings

Some of the tips selected to calculate energy savings might have also achieved a certain level of peak demand savings. However, additional information is required to estimate the demand savings attributable to each tip that contributed to reducing the peak demand on the electricity distribution system. Other ENSC components use an on-peak demand-to-energy ratio, which was calculated by Navigant from the modelled savings of specific measures involved in the 2013-2015 DSM Plan. Unfortunately, the HER component was not included in the DSM Plan. Since the set of measures used by HER were only applied to this component, it is not possible to use the on-peak demand-to-energy ratio of another program. Given that the impact of the web-based component is small, the Evaluator has decided that no peak demand savings are attributed to this component for 2014.

6.3 Net-to-gross Ratio

This section discusses HER web-based component's NTGR evaluation, which included the assessment of the free-ridership level associated with each product category.

6.3.1 Free-ridership

In HER's web-based component, free-ridership occurs when participants declare that they would still have implemented the energy-efficient measures in the absence of the program. The free-ridership level of each product category was assessed through a survey of web-based participants using questions designed to determine the level of influence that HER had on participants' decisions by trying to measure the following variables:

- › The probability that participants would still have adopted the same energy efficiency behavior if they had not visited the HER web portal.
- › The level of influence that the online home energy report had on the participants' decisions to adopt this behavior.

The responses to each question were then converted into a level of program attribution, which was used to calculate the overall free-ridership level of each product category.

6.3.2 NTGR Calculation

The NTGR value of each product category has been established by applying its free-ridership level established and the following equation:

$$NTGR = (1 - \% \text{ free-ridership})$$

The table below summarizes the results of these calculations.

Table 21: Net-to-gross Ratios

Product Category	Free-Ridership	NTGR
Energy-efficiency Dishwasher	73%	27%
Energy-efficiency Room Air-conditioner	54%	46%
Insulate Windows with Heat-shrink Film	83%	17%
Reducing Shower Time	41%	59%
Turn off the Computer at Night	51%	49%
Wash Clothes with Cold Water	82%	18%
Hang Laundry to Dry	75%	25%

6.4 Net Savings

The net energy savings were estimated by applying the NTGR to the gross energy savings value in the following equation.

$$\text{Net Energy Savings} = \text{Gross Energy Savings} \times \text{NTGR}$$

Since each product category's NTGR was different, the net energy savings were calculated separately for each of them. The tables below summarize the results of these calculations.

Overall, the total net energy savings amounted to 0.194 GWh at the meter and 0.213 GWh at the generator.

Table 22: Web-based Component Evaluation Results for 2013 – Total Net Energy Savings

Product Category	Energy-efficient Dishwasher	Energy-efficient Room Air-conditioner	Insulate Windows with Heat-shrink Film	Reducing Shower Time	Turn off the Computer at Night	Wash Clothes with Cold Water	Hang laundry to dry	Total
Energy Savings								
Gross Energy Savings – at Meter (GWh)	0.010	0.010	0.015	0.127	0.001	0.012	0.059	0.235
NTGR	27%	46%	17%	59%	49%	18%	25%	-
Net Energy Savings – at Meter (GWh)	0.003	0.005	0.003	0.075	0.001	0.002	0.015	0.102
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Net Energy Savings – at Generator (GWh)	0.003	0.005	0.003	0.083	0.001	0.002	0.016	0.113

Table 23: Web-based Component Evaluation Results for 2014 – Total Net Energy Savings

Product Category	Energy-efficient Dishwasher	Energy-efficient Room Air-conditioner	Insulate Windows with Heat-shrink Film	Reducing Shower Time	Turn off the Computer at Night	Wash Clothes with Cold Water	Hang laundry to dry	Total
Energy Savings								
Gross Energy Savings – at Meter (GWh)	0.009	0.009	0.013	0.113	0.001	0.011	0.052	0.209
NTGR	27%	46%	17%	59%	49%	18%	25%	-
Net Energy Savings – at Meter (GWh)	0.002	0.004	0.002	0.067	0.000	0.002	0.013	0.091
Line Loss Factor	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100
Net Energy Savings – at Generator (GWh)	0.003	0.005	0.003	0.074	0.001	0.002	0.014	0.100

7 OVERALL HER RESULTS

This section summarizes the overall results of the impact evaluation of HER. With the net savings achieved by both the paper-based and web-based components combined, the total energy savings amounted to 34.711 GWh, and the peak demand savings amounted to 3.938 MW. The table below presents the total net savings established by the impact evaluation of HER.

Table 24: Total Evaluated Savings at the Generator for HER

	Net Savings		
	2013	2014	Total
Energy Savings			
Paper-based Participants (GWh)	9.162	25.336	34.498
Web-based Participants (GWh)	0.113	0.100	0.213
Total	9.275	25.437	34.711
Peak Demand Savings			
Report-based Participants (MW)	1.046	2.892	3.938

CONCLUSION

Launched in 2013, HER is an innovative program intended to promote behavioural changes towards greater energy efficiency. Since its inception, a total of 93,119 participants have taken part in the paper-based component of HER, and 10,662 participants in the web-based component. The 2014 evaluation revealed that three-quarters of the web-based participants recalled signing up for HER, and that the majority of them were satisfied with the program and the report they received. The Evaluator did review a sample report and was satisfied with its overall quality and content.

The 2014 evaluation of HER also demonstrated that the paper-based component seemed to be achieving the expected results in terms of changing participants' electricity consumption behaviour. The impact of the web-based component, however, has been more difficult to evaluate and the Evaluator has not been able to establish any significant level of savings associated with this component.

Participants in the web-based component of HER generally provided low ratings when asked about the influence that HER had on their adoption of energy-efficient behaviours, such as purchasing energy-efficient appliances, reducing their shower time, turning off their computers at night, hanging their laundry to dry, installing heat-shrink film and washing clothes in cold water. The majority of respondents mentioned that it would have been likely for them to adopt these energy-efficient behaviours without HER. That said, when comparing their specific behaviours prior to and after their participation in HER, it was found that there had been changes in their behaviours following their participation in HER. For example, the average participant hung their laundry to dry more often, did more loads of laundry in cold water, turned off their computers at night more often and reduced their shower time.

The evaluation revealed that the HER paper-based component generated net energy savings of 34.498 GWh and the web-based component generated net savings of 0.291 GWh; in total, HER has generated 34.789 GWh in net savings since its inception in 2013. To calculate the net savings of HER, the Econoler team first reviewed the methodology used by Opower for calculating the paper-based component savings. In addition, Econoler defined the unitary savings values for seven specific tips recommended to participants by the web-based component. The participant survey was used to estimate the number of participants who had implemented the identified tips and they were asked questions to determine the level of influence that HER had on the participant's decision to implement the seven tips recommended. The energy savings achieved by these two components are considered net savings, since they have already included the program's influence on the participant's decision, by using a control group comparison for the paper-based component and a self-declared approach for the web-based component.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix summarizes all the recommendations made by the Evaluator throughout this report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Explain in greater detail the characteristics of HER in the program documentation. Designed to influence and change participants' electricity use behaviour, HER is different from other program components undertaken by ENSC. The specific and particular challenges and characteristics of this component should be clearly made known to program staff and the Evaluator. The program manual and the evaluation plan should be used to document and present all this information. Therefore, the Evaluator recommends that the program manual and the evaluation plan explain in greater detail the following elements of HER: › The number of selected participants. The program manual explains how participating households were selected, but the number does not correspond to the number of those finally selected by Opower. › The process for selecting the tips recommended to participants. › All the program documents available or developed when designing HER. It is of crucial importance that Opower help develop a comprehensive evaluation plan by listing all the data available, including methodologies, databases, and any data-collection tools available or program documents so that the Evaluator knows how to evaluate the program and what other data to be collected.
	2 Review the raw and treated databases from Opower. Some confidentiality issues could not be solved within the evaluation timeframe and it was impossible for the Evaluator to review the raw data that Opower received and the treated data upon which it had applied the adjustments. For this evaluation, the Evaluator reviewed the adjustment methodology provided by Opower and considered the logic underlying this methodology to be sound. However, it is recommended that both databases be reviewed to validate whether the adjustments were applied as defined in the methodology. This review should be conducted in the next evaluation now that the confidentiality issues have been solved.
	3 Conduct a billing analysis to compare the pre-participation electricity consumption of the treatment and control groups. Socio-demographic data were analyzed and statistical tests were conducted to validate whether the control group selected was comparable to the treatment group (participants). An additional interesting test could be to analyze past electricity consumption from both groups. This analysis would help determine whether the savings observed through the billing analysis are attributable to HER and not to any other trend that could be observed with the treatment group, but not with the control group. An analysis of the electricity consumption trend for a five-year period should be conducted as part of the next evaluation.

Sections	Recommendations
Program Documentation	4 The program manual mentions that Opower follows a set of criteria when creating both the treatment and the control groups. The Evaluator recommends that ENSC consider adding the age of the home to this set of criteria to indicate the particular building code according to which a house was built.
	5 The latest version of the tip library has 92 pages. To allow for easier navigation throughout the tip library, the Evaluator suggests creating and placing an index at the beginning of the library to group similar tips under a number of more general topic areas, thereby making it easier for the reader to locate particular groups of tips in the library. For instance, several tips regarding heating, lighting, and hot water can be grouped under the topic area of “electricity end-use”. To better organize the tip library, another option is to divide the tips into two categories: behavioural change and resource acquisition.

APPENDIX II

PARTICIPANT SURVEY QUESTIONNAIRE

Hello may I please speak with [INSERT NAME]?

1. Yes [GOTO INTRODUCTION]
2. No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

I2. Hello, my name is _____ and I am with CRA (Corporate Research Associates), and we are performing a study on energy efficiency behaviours among households in Nova Scotia for Efficiency Nova Scotia Corporation (ENSC). We would appreciate your collaboration in answering questions related to your household's energy usage patterns and consumption. The information you provide will be used to help Efficiency Nova Scotia improve its energy efficiency services. The survey will take about fifteen minutes. Is this a good time for you?

1. Yes [CONTINUE]
2. No, I am not the person best suited to answer questions on my household's energy usage patterns and consumption [PROMPT: "Is there someone else in the household who would know about your home's energy usage patterns and consumption?"]
3. Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]

No [THANK & TERMINATE]

99. Refused [THANK AND TERMINATE]

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"

[SCHEDULED, IF NECESSARY, FOR: _____]

Behaviour Changes (Series B)

[ASK ALL PARTICIPANTS]

- B1. In the last 12 months, did you or someone else in your household purchase one or more energy-efficient appliances for your home?
1. Yes
 2. No [GO TO B5]
 8. (Don't Know) [GO TO B5]
 9. (Refused) [GO TO B5]

- B2. I am going to read you a list of energy-efficient appliances that your household may have purchased. For each one, can you please tell me if you or someone else from your household purchased it in the last 12 months [1=YES, PURCHASED, 2=NO, NOT PURCHASED, 8=DON'T KNOW, 9=REFUSED]?
- Energy-efficient refrigerator
 - Energy-efficient clothes washer
 - Energy-efficient dishwasher
 - Energy-efficient freezer
 - Energy-efficient room air conditioner
 - Any other energy-efficient appliance? SPECIFY: _____
- B3. [ASK IF B2a-e = YES] How many [INSERT ANSWER B2a-e] did you purchase in the last 12 months? [RECORD NUMBER. PROBE FOR SPECIFIC ANSWER. 98=DON'T KNOW, 99=REFUSED]
- B4. In the last 12 months, have you taken any steps to reduce your home energy use?
- Yes
 - No [GO TO H1]
 - (Don't Know) [GO TO H1]
 - (Refused) [GO TO H1]
- B5. I am going to read you a list of energy-efficient behaviours that your household may have adopted. For each one, can you please tell me if your household has adopted it in the last 12 months [1=YES, 2=NO, 3=I WAS ALREADY DOING THAT, 8=DON'T KNOW, 9=REFUSED]?
- Insulate your windows with heat-shrink film
 - Hang laundry to dry
 - Wash clothes in cold water
 - Turn off your computer at night
 - Reduce shower time
 - Reduce your refrigerator's temperature set point
 - Turn off lights when not needed
 - Adjust the display of your television by reducing the brightness and contrast
 - Turn off your water heater when you're away
 - Use a ceiling fan rather than air conditioning
 - Use a home power monitor to have real-time feedback on your electricity consumption

[NOTE TO INTERVIEWERS – READ IF NECESSARY IN B5a: A heat-shrink film is a transparent plastic film that you stick to your window frame inside your house and that you heat with a hair dryer to stretch it and remove creases.]

Home Energy Report (Series H)

[ASK ALL PARTICIPANTS]

- H1. Do you recall having signed up on the Efficiency Nova Scotia website to have access to an online report which compares your household's electricity usage to similar homes, illustrates energy usage patterns and provides you with energy efficiency tips to help you reduce your energy consumption?
1. Yes
 2. No [GO TO DEMOGRAPHICS]
 8. (Don't Know) [GO TO DEMOGRAPHICS]
 9. (Refused) [GO TO DEMOGRAPHICS]
- H2. Thinking of this online report, in general, what have you done with it? Did you... [ACCEPT ONE RESPONSE]
1. Read the website content thoroughly
 2. Read some of the website's content
 3. Skim some of the website's content
 4. Glance at the pictures, graphs, or headlines
 6. (Other) [SPECIFY _____]
 8. (Don't know)
 9. (Refused)

For the purpose of the survey, when referring to this online report, I will call it the Home Energy Report.

Program Participation (Series P)

- P1. What was the SINGLE most important reason you decided to sign up online for your Home Energy Report? [ACCEPT ONE RESPONSE] [DO NOT READ]
1. (To save on energy/to save on energy costs)
 2. (Comfort)
 3. (To help the environment)
 4. (Reduce greenhouse gases)
 5. (To reduce my water consumption)
 6. (To find out/improve my home energy rank compared to other similar houses)
 7. (To get Air Miles)
 96. (Other) [SPECIFY _____]
 98. (Don't know) [GO TO P3]
 99. (Refused) [GO TO P3]
- P2. Were there any other reasons? [DO NOT READ. ACCEPT MULTIPLE. SAME LIST AS P1]

- P3. Before signing up for the Home Energy Report, had you participated in any of Efficiency Nova Scotia's energy efficiency programs?
1. Yes
 2. No
 8. (Don't know)
 9. (Refused)
- P4. [ASK IF P3=YES] Which Efficiency Nova Scotia programs did you participate in before the Home Energy Report? [RECORD VERBATIM ANSWER. ALLOW MULTIPLE. 98=DON'T KNOW, 99=REFUSED]

Tips (Series B)

Questions on Tips: Buy Energy-efficient Appliances

[ASK BF1 TO BF4 SERIES IF PURCHASED ENERGY-EFFICIENT DISHWASHER (B2c=YES) OR ENERGY-EFFICIENT ROOM AIR CONDITIONER (B2e=YES); ASK TWICE IF PURCHASED BOTH; OTHERWISE SKIP TO BW1.]

We now have a few questions about your decision to purchase an energy efficient appliance in the last 12 months.

- BF1. What makes you think the [dishwasher/ the room air conditioner] unit(s) you purchased in the last 12 months is/are energy-efficient? [DO NOT READ. ACCEPT MULTIPLE]
1. (The Energy Star symbol on the appliance)
 2. (The store salesperson told me it was energy-efficient)
 3. (The EnerGuide label on the appliance/energy consumption on the EnerGuide label)
 6. (Other) [SPECIFY_____]
 8. (Don't know)
 9. (Refused)
- BF2. [ASK IF BF1≠1] Was this [dishwasher/room air conditioner] an Energy Star model?
1. Yes
 2. No
 8. (Don't Know)
 9. (Refused)

BF3. How influential was your Home Energy Report on your decision to purchase this [energy-efficient dishwasher/energy-efficient room air conditioner]? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your purchase decision' and 10 indicates that the Home Energy Report was 'extremely influential on your purchase decision'. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

BF4. How likely would you have been to purchase a new [energy-efficient dishwasher/energy-efficient room air conditioner] without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not purchased this appliance anyway? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
8. (Don't know)
9. (Refused)

Questions on Tip: Insulate your Windows with Heat-Shrink Film [ASK IF B5a=YES]

We now have a few questions about your decision to install heat-shrink film in the last 12 months.

BW1. How influential was your Home Energy Report on your decision to insulate your windows with heat-shrink film? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

BW2. How likely would you have been to insulate your windows with heat-shrink film without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not insulated your windows with heat-shrink film anyway? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
8. (Don't know)
9. (Refused)

BW3. On what type of window did you mostly install heat-shrink film? [READ. CODE ONLY ONE]

1. Sliding windows
2. Awning windows
3. Casement windows
4. Hopper windows
5. Single- or double-hung windows
8. (Don't know)
9. (Refused)

BW4. On how many windows did you install heat-shrink film? [RECORD ANSWER. PROBE FOR A SPECIFIC ANSWER. 98=DON'T KNOW, 99=REFUSED]

BW5. Do you plan on installing heat-shrink film on your windows again this winter? [CODE ONLY ONE]

1. Yes
2. No
8. (Don't Know)
9. (Refused)

Questions on Tip: Hang Laundry to Dry [ASK IF B5b=YES]

We now have a few questions about your decision to hang laundry to dry in the last 12 months.

BL1. How influential was your Home Energy Report on your decision to hang your laundry to dry? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

BL2. How likely would you have been to hang your laundry to dry without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not hung your laundry to dry anyway? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
8. (Don't know)
9. (Refused)

BL3. What do you use to hang your laundry to dry? [ACCEPT MULTIPLE RESPONSES] [READ]

1. Indoor drying racks / hangers
2. Outdoor clothesline
3. Outdoor drying racks, or
6. Something else [SPECIFY _____]
8. (Don't know)
9. (Refused)

BL4. [ASK IF BL3=2 OR 3, ASK TWICE IF REQUIRED] Did you purchase this [insert response from BL3] in the past 12 months?

1. Yes
2. No
8. (Don't Know)
9. (Refused)

BL5. [ASK IF BL4=YES, ASK TWICE IF REQUIRED] Did you obtain a discount on this [**INSERT RESPONSE FROM BL3**], or obtained it/them for free under Efficiency Nova Scotia's Instant Savings program? This program offered instant discounts at the cash register for the purchase of clothes lines and outdoor drying racks in the fall of 2013 and the spring of 2014.

1. Yes, got a discount or it for free
2. No,
8. (Don't Know)
9. (Refused)

BL6. Thinking about a typical week, approximately how many loads of clothes washing does your household do per week? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

- ___ Response
- ___ 97 (I don't own a washing machine) [GO TO BV1]
- ___ 98 (Don't Know) [GO TO BL9]
- ___ 99 (Refused) [GO TO BL9]

BL7a. [ASK IF ANSWER TO BL6 > 0] Thinking of those [ANSWER TO BL6] loads, approximately how many were hung to dry in a typical week in the spring and summer period prior to you signing up online for your Home Energy Report? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

- ___ Response ___ 98 Don't Know ___ 99 Refused

BL7b. [ASK IF ANSWER TO BL6 > 0] Thinking of those [ANSWER TO BL6] loads, approximately how many were hung to dry **in the fall and winter period** prior to you signing up online for your Home Energy Report? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

___ Response ___ 98 Don't Know ___ 99 Refused

BL8a. [ASK IF ANSWER TO BL6 > 0] Thinking of those [ANSWER TO BL6] loads, approximately how many are hung to dry **in the spring and summer period**, after you had signed up online for your Home Energy Report? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

___ Response ___ 97 Non applicable ___ 98 Don't Know ___ 99 Refused

BL8b. [ASK IF ANSWER TO BL6 > 0] Thinking of those [ANSWER TO BL6] loads, approximately how many are hung to dry **in the fall and winter period**, after you had signed up online for your Home Energy Report? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

___ Response ___ 97 Non applicable ___ 98 Don't Know ___ 99 Refused

BL9. Do you own a clothes dryer?

1. Yes
2. No
8. (Don't Know)
9. (Refused)

BL10. [ASK IF BL9 = 1] Is it an electric or gas clothes dryer? [CODE ONE ONLY]

1. Electric
2. Gas
8. (Don't Know)
9. (Refused)

BL11. [ASK IF BL9=2] Did you own a clothes dryer before signing up for your online Home Energy Report? [DO NOT READ. ACCEPT ONLY ONE, PROBE FOR SPECIFIC NO RESPONSE]

1. Yes
2. No, but I was using the clothes dryer of a Laundromat or of my building laundry room
3. No, but I was using someone else's clothes dryer
4. No
8. (Don't Know)
9. (Refused)

Questions on Tip: Wash Clothes in Cold Water [ASK IF B5c=YES]

BV1. In the last 12 months, did you participate in Efficiency Nova Scotia's Residential Direct Install program? As part of this program, someone would have come to your house and installed new lighting or domestic water heating energy efficiency products, such as compact fluorescent light bulbs (CFLs) and faucet aerators, at no charge.

1. Yes [GO TO BC1]
2. No
8. (Don't know) [GO TO BC1]
9. (Refused) [GO TO BC1]

BV3. How influential was your Home Energy Report on your decision to wash your clothes in cold water? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

BV4. How likely would you have been to wash your clothes in cold water without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not washed your clothes in cold water anyway? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
8. (Don't know)
9. (Refused)

BV5. [DO NOT ASK IF ALREADY PROVIDED A RESPONSE TO BL6] Thinking about a typical week, approximately how many loads of clothes washing does your household do per week? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

___ Response
___ 97 (I don't own a washing machine) [GO TO BC1]
___ 98 (Don't Know) [GO TO BC1]
___ 99 (Refused) [GO TO BC1]

BV6. [ASK IF ANSWER TO BL6 OR BV5 > 0] Thinking of the [ANSWER TO BL6 OR BV5] loads of clothes washing your household does in a typical week, approximately how many were washed in cold water prior to you signing up online for your Home Energy Report? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

___ Response ___ 98 Don't Know ___ 99 Refused

BV7. [ASK IF ANSWER TO BL6 OR BV5 > 0] Thinking of the [ANSWER TO BL7 OR BV6] loads of clothes washing your household does in a typical week, approximately how many are washed in cold water, now that you have signed up online for your Home Energy Report? [RECORD NUMBER, PROBE FOR SPECIFIC ANSWER]

___ Response ___ 98 Don't Know ___ 99 Refused

Questions on Tip: Turn Off Computer at Night [ASK IF B5d=YES]

We now have a few questions about your decision to turn off your computer at night in the last 12 months

BC1. How influential was your Home Energy Report on your decision to turn off your computer at night? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

BC2. How likely would you have been to turn off your computer at night without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not turned off your computer at night anyway? [CODE ONE ONLY]

1. Definitely
2. Probably
3. Probably not
4. Definitely not
8. (Don't know)
9. (Refused)

BC3. Prior to signing up online for your Home Energy Report, how many times a week did you used to turn off your computer at night? [RECORD NUMBER 0-7. PROBE FOR SPECIFIC ANSWER. 8=DON'T KNOW, 9=REFUSED]

BC4. Now that you have signed up online for your Home Energy Report, how many times a week do you turn off your computer at night? [RECORD NUMBER 0-7. PROBE FOR SPECIFIC ANSWER. 8=DON'T KNOW, 9=REFUSED]

BC5. What types of computers do you turn off at night? [READ CHOICES. ACCEPT MULTIPLE]

1. Desktop computer
2. Laptop computer
7. (Other, specify: _____)
8. (Don't Know)
9. (Refused)

BC6. Is the power-saving mode on this computer active? [CODE ONLY ONE]

- 1. Yes
- 2. No
- 8. (Don't Know)
- 9. (Refused)

BC7. [ASK IF YES IN BC6] How many minutes does it take for your computer to go into power-saving mode? [RECORD NUMBER OF MINUTES. PROBE FOR SPECIFIC ANSWER. 98=DON'T KNOW, 99=REFUSED]

Questions on Tip: Reduce Shower Time [ASK IF B5e=YES]

We now have a few questions about your decision to reduce your shower time in the last 12 months.

BS1. How influential was your Home Energy Report on your decision to reduce your shower time? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'. [PROBE TO AVOID ACCEPTING A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

BS2. How likely would you have been to reduce your shower time without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not reduced your shower time anyway? [CODE ONE ONLY]

- 1. Definitely
- 2. Probably
- 3. Probably not
- 4. Definitely not
- 8. (Don't know)
- 9. (Refused)

BS3. Prior to signing up online for your Home Energy Report, what was your typical shower time in minutes, approximately? [RECORD NUMBER OF MINUTES. PROBE FOR SPECIFIC ANSWER, 98=DON'T KNOW, 99=REFUSED]

BS4. Now that you have signed up online for your Home Energy Report, what is your current typical shower time in minutes, approximately? [RECORD NUMBER OF MINUTES. PROBE FOR SPECIFIC ANSWER, 98=DON'T KNOW, 99=REFUSED]

Satisfaction with the Program (Series CS)

Moving along to another topic... The following questions will be about your participation in the Home Energy Report. The Home Energy Report refers to the online report that illustrates your household's energy usage patterns and provides you with energy efficiency tips to help you reduce your energy consumption.

CS1. How did you first learn about the Home Energy Report? **[DON'T READ; ALLOW MULTIPLE RESPONSE BUT DO NOT PROBE FOR MULTIPLE]**

1. Media advertising
2. Contacted directly by Efficiency Nova Scotia
3. Through a third party contractor or service provider
4. Efficiency Nova Scotia website
5. Facebook or other social media
6. Word of mouth
7. (Refused)
8. (Don't know)
9. (Other: SPECIFY_____)

S1. Overall, how satisfied are you with the Home Energy Report? Are you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with it? **[CODE ONLY ONE]**

1. Completely satisfied
2. Mostly satisfied
3. Mostly dissatisfied
4. Completely dissatisfied
7. (Neither satisfied nor dissatisfied)
8. (Don't know)
9. (Refused)

S2. **[IF DISSATISFIED—S1=3 or 4]** You indicated being dissatisfied with the Home Energy Report overall. For what reasons were you not satisfied with the Home Energy Report overall? Probe: Any other reasons? **[DO NOT READ. PROBE FOR SPECIFIC REASONS. ACCEPT MULTIPLE]**

1. (I expected more)
2. (My energy consumption did not decrease after following the tips)
3. (I did not think the tips were relevant for my home/did not like the tips)
4. (The online report was not easy to read/understand)
5. (I experienced difficulty creating my online account)
96. (Other) [SPECIFY _____]
98. (Don't know)
99. (Refused)

S3. Now I'm going to ask you about your experience with specific aspects of the Home Energy Report. For each one, please tell me if you are completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with that specific aspect. [CODE ONE ONLY PER ASPECT]

- a. The appearance of the report
- b. The clarity of the report
- c. The usefulness of the tips provided
- d. The ease to create and update your online account

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 7. (Neither satisfied nor dissatisfied)
- 8. (Don't know)
- 9. (Refused)

S4. [ASK IF S3c=3 or 4] You mentioned being dissatisfied with the usefulness of the tips provided in your Home Energy Report. In your opinion, what could be done to improve this aspect? [98 = Don't know, 99 = Refused] [RECORD ANSWER]

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

- 1. Yes
- 2. No
- 8. (Don't know)
- 9. (Refused)

IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO CS27.

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 7. (Neither satisfied nor dissatisfied)
- 8. (Don't know)
- 9. (Refused)

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's... **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**

- a. Service attitude
 - b. Knowledge of programs available
 - c. Ability to provide advice
-
- 1. Completely satisfied
 - 2. Mostly satisfied
 - 3. Mostly dissatisfied
 - 4. Completely dissatisfied
 - 7. (Neither satisfied nor dissatisfied)
 - 8. (Don't know)
 - 9. (Refused)

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others? **[CODE ONE ONLY]**

- 1. Definitely
- 2. Probably
- 3. Probably not
- 4. Definitely not
- 7. (Not eligible to any other programs)
- 8. (Don't know)
- 9. (Refused)

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified? Would you definitely, probably, probably not, or definitely not participate in other programs? **[CODE ONE ONLY]**

- 1. Definitely
- 2. Probably
- 3. Probably not
- 4. Definitely not
- 8. (Don't know)
- 9. (Refused)

Recommendations (Series R)

[ASK ALL RESPONDENTS]

R1. Do you have any recommendations that you think would help improve the Home Energy Report? PROBE: Anything else? **[DO NOT READ, ACCEPT MULTIPLE]**

1. (Improve the appearance of the report)
2. (Improve the content of the report/Provide more relevant tips)
3. (Make the report clearer)
4. (No recommendation)
6. (Other [SPECIFY _____])

Demographic Characteristics (Series D)

[ASK ALL RESPONDENTS]

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

D1. What type of residence do you live in? [READ RESPONSES 1-7, THEN 96; SELECT ONE RESPONSE]

1. Apartment building that has fewer than five stories
2. Apartment building that has five to twenty stories
3. Row house (Single story apartment building)
4. Detached single-family home
5. Semi-detached house
6. Mobile home or house trailer
7. Townhouse or duplex with shared adjacent walls
96. Or some other type [SPECIFY: _____]
98. (Don't know)
99. (Refused)

D2. Do you own or rent this home?

1. Own/buying
2. Rent/lease
3. Other (Describe) _____
99. (Refused)

D3. Do you pay the electric bills for your home?

- 1. Yes
- 2. No
- 96. (Other) [Specify_____]
- 98. (Don't Know)
- 99. (Refused)

D4. Including yourself, how many people live in this residence on a full-time basis?

Number of people: _____ [NOTE: DON'T ALLOW ZERO FOR A RESPONSE]

- 99. (Refused)

D5. What is your age group? Are you: [READ]

- 1. 18 to 24
- 2. 25 to 34
- 3. 35 to 44
- 4. 45 to 54
- 5. 55 to 64
- 6. 65 or over
- 99. (Refused)

D6. What is the highest grade of schooling completed by the head of your household? [READ IF NECESSARY]

- 1. (Less than high school graduation diploma)
- 2. (High school graduation diploma and/or some post secondary)
- 3. (Trades certificate or diploma)
- 4. (College certificate or diploma)
- 5. (University degree, certificate or diploma)
- 97. Other (SPECIFY: _____)
- 98. (Don't know)
- 99. (Refused)

D7. Which of the following income categories best describes your total annual household income before taxes in 2013? Stop me when I reach the right category. [READ LIST; SELECT ONE RESPONSE]

- 1. Less than \$15,000
- 2. \$15,000 - \$24,999
- 3. \$25,000 - \$34,999

- 4. \$35,000 - \$49,999
- 5. \$50,000 - \$69,999
- 6. \$70,000 - \$79,999
- 8. \$80,000 or more
- 98. (Don't know)
- 99. (Refused)

D8. [DO NOT READ] Gender:

- 1. Male
- 2. Female

END: THAT IS ALL THE QUESTIONS I HAVE FOR YOU. THANK YOU FOR TAKING THE TIME TO RESPOND TO THIS SURVEY.

APPENDIX III PARTICIPANT SURVEY RESULTS

The participant survey results are presented in the following tables.

B1. In the last 12 months, did you or someone else in your household purchase one or more energy-efficient appliances for your home?

Purchased an Energy Efficient Appliance	2014
<i>Sample Size</i>	<i>340</i>
Yes	38%
No	61%
Don't know/Refused	1%

B2. I am going to read you a list of energy-efficient appliances that your household may have purchased. For each one, can you please tell me if you or someone else from your household purchased it in the last 12 months...

Purchased an Energy Efficient Appliance**	2014
<i>Sample Size*</i>	<i>129</i>
Energy-efficient clothes washer	31%
Energy-efficient dishwasher	25%
Energy-efficient refrigerator	24%
Energy-efficient freezer	16%
Energy-efficient room air conditioner	12%
Others	60%
*Base: Respondents who purchased an energy efficient appliance **Percent saying 'yes'	

B2f. Other energy efficient appliances purchased.

Purchased an Energy Efficient Appliance – Other Mentions	2014
<i>Sample Size*</i>	<i>77</i>
Energy-efficient stove	27%
Heat pump	23%
Energy-efficient dryer	23%
Dehumidifier	13%
Energy-efficient microwave	9%
Water heater	9%
Others	17%
*Base: Respondents who mentioned other types of appliances in B2	

- B4. In the last 12 months, have you taken any steps to reduce your home energy use?
- B5. I am going to read you a list of energy-efficient behaviours that your household may have adopted. For each one, can you please tell me if your household has adopted it in the last 12 months?

Taken Steps to Reduce Home Energy Use	2014
<i>Sample Size</i>	340
Yes to at least one energy efficient behaviour	80%
No	8%
Already undertaking activities	12%

Adopted Energy Efficient Behaviours**	2014
<i>Sample Size*</i>	313
Turn off lights when not needed	72%
Wash clothes in cold water	57%
Turn off your computer at night	53%
Hang laundry to dry	50%
Use a ceiling fan rather than air conditioning	44%
Reduce shower time	43%
Turn off your water heater when you're away	31%
Reduce your refrigerator's temperature set point	17%
Adjust the display of your television by reducing the brightness and contrast	17%
Insulate your windows with heat-shrink film	8%
Use a home power monitor to have real-time feedback on your electricity consumption	6%
*Base: All respondents except those who purchased an energy efficient appliance AND who have not taken steps to reduce home energy use. **Percent saying 'yes'	

- H1. Do you recall having signed up on the Efficiency Nova Scotia website to have access to an online report which compares your household's electricity usage to similar homes, illustrates energy usage patterns and provides you with energy efficiency tips to help you reduce your energy consumption?

Recall Signing Up for HER	2014
<i>Sample Size</i>	340
Yes	74%
No	20%
Don't know	7%

H2. Thinking of this online report, in general, what have you done with it? Did you...

Done with HER	2014
<i>Sample Size*</i>	250
Read the website content thoroughly	38%
Read some of the website's content	34%
Skim some of the website's content	13%
Glance at the pictures, graphs or headlines	6%
Others	5%
Don't know/refused	4%
*Base: Respondents who recall signing up for HER	

P1. What was the SINGLE most important reason you decided to sign up online for your Home Energy Report?

P2. Were there any other reasons?

Motivations for Signing Up for HER	2014	
	Most Important Reason	Other Reasons**
<i>Sample Size*</i>	250	243
To save on energy/to save on energy costs	46%	14%
To find out/improve home energy rank compared with other similar houses	24%	10%
Personal interest/interested in the information	5%	2%
To see/track energy use	5%	1%
Find tips to improve efficiency-usage	4%	3%
To stop receiving flyers/letters in the mail	2%	-
To help the environment	1%	3%
To get Air Miles	1%	1%
Reduce greenhouse gases	-	1%
Don't know/no other reasons/Refused	3%	61%
Others	9%	6%
*Base: Respondents who recall signing up for HER **Multiple Responses		

P3. Before signing up for the Home Energy Report, had you participated in any of Efficiency Nova Scotia's energy efficiency programs?

Participated in Other ENSC programs	2014
<i>Sample Size*</i>	250
Yes	56%
No	43%
Don't know	1%

*Base: Respondents who recall signing up for HER

P4. Which Efficiency Nova Scotia programs did you participate in before the Home Energy Report?

ENSC Programs Previously Participated	2014
<i>Sample Size*</i>	139
Instant Savings/Light bulb replacement	49%
Energy Audit	29%
Water saving/low flow shower heads/faucet aerators/toilets	22%
Hot water tank wrap	17%
Home Energy Assessment	15%
Appliance Retirement	7%
Insulation	6%
Windows/doors	4%
Home heating	4%
Power bars/Smart Power Strips	2%
Clothesline	1%
Residential Direct Install	1%
Thermostat/Programmable thermostat	1%
Others	10%
Don't know	2%

*Base: Respondents who participated in other ENSC programs

BF1. What makes you think the [dishwasher/the room air conditioner] unit(s) you purchased in the last 12 months is/are energy-efficient?

Reason for Believing Appliance was Energy Efficient	2014	
	Dishwasher (%)	Air conditioner (#)
<i>Sample Size*</i>	25	14
EnerGuide label on the appliance/energy consumption on EnerGuide label	40%	3
The Energy Star symbol on the appliance	32%	1
Information provided with appliance	12%	3
New model should be more efficient	12%	1
Researched/compared appliances	8%	-
Salesperson indicated it was energy efficient	4%	-
Word of mouth	-	4
Because it was a heat pump	-	3
Others	4%	2
*Base: Respondents who purchased an energy efficient dishwasher or air conditioner		

BF2. Was this [dishwasher/room air conditioner] an Energy Star model?

Appliance was Energy Star	2014	
	Dishwasher (%)	Air conditioner (#)
<i>Sample Size</i>	25	14
Yes	96%	11
No	-	1
Don't know	4%	2
*Base: Respondents who purchased an energy efficient dishwasher or air conditioner. Results are combined from BF1 and BF2.		

BF3. How influential was your Home Energy Report on your decision to purchase this [energy-efficient dishwasher/energy-efficient room air conditioner]? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your purchase decision' and 10 indicates that the Home Energy Report was 'extremely influential on your purchase decision'.

Importance of HER in Influencing Purchase	2014			
	Dishwasher		Air conditioner	
	Sample Size*	Mean Score**	Sample Size*	Mean Score**
Average rating: 10= "Extremely influential", 0= "No influence at all"				
HER influence on purchase decision	24	3.1	14	4.3
*Base: Respondents who purchased an energy efficient dishwasher or air conditioner ** "Don't know/refused" have been removed from calculation				

BF4. How likely would you have been to purchase a new [energy-efficient dishwasher/energy-efficient room air conditioner] without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not purchased this appliance anyway?

Likelihood of Purchasing Appliance Without HER**	2014	
	Dishwasher (%)	Air conditioner (#)
Sample Size*	25	14
Definitely	28%	8
Probably	72%	4
Probably not	-	2
Definitely not	-	-
*Base: Respondents who purchased an energy efficient dishwasher or air conditioner ***"Don't know/refused" have been removed from calculation		

BW1. How influential was your Home Energy Report on your decision to insulate your windows with heat-shrink film? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'.

Importance of HER in Installing Heat Shrink Film	2014	
	Sample Size*	Mean Score**
Average rating: 10= "Extremely influential", 0= "No influence at all"		
HER influence on purchase decision	18	1.8
*Base: Respondents who insulated with heat shrink film ***"Don't know/refused" have been removed from calculation		

BW2. How likely would you have been to insulate your windows with heat-shrink film without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not insulated your windows with heat-shrink film anyway?

Likelihood of Insulating Windows Without HER	2014 (#)
<i>Sample Size*</i>	18
Definitely	13
Probably	4
Probably not	1
Definitely not	-
*Base: Respondents who insulated with heat shrink film	

BW3. On what type of window did you mostly install heat-shrink film?

Types of Windows Heat Shrink Film Installed	2014 (#)
<i>Sample Size*</i>	18
Sliding windows	8
Single or double-hung windows	6
Casement windows	3
Don't know	1
*Base: Respondents who insulated with heat shrink film	

BW4. On how many windows did you install heat-shrink film?

Number of Windows Heat Shrink Film Installed	2014 (#)
<i>Sample Size*</i>	18
1-2	6
3-4	6
5+	6
Average	3.9
*Base: Respondents who insulated with heat shrink film	

BW5. Do you plan on installing heat-shrink film on your windows again this winter?

Plan on Installing Heat Shrink Film on Windows Again	2014 (#)
<i>Sample Size*</i>	18
Yes	17
No	1
*Base: Respondents who insulated with heat shrink film	

BL1. How influential was your Home Energy Report on your decision to hang your laundry to dry? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'.

Importance of HER in Deciding to Hang Laundry to Dry	2014	
	Sample Size*	Mean Score**
Average rating: 10= "Extremely influential", 0= "No influence at all"		
HER influence on decision	110	2.3
*Base: Respondents who hung laundry to dry ***"Don't know/refused" have been removed from calculation		

BL2. How likely would you have been to hang your laundry to dry without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not hung your laundry to dry anyway?

Likelihood of Hanging Laundry to Dry Without HER**	2014 (%)
Sample Size*	109
Definitely	67%
Probably	27%
Probably not	6%
Definitely not	1%
*Base: Respondents who hung laundry to dry ***"Don't know/refused" have been removed from calculation	

BL3. What do you use to hang your laundry to dry?

How Laundry is Hung to Dry*	2014 (%)
Sample Size**	110
Outdoor Clothesline	85%
Indoor drying racks/hangers	51%
Outdoor Drying Racks	8%
*Multiple Responses **Base: Respondents who hung laundry to dry	

BL4. Did you purchase this outdoor clothesline/outdoor drying rack in the past 12 months?

Purchase Clothesline/Drying Rack in Past 12 Months	2014	
	Clothesline (%)	Drying Rack (#)
Sample Size*	94	9
Yes	23%	2
No	77%	7
*Base: Respondents who use a clothesline or outdoor drying rack to dry clothing		

BL5. Did you obtain a discount on this outdoor clothesline/outdoor drying rack, or obtained it/them for free under Efficiency Nova Scotia's Instant Savings program?

Received Discount on Clothesline	2014	
	Clothesline (%)	Drying Rack (#)
Sample Size*	22	2
Yes	9%	-
No	91%	2
*Base: Respondents who purchased clothesline/drying rack in past 12 months		

BL6. Thinking about a typical week, approximately how many loads of clothes washing does your household do per week?

BL7a. Thinking of those [ANSWER TO BL6] loads, approximately how many were hung to dry in a typical week in the spring and summer period prior to you signing up online for your Home Energy Report?

BL7b. Thinking of those [ANSWER TO BL6] loads, approximately how many were hung to dry in the fall and winter period prior to you signing up online for your Home Energy Report?

BL8a. Thinking of those [ANSWER TO BL6] loads, approximately how many are hung to dry **in the spring and summer period**, after you had signed up online for your Home Energy Report?

BL8b. Thinking of those [ANSWER TO BL6] loads, approximately how many are hung to dry **in the fall and winter period**, after you had signed up online for your Home Energy Report?

Loads of Clothes Washing Hung to Dry	2014				
	Loads done in a typical week	Loads hung in a typical week in spring and summer before HER	Loads hung in a typical week in fall and winter before HER	Loads hung in a typical week in spring and summer after HER	Loads hung in a typical week in fall and winter after HER
Sample size*	110	109	109	109	109
0	-	5%	24%	3%	22%
1-2 loads	23%	45%	50%	42%	50%
3-4 loads	45%	31%	11%	30%	15%
5-9 loads	22%	12%	7%	16%	8%
10+ loads	9%	2%	-	4%	-
Don't know	1%	6%	7%	6%	6%
Average**	4.3	2.7	1.6	3.2	1.7
*Base: Respondents who hung laundry to dry					
**Don't know removed from calculation of mean score					

BL9. Do you own a clothes dryer?

Own a Clothes Dryer	2014 (%)
Sample Size*	110
Yes	98%
No	2%
*Base: Respondents who hung laundry to dry	

BL10. Is it an electric or gas clothes dryer?

Type of Clothes Dryer	2014 (%)
Sample Size*	108
Electric	97%
Gas	3%
*Base: Respondents who hung laundry to dry and own a clothes dryer	

BL11. Did you own a clothes dryer before signing up for your online Home Energy Report?

Own Clothes Dryer Prior to HER	2014 (#)
<i>Sample Size*</i>	2
Yes	1
No	1
*Base: Respondents who do not own a clothes dryer	

BV1. In the last 12 months, did you participate in Efficiency Nova Scotia's Residential Direct Install program? As part of this program, someone would have come to your house and installed new lighting or domestic water heating energy efficiency products, such as compact fluorescent light bulbs (CFLs) and faucet aerators, at no charge.

Previously Participated in RDI	2014 (%)
<i>Sample Size*</i>	132
Yes	32%
No	68%
*Base: Respondents who washed clothes in cold water	

BV2. During your participation in this program, you might have received information during the visit from the installer about the benefits of washing your clothes in cold water. The installer would have spoken to you about your clothes washing behaviour and encouraged you to set your washing temperature to cold. The installer might have also placed a removable sticker on your washing machine with a "Set wash temperature to cold!" reminder. Do you recall having this conversation with the installer?

Recall Discussion with RDI Installer Regarding Cold Water Washing	2014 (%)
<i>Sample Size*</i>	42
Yes	31%
No	67%
Don't know	2%
*Base: Respondents who washed clothes in cold water and participated in RDI	

BV3. How influential was your Home Energy Report on your decision to wash your clothes in cold water? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'.

Importance of HER in Decision to Wash Clothes in Cold Water	2014	
	Sample Size*	Mean Score**
Average rating: 10= "Extremely influential", 0= "No influence at all"		
HER influence on decision to wash in cold water	118	1.6
*Base: Respondents who washed clothes in cold water. ***"Don't know/refused" have been removed from calculation		

BV4. How likely would you have been to wash your clothes in cold water without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not washed your clothes in cold water anyway?

Likelihood of Washing Clothes in Cold Water Without HER	2014 (%)
Sample Size*	118
Definitely	70%
Probably	24%
Probably not	6%
Definitely not	-
*Base: Respondents who washed clothes in cold water	

BV5. Thinking about a typical week, approximately how many loads of clothes washing does your household do per week?

BV6. Thinking of the [ANSWER TO BL6 OR BV5] loads of clothes washing your household does in a typical week, approximately how many were washed in cold water prior to you signing up online for your Home Energy Report?

BV7. Thinking of the [ANSWER TO BL7 OR BV6] loads of clothes washing your household does in a typical week, approximately how many are washed in cold water, now that you have signed up online for your Home Energy Report?

Loads of Washing Done in Cold Water	2014		
	Loads done in a typical week	Loads washed in cold water prior to HER	Loads washed in cold water after HER
<i>Sample size*</i>	<i>118**</i>	<i>118</i>	<i>118</i>
0	-	7%	-
1-2 loads	19%	25%	25%
3-4 loads	38%	31%	34%
5-9 loads	20%	14%	16%
10+ loads	9%	3%	4%
Don't know****	14%	19%	20%
Average***	4.4	3.3	3.7
<i>*Base: Respondents who washed clothes in cold water</i> <i>**Results for BL6 and BV5 combined</i> <i>***Don't know removed from calculation of mean score</i> <i>****Due to a programming error, 15 respondents did not receive BV5. These respondents have been included as don't know responses.</i>			

BC1. How influential was your Home Energy Report on your decision to turn off your computer at night? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'.

Importance of HER in Decision to Turn Off Computer at Night	2014	
	<i>Sample Size*</i>	Mean Score**
Average rating: 10= "Extremely influential", 0= "No influence at all"		
HER influence on decision to turn off computer at night	<i>119</i>	2.5
<i>*Base: Respondents who turned off computer at night</i> <i>***"Don't know/refused" have been removed from calculation</i>		

BC2. How likely would you have been to turn off your computer at night without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not turned off your computer at night anyway?

Likelihood of Turning off Computer Without HER	2014 (%)
<i>Sample Size*</i>	121
Definitely	58%
Probably	23%
Probably not	15%
Definitely not	4%
*Base: Respondents who turned off computer at night	

BC3. Prior to signing up online for your Home Energy Report, how many times a week did you use to turn off your computer at night?

BC4. Now that you have signed up online for your Home Energy Report, how many times a week do you turn off your computer at night?

Times per Week Computer was Turned Off at Night	2014 (%)	
	Times per week turned off computer before HER	Times per week turned off computer after HER
<i>Sample Size*</i>	121	121
0	17%	2%
1-2	9%	3%
3-4	9%	3%
5-6	6%	11%
7+	59%	80%
Average**	4.9	6.4
*Base: Respondents who turned off computer at night		
***"Don't know/refused" removed from calculation of mean score		

BC5. What types of computers do you turn off at night?

Types of Computers Turned off at Night**	2014 (%)
<i>Sample Size*</i>	121
Laptop computer	67%
Desktop computer	66%
Tablet/iPad	8%
Others	4%
*Base: Respondents who turned off computer at night **Multiple Responses	

BC6. Is the power-saving mode on this computer active?

Power Saving Mode is Active	2014 (%)
<i>Sample Size*</i>	121
Yes	84%
No	7%
Don't know	9%
*Base: Respondents who turned off computer at night	

BC7. How many minutes does it take for your computer to go into power-saving mode?

Number of Minutes for Computer to Enter Power Saving Mode	2014 (%)
<i>Sample Size*</i>	121
1-2	26%
3-5	30%
6+	21%
Don't know	23%
*Base: Respondents who turned off computer at night	

BS1. How influential was your Home Energy Report on your decision to reduce your shower time? Please give your answer on a scale of 0 to 10, where 0 indicates the Home Energy Report 'had no influence at all on your decision' and 10 indicates that the Home Energy Report was 'extremely influential on your decision'.

Importance of HER in Decision to Reduce Shower Time	2014	
	Sample Size*	Mean Score**
Average rating: 10= "Extremely influential", 0= "No influence at all"		
HER influence on decision to reduce shower time	97	3.5
*Base: Respondents who reduced shower time ***"Don't know/refused" have been removed from calculation		

BS2. How likely would you have been to reduce your shower time without your Home Energy Report? Without your Home Energy Report, would you have definitely, probably, probably not, or definitely not reduced your shower time anyway?

Likelihood of Reducing Shower Time without HER**	2014 (%)
Sample Size*	97
Definitely	44%
Probably	31%
Probably not	22%
Definitely not	3%
*Base: Respondents who reduced shower time. **"Don't know removed from calculation"	

BS3. Prior to signing up online for your Home Energy Report, what was your typical shower time in minutes, approximately?

BS4. Now that you have signed up online for your Home Energy Report, what is your current typical shower time in minutes, approximately?

Typical Shower Time	2014 (%)	
	Shower Time before HER	Shower Time after HER
Sample Size*	100	100
Less than 5 minutes	11%	23%
5-9 minutes	31%	49%
10-19 minutes	40%	25%
20+ minutes	12%	-
Don't know/refused	6%	3%
Average**	10.0	6.6
*Base: Respondents who reduced shower time ***"Don't know/refused" removed from calculation of mean score		

CS1. How did you first learn about the Home Energy Report?

Sources of Awareness*	2014 (%)
<i>Sample Size</i>	250
Media advertising	26%
Through the mail/Bill insert	21%
Word of mouth	14%
Internet (general)	6%
Contacted directly by ENSC	6%
ENSC website	5%
Facebook or other social media	3%
Booth at community centre/event	2%
Through Nova Scotia Power	2%
Email/Email from ENSC	2%
Air Miles promotion	1%
Through the HER report received in the mail	1%
Through third party contractor or service provider	1%
Others	6%
Don't know	12%
*Multiple Responses	

S1. Overall, how satisfied are you with the Home Energy Report? Are you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with it?

Satisfaction with HER	2014 (%)
<i>Sample Size*</i>	238
Completely satisfied	20%
Mostly satisfied	59%
Mostly dissatisfied	15%
Completely dissatisfied	5%
Neither satisfied nor dissatisfied	1%
*Don't know removed from calculations	

S2. You indicated being dissatisfied with the Home Energy Report overall. For what reasons were you not satisfied with the Home Energy Report overall?

Reasons for Dissatisfaction**	2014 (%)
<i>Sample Size*</i>	48
Not accurate/Don't agree with report	38%
Poor comparison/House not comparable to other houses in area	25%
Not enough information on energy use/Want more detail	15%
I did not think the tips were relevant for my home/did not like the tips	10%
My energy consumption did not decrease after following the tips	10%
I experienced difficulty creating my online account	2%
I expected more	2%
Others	23%
Refused	2%
*Base: Respondents who were dissatisfied with HER **Multiple Responses	

S3. Now I'm going to ask you about your experience with specific aspects of the Home Energy Report. For each one, please tell me if you are completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with that specific aspect.

Satisfaction with Aspects of HER	2014	
	<i>Sample Size**</i>	Satisfied*
Appearance of report	229	98%
Clarity of report	233	93%
Usefulness of tips provided	239	84%
Ease to create and update online account	186	88%
* Percentage completely satisfied/mostly satisfied. ***"Don't know/Refused" removed from calculations		

S4. You mentioned being dissatisfied with the usefulness of the tips provided in your Home Energy Report. In your opinion, what could be done to improve this aspect?

Suggestions to Improve Usefulness of Tips	2014 (%)
<i>Sample Size*</i>	31
Already aware of information/tips/information isn't new	42%
Information/tips should be more specific to the house	10%
Didn't decrease energy costs/power bill is still high	6%
Provide more detail	6%
Don't know/refused	36%
*Base: Respondents who were dissatisfied with usefulness of tips provided in HER	

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

Contact with ENSC Contact Centre	2014
<i>Sample Size*</i>	250
Yes	26%
No	70%
Don't know	5%
*Base: Respondents who recalled signing up for HER	

CS7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects?

Satisfaction with Overall Performance**	2014	
	<i>Sample Size*</i>	Satisfied***
Service attitude	61	92%
Knowledge of programs available	61	89%
Overall level of service provided	63	84%
Ability to provide advice	62	82%
*Base: Number of respondents who had contact with ENSC contact center representatives **Percentage completely satisfied/mostly satisfied. ***"Don't know/Refused" removed from calculations		

CS27. Based on your personal experience, would you definitely, probably, probably not, or definitely not recommend the programs offered by Efficiency Nova Scotia to others?

Would Recommend Programs to Others**	2014 (%)
<i>Sample Size*</i>	247
Definitely	53%
Probably	39%
Probably not	5%
Definitely not	3%
*Base: Respondents who recalled signing up for HER ***"Don't know/refused" have been removed from calculation	

CS28. How likely would you be to participate in other programs offered by Efficiency Nova Scotia if your household qualified?

Would Participate in Other ENSC Programs**	2014 (%)
<i>Sample Size*</i>	244
Definitely	51%
Probably	43%
Probably not	4%
Definitely not	1%
*Base: Respondents who recalled signing up for HER ***"Don't know/refused" have been removed from calculation	

R1. Do you have any recommendations that you think would help improve the Home Energy Report?

Recommendations**	2014
<i>Sample Size*</i>	250
More detailed information on energy usage	6%
Improve house comparisons/Compare to houses of similar size/age	5%
Report should be more specific to the house (how house is occupied/heated)	4%
Improve the content of the report/Provide more relevant tips	4%
Make the report more clear	1%
No recommendations	72%
Others	10%
*Base: Respondents who recalled signing up for HER **Multiple Responses	

D1. What type of residence do you live in?

Type of Residence	2014
<i>Sample Size</i>	340
Single-family detached	87%
Semi-detached	3%
Townhouse or duplex	3%
Mobile home or house trailer	2%
Apartment building that has fewer than five stories	1%
Apartment building that has five to twenty stories	1%
Row house	1%
Others	1%

D2. Do you own or rent this home?

Home Ownership	2014
<i>Sample Size</i>	340
Own	94%
Rent	5%

D3. Do you pay the electric bills for your home?

Pay Electric Bill	2014
<i>Sample Size</i>	340
Yes	99%
No	-
Others	1%
Refused	-

D4. Including yourself, how many people live in this residence on a full-time basis?

Full-time Residents	2014
<i>Sample Size</i>	340
1	11%
2	53%
3	17%
4	13%
5 or more	6%
Average	2.5

D5. What is your age group? Are you...

Respondent Age	2014
<i>Sample Size</i>	<i>340</i>
18 to 24	1%
25 to 34	5%
35 to 44	11%
45 to 54	22%
55 to 64	33%
65 or older	27%
Refused	1%

D6. What is the highest grade of schooling completed by the head of your household?

Education	2014
<i>Sample Size</i>	<i>340</i>
Less than high school	1%
High school graduate	21%
Trade certificate	5%
College diploma	20%
University diploma	49%
Others	1%
Don't know/Refused	2%

D7. Which of the following income categories best describes your total annual household income before taxes in 2013?

Household Income	2014
<i>Sample Size</i>	<i>340</i>
Less than \$15,000	1%
\$15,000 to \$24,999	2%
\$25,000 to \$34,999	6%
\$35,000 to \$49,999	10%
\$50,000 to \$69,999	17%
\$70,000 to \$79,999	8%
\$80,000 or more	36%
Refused / Don't know	19%

D8. Gender:

Gender	2014
<i>Sample Size</i>	<i>340</i>
Male	61%
Female	39%





RESIDENTIAL FINANCING

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

CRA	Corporate Research Associates
DSM	Demand-side Management
ENSC	Efficiency Nova Scotia Corporation
HEA	Home Energy Assessment
PM	Program Manager
PACE	Property Assessed Clean Energy
RBC	Royal Bank of Canada

DEFINITIONS

Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables, such as hours of operation, wattage or base consumption.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VI
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	2
2.1 Presentation of the Team.....	2
2.2 Evaluation Activities	2
2.2.1 Interview with Program Manager.....	2
2.2.2 Interview with Partner Bank.....	3
2.2.3 Interviews with Participants	3
3 PROCESS EVALUATION	4
3.1 Participation in Residential Financing.....	4
3.2 Pilot Design and Evaluation	4
3.3 Pilot Documentation	5
4 MARKET EVALUATION	7
4.1 Partner Perspectives.....	7
4.2 Participant Perspectives.....	7
4.2.1 Awareness and General Perceptions	7
4.2.2 Loan Option Preference	8
4.2.3 Satisfaction with the Financing Option and ENSC	8
4.2.4 Satisfaction with Financing Information, Forms and Communications	9
4.2.5 Satisfaction with Speed of Financing Processing and Loan Distribution	9
4.2.6 Recommendations for Improvement	10
CONCLUSION.....	11
APPENDIX I 2014 RECOMMENDATIONS.....	12
APPENDIX II INTERVIEW GUIDE WITH THE BANK	14
APPENDIX III INTERVIEW GUIDE WITH PARTICIPANTS.....	16

LIST OF FIGURES

Figure 1: Methodological Model	2
Figure 2: Participation in Residential Financing in 2014	4

EXECUTIVE SUMMARY

This report presents the results of the 2014 process evaluation of Residential Financing. The 2014 evaluation was based on in-depth interviews with the Program Manager (PM), the financial partner and 10 participants.

Because the energy savings achieved by the projects completed through Residential Financing are accounted for under their respective program components, namely Green Heat, Solar and Home Energy Assessment (HEA), the evaluation is limited to a process evaluation.

Program Component Overview

Residential Financing is a zero-percent interest rate financing pilot initiative available to eligible participants in three of Efficiency Nova Scotia Corporation's (ENSC) program components: Green Heat, Solar (for hot water systems only) and HEA. The pilot was first offered from August 2012 to December 2012 with the Royal Bank of Canada (RBC) as the financial partner.

ENSC re-launched the pilot in March 2013 by partnering with a new bank to offer eligible participants loans ranging from \$2,500 to \$15,000 over a maximum amortization period of five years. ENSC buys down the interest rate to zero percent so participants can benefit from a zero-percent interest loan.

Key Findings

A total of 66 participants took part in Residential Financing in 2014—with three of them taking part through Solar, 21 through HEA and 42 through Green Heat. The 2014 evaluation of Residential Financing demonstrated that this pilot was pivotal in helping participants complete upgrades in their homes. Most interviewed participants would have postponed their work if they had not been approved for ENSC financing, except for some necessary home improvements. Furthermore, the Residential Financing pilot proved useful to participants as it enabled them to undertake all the home improvements required all at once. The zero-percent interest rate was by far the most compelling motivator for participants to choose ENSC financing over any other source of financing. All the interviewed participants expressed a strong preference for a zero-percent interest loan rate rather than a low-interest loan coupled with a rebate, except if both loan options offered the same overall cost or if monthly budgeting posed a problem.

All 10 participants interviewed learned about Residential Financing after they had decided to take part in Green Heat, Solar or HEA. Many participants recommended that ENSC provide information about the financing option when they apply to participate in eligible programs to help them decide on the feasible scope of home improvements. Increasing awareness among the general public was also recommended by participants interviewed.

The level of satisfaction with Residential Financing was very high among participants and the financing partner. The ease of making financing applications, the timeliness of loan approval and fund disbursements, and the help provided by ENSC staff contributed to a nearly perfect satisfaction rating from participants. The financing partner spoke highly of the relationship with ENSC staff and believes that ENSC has thus far provided sufficient opportunities for it to offer input on its financing option. Participants were also very satisfied with their interactions with ENSC staff, the clarity of application forms and paperwork and the speed with which applications were processed. In general, participants were satisfied with the time it took for the loan to be granted after their application was approved. That said, some participants reported delays or errors in loan disbursement to the contractor.

Even though participants were generally satisfied with communications, a few recommended that ENSC give advance notice about the major communications scheduled to reassure participants and avoid confusion. More specifically, they suggested establishing a formal communications timeline for the application review and loan disbursement process with key milestones.

Recommendations

Overall, the Econoler team assessed that Residential Financing was useful in helping participants complete energy efficiency upgrades. In addition to the general recommendations presented for all ENSC program components in the overall executive summary of the 2014 demand-side management (DSM) programs, the team outlines specific recommendations throughout the report, which aim at optimizing Residential Financing. Based on the evaluation results, here follow the most important recommendations:

- 2014 Fin.-R1. Incorporate the financing option into existing program components instead of making it a distinct program component.** Residential Financing is managed and evaluated as a distinct program. Because energy savings achieved by the projects completed with financial assistance from Residential Financing are accounted for under their respective program components, referring to it as a separate program can be misleading. The Evaluator recommends turning Residential Financing into an option available under Green Heat, Solar and HEA, rather than continuing to treat it as a program component.
- 2014 Fin.-R2. Increase awareness of the financing option.** All 10 participants interviewed during this evaluation first heard about Residential Financing from their contractor after they had decided to take part in Solar, HEA or Green Heat. Many participants indicated that prior knowledge of the financing option would have further helped them decide on the feasible scope of home improvements. Also considering that most of the participants would have postponed their work if they had not been approved for ENSC financing, ENSC should increase the promotion of the Residential Financing component to help participants better plan their home improvements. In addition, ENSC should use this opportunity to provide more

information on the terms and conditions of the financing option, including that it is offered across suppliers and contractors.

- 2014 Fin.-R3. Develop a formal communications timeline.** The interviews with participants revealed a high level of satisfaction with communications given the frequency of contacts during the preapproval process and the quick preapproval. That said, nearly none of the participants interviewed had any communications with ENSC or the bank during the period from loan application preapproval until loan disbursement. To reassure participants and avoid confusion about the status of their participation process, participants recommended that ENSC give advance notice regarding the major communications scheduled. The Evaluator therefore recommends establishing henceforth a formal communications timeline for the application review and loan disbursement process, with clearly identified key milestones, as to provide the participant with a clear view of the communication process.
- 2014 Fin.-R4. Monitor the loan disbursement process and the time required for payments to be received.** Interviews conducted with participants revealed that in two cases, the loan disbursement was mistakenly allocated to a participant instead of a contractor, and that in one case, there was a delay in loan disbursement to the contractor. Even though these issues were properly solved by ENSC, the Evaluator still recommends collecting the feedback of contractors and participants on the loan disbursement process, and monitoring the time required for payments to be received. To avoid issues or dissatisfaction among contractors or participants, assessing these two elements should be part of future evaluations and closely monitored.

1 PROGRAM DESCRIPTION

Residential Financing is a zero-percent interest rate financing pilot initiative available to eligible participants in three of Efficiency Nova Scotia Corporation's (ENSC) program components, namely Green Heat, Solar (for hot water systems only) and Home Energy Assessment (HEA). The pilot was first offered from August 2012 to December 2012 with the Royal Bank of Canada (RBC) as the financial partner.

ENSC re-launched the pilot in March 2013 by partnering with a new bank to offer eligible participants loans between \$2,500 and \$15,000 over a maximum amortization period of five years. ENSC buys down the interest rate to zero percent so participants can benefit from a zero-percent interest loan.

Participants in Residential Financing must first obtain pre-authorization and credit approval. Then, they can have upgrades installed by a contractor or install the upgrades themselves. Once the upgrades have been made, participants must submit the invoices along with a final application form for verification and approval. Once the approval is given, ENSC instructs the bank to release the loan to ENSC, which then transfers the loan to the contractor hired or the participant, depending on who has completed the installation.

No savings are associated to Residential Financing. Any savings achieved as a result of this initiative are attributed to Green Heat, Solar or HEA.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and the activities carried out for the Residential Financing evaluation.

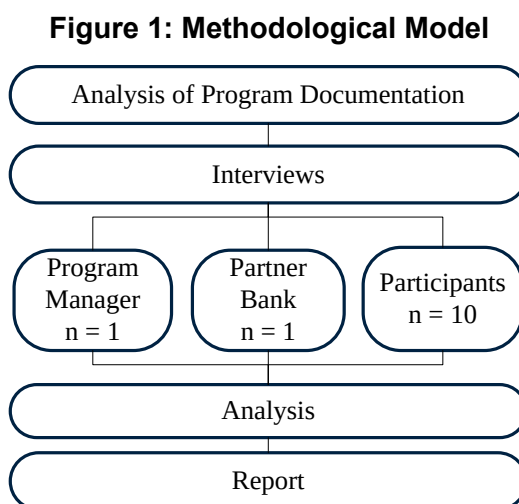
2.1 Presentation of the Team

To carry out the 2014 evaluation, Econoler collaborated with Corporate Research Associates (CRA). Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all deliverables.
- › CRA conducted the interview with the Program Manager (PM), in collaboration with Econoler, as well as the interviews with the bank and participants. CRA also analyzed and reported on the data collected from these interviews.

2.2 Evaluation Activities

Figure 1 illustrates the research strategy and data collection activities used for the 2014 evaluation.



Each step of this methodological model is further detailed in the following sub-sections.

2.2.1 Interview with Program Manager

The Econoler team conducted one interview with the PM in September 2014 to gain a basic understanding of the pilot mechanism and delivery. Based on the information obtained from this interview, a list of questions and topics to include in the data collection tools was prepared.

2.2.2 Interview with Partner Bank

In November 2014, CRA conducted one interview with the partner bank to learn about its involvement in Residential Financing, its participation process, as well as its perception and level of satisfaction regarding Residential Financing.

The guide used for conducting the interview with the bank is presented in Appendix II for reference.

2.2.3 Interviews with Participants

In November 2014, CRA conducted 10 participant interviews to collect their feedback on the following aspects of Residential Financing:

- › Pilot awareness
- › Participant motivations
- › Satisfaction with the pilot and ENSC
- › Participants' preferences in terms of financing options
- › Recommendations for improvement

The guide used for conducting the interviews with participants is presented in Appendix III for reference.

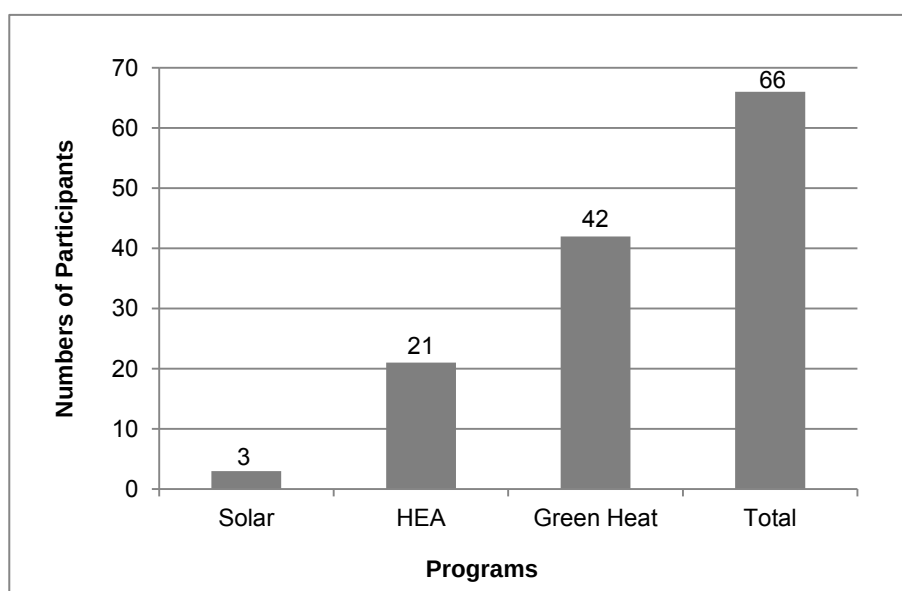
3 PROCESS EVALUATION

The process evaluation of ENSC's Residential Financing pilot has been carried out on the basis of the information gathered from the pilot documentation and an interview with the PM. This section presents the findings from this process evaluation.

3.1 Participation in Residential Financing

As Figure 2 illustrates, a total of 66 participants took part in Residential Financing in 2014; with three of them taking part through Solar, 21 through HEA and 42 through Green Heat.

Figure 2: Participation in Residential Financing in 2014



3.2 Pilot Design and Evaluation

Most incentives offered by energy efficiency programs are meant to offset part or all of the incremental cost of energy efficiency measures. If the participant does not have enough capital to pay for a measure, a subsidy-based financing mechanism, such as the one in place under Residential Financing, can be offered.

However, referring to Residential Financing as a distinct program component for evaluation purposes can be misleading. Indeed, the energy savings achieved by the projects completed with financial assistance from Residential Financing are accounted for under their respective program components, namely Green Heat, Solar and HEA. The Evaluator recommends turning Residential Financing into an option available under Green Heat, Solar and HEA, rather than continuing to treat it as a program

component. Accordingly, to evaluate the effectiveness of the financing mechanism of the Residential Financing option, relevant data and information can be retrieved from the three program components.

Currently, Residential Financing's mechanism allows contractors to be paid when participants' projects have been completed and the money is released by the partner bank. This process can result in delayed payments to contractors, thereby causing their dissatisfaction. If contractors ask participants to pay them before the work is completed, this would cause trouble for participants. The interviews conducted with participants revealed that in two cases, loan disbursement was mistakenly allocated to a participant instead of a contractor, and that in one case, there was a delay in loan disbursement to the contractor. In all three cases, the problem was properly addressed by ENSC. The Evaluator still recommends measuring the satisfaction of contractors and participants with the loan disbursement process, and monitoring the time required for payments to be received. These two elements should be made research themes in future evaluations and closely monitored to avoid issues or dissatisfaction among contractors or participants.

In addition, the Evaluator recommends that for internal control purposes, ENSC continue to collect information regarding the number of financing requests received per year, the number of accepted or rejected requests, the number of default payments, etc. to establish performance indicators.

3.3 Pilot Documentation

As part of the evaluation, the Evaluator analyzed the program documentation and worked together with the PM to improve and revise the program manual, the evaluation plan and the logic model, where applicable. More specifically, this revision work allowed defining relevant goals and barriers for Residential Financing that can also be easily assessed. For example, the lack of qualified participants because they have low creditworthiness ratings is one common barrier, which would be difficult to overcome. Even though ENSC is considering having participants obtain financing from local municipalities without having to go through credit checks and letting them repay their municipalities through property taxes, the Evaluator still recommends that this barrier be eliminated.

When reviewing the pilot documentation, the Evaluator also noticed that the following detail was missing from the program manual and should be added so as to give a clearer and more detailed explanation of Residential Financing's characteristics:

- › When mentioning the possible sources of financing that participants can have access to, the program manual should mention not only financial institutions, but also other possible sources of financing to borrow from, such as credit cards, lines of credit, property assessed clean energy (PACE) financing and financing from Nova Scotia Power.

Although this is Residential Financing's first process evaluation, ENSC developed a program manual, an evaluation plan, a logic model and a process flow chart for this program component. Most process-related recommendations made by the Evaluator since the 2011 evaluation were followed when this pilot was designed. The Evaluator encourages ENSC to adopt this approach to designing

new pilots and program components as part of its standard practice for ensuring high-quality program design. Although the Evaluator recommends not referring to Residential Financing as a distinct program component when evaluating it and turning it into an option available under Green Heat, Solar and HEA, the documentation developed for Residential Financing should be incorporated into the current documentation used for Green Heat, Solar and HEA.

In addition to the program manual, the evaluation plan, the logic model and the process flow chart, ENSC developed a project workflow checklist outlining the steps to be followed by the PM under Residential Financing. Since every step in processing each new project proposal or application must be properly completed before moving onto the following step, incorporating this workflow into the Data Management System (DMS) provides an excellent tool for ensuring that the administrative procedures for application processing are followed without having to depend on direct oversight. This tool can also prevent the occurrence of missing information in the database, which can undermine evaluation accuracy. For Residential Financing, ENSC also uses an additional paper-printed checklist.

4 MARKET EVALUATION

This section presents the findings of the 2014 Residential Financing market evaluation based on the information and feedback collected from the partner and participants.

4.1 Partner Perspectives

An interview with the partner bank was conducted as part of the Residential Financing evaluation. The financing partner spoke highly of its relationship with ENSC staff (rating of 9 on a 10-point satisfaction scale) and believes that ENSC has thus far provided sufficient opportunities for it to offer input on its financing option. Moreover, regular monthly communications with ENSC is considered a valuable tool to ensure Residential Financing remains successful.

The timeliness of communications from ENSC and the submission of credit applications by ENSC on behalf of applicants also garner positive responses (rating of 8 on a 10-point scale). The marketing and outreach activities of the program are also endorsed by the financing partner (rating of 7 on a 10-point scale), though it did receive the lowest satisfaction score. In the Evaluator's opinion, this low score may be explained by the slow program uptake felt by the financial partner, although the partner did point out that the program had now reached momentum. At the same time, the financing partner would like a chance to review communication materials and provide feedback on content based on its expertise.

The financing partner was informed that although Residential Financing currently offers interest loans at a zero-percent rate, a low-interest loan combined with a rebate was considered for the future to minimize perceptions that zero-percent financing necessarily includes hidden fees. The financing partner agreed with this argument after internal discussions and did not object to considering a low-interest loan combined with an incentive. It should be noted that participants interviewed as part of this evaluation voiced a strong preference for the zero-percent interest rate option, which is considered by far to be the program's most attractive feature.

4.2 Participant Perspectives

A total of 10 in-depth interviews were conducted with participants who received financing for home improvements under Green Heat (5 interviews), HEA (4 interviews) and Solar (1 interview). The following sub-sections present findings of an analysis of the feedback collected from these interviews.

4.2.1 Awareness and General Perceptions

Nearly all participants interviewed (8 of 10) each hired a contractor to complete their home improvements, with all 10 participants having first heard about the financing option from their contractors or product suppliers.

Most notably, all 10 participants learned about the financing option after having decided to take part in the ENSC energy efficiency program. A few looked for additional information by browsing the ENSC website or calling the PM. Not surprisingly, many participants recommended that ENSC provide information about the financing option when they apply to participate in eligible programs to help them decide on the feasible scope of home improvements.

Of note, the Solar participant interviewed heard about the financing option from a supplier, who did not disclose that the financing or rebate was available across suppliers. As a result, this participant was made to believe that only this particular supplier was approved for the ENSC rebate or financing option and consequently did not obtain the best quotes. This was cause for much frustration with ENSC on the part of this participant.

Nearly all the participants interviewed (9 of 10) were aware of the rebate option prior to the interview, although all the participants interviewed decided to apply for the zero-percent interest rate financing because they thought this option would be more financially beneficial to them. This option also enabled them to undertake all the home improvements required all at once. In fact, the zero-percent interest rate was by far the most compelling motivator for them to choose the ENSC financing option. As a result, very few looked at other financing alternatives, given that zero-percent interest-rate financing is not often available for this type of loan. If two Green Heat participants had not been approved by the bank for ENSC financing, they would have considered using the loans offered by Nova Scotia Power with their personal line of credit.

For the most part, participants would have postponed completing the work if they had not been approved for ENSC financing, except for making some necessary home improvements with financing from another source.

4.2.2 Loan Option Preference

When asked about the most important factor that they considered when choosing a loan (the interest rate, the loan period, or the monthly payment amount), most of the participants interviewed mentioned the total cost of the loan. As such, the interest rate appears to hold the greatest appeal. As a result, all the interviewed participants expressed strong preference for a zero-percent interest loan rather than a low-interest loan coupled with a rebate, except if both loan options offered the same overall cost or if monthly budgeting posed a problem. The difference between the monthly repayments in the example provided (\$250 for a zero-percent interest loan vs. \$222 for a low-interest loan) was not sufficient to make the low-interest loan interesting. Either a lower monthly payment or a higher rebate amount may have swayed their decisions.

4.2.3 Satisfaction with the Financing Option and ENSC

Overall, the level of satisfaction with the ENSC financing option was high. In fact, nine of 10 participants gave the full satisfaction rating on a 5-point scale, while one participant gave Residential Financing a rating of four. Participants were most satisfied with ENSC providing access to

no-cost financing, thus allowing them to complete all the home improvements required in one single project. The ease in making financing applications, the timeliness of loan approval and fund disbursements, and the help provided by ENSC staff also contributed to the nearly perfect satisfaction rating. Most of the issues identified were related to program scope and delivery rather than the financing option itself.

Participants' overall satisfaction with the financing option was high, particularly their interactions with ENSC staff. All 10 participants interviewed gave the full satisfaction rating to ENSC staff, with many of them praising the staff's efficiency and kindness. The staff was described as responsive, proactive, accommodating, courteous, friendly, helpful, dedicated, and solution-driven.

Very few participants recalled direct interactions with the bank, other than being notified of the loan transfer by telephone or informed of the loan conditions once their applications were approved. In two cases, the loan disbursement was mistakenly allocated to a participant instead of a contractor, which caused frustration, though the problem was later solved to participants' satisfaction.

4.2.4 Satisfaction with Financing Information, Forms and Communications

Participants recalled receiving limited information regarding the financing option. Very few participants received printed materials from ENSC prior to applying for financing, although most recalled having discussed their options with ENSC staff prior to choosing between the rebate and the financing option. In fact, most participants recalled that the first printed/written materials provided to them by ENSC were the pre-approval application form and related email communications.

Participants were highly satisfied with the application forms and other paperwork required to obtain financing, with nine in 10 participants giving this aspect a rating of five on a 5-point scale. The simplicity and clarity of the pre-approval form and the direct assistance provided by ENSC staff to fill out the form contributed much to participants' satisfaction. The bank's loan application forms were considered straightforward.

Nearly none of the participants interviewed had any communication with ENSC or the bank during the period from loan application pre-approval until loan disbursement. That said, the level of satisfaction with communications was still high, given the frequency of contacts during the pre-approval process and the quick pre-approval. However, a few participants recommended that ENSC provide prior notice regarding the major communications scheduled to reassure participants and avoid confusion. One participant experienced issues with their file being lost and not being aware of this situation for weeks, given the lack of clear timelines and status communications.

4.2.5 Satisfaction with Speed of Financing Processing and Loan Distribution

For the most part, participants were highly satisfied with the speed at which their application was pre-approved. In fact, many mentioned that the process took between a few minutes to two weeks. As such, the participants did not seem to have had concern about having to monitor the approval wait

time, since many of them did not recall exactly how long it took. In only two instances, the pre-approval and loan disbursement was lengthy, with no apparent explanation provided by ENSC or the partner bank for the delay.

In general, participants did not recall the length of time it took for the loan to be granted after their application was approved. This did not cause dissatisfaction, however, because the disbursement was generally made directly to the contractor. Three participants reported delays or errors in loan disbursement to the contractor, although the issues were properly addressed by ENSC.

4.2.6 Recommendations for Improvement

Recommendations for improving the financing option primarily entailed increasing awareness among the general public, and not just among program participants; establishing a formal communications timeline for the application review and loan disbursement process, with key milestones identified; and increasing the amount of loan allowed or expand the range of products eligible for financing (Indeed, a few participants mentioned that not all types of home improvements were eligible for financing and that some of the work completed had a financing cap.)

CONCLUSION

The 2014 evaluation of Residential Financing demonstrated that this pilot was designed in accordance with most of the process-related recommendations made by the Evaluator since the 2011 evaluation. Residential Financing has a program manual, an evaluation plan, a logic model, a process flow chart and a project workflow checklist. The Evaluator commends ENSC for developing Residential Financing using this standard practice, thus ensuring high-quality program design.

A total of 66 participants took part in Residential Financing in 2014—among them three participated through Solar, 21 through HEA and 42 through Green Heat. The in-depth interviews with participants showed that ENSC's financing option was pivotal in helping participants complete upgrades in their homes. Most interviewed participants would have postponed their work if they had not been approved for ENSC financing, except for some necessary home improvements. The zero-percent interest rate was by far the most compelling motivator for participants to choose the ENSC financing over any other source of financing. All the interviewed participants expressed a strong preference for a zero-percent interest loan rate rather than a low-interest loan coupled with a rebate, except if both loan options offered the same overall cost or if monthly budgeting posed a problem.

The level of satisfaction with Residential Financing was very high among participants and the financing partner. The ease of making financing applications, the timeliness of loan approval and fund disbursements, the clarity of application forms and paperwork, the speed with which applications were processed, and the help provided by ENSC staff all received high satisfaction ratings from participants. The financing partner also expressed satisfaction with communications and their relationship with ENSC staff. The partner also believes that ENSC has thus far provided sufficient opportunities for it to offer input on its financing option.

Participants made recommendations to improve Residential Financing. Considering that all 10 interviewed participants learned about Residential Financing after they had decided to take part in their respective program, many of them recommended that ENSC provide information about the financing option when they apply to participate in eligible programs. Promoting Residential Financing at a larger scale among the general public was also suggested. Though they were mostly satisfied with communications, a few participants recommended that ENSC establish a formal communications timeline for the application review and loan disbursement process, with key milestones.

Appendix I

2014 RECOMMENDATIONS

This Appendix presents all recommendations made by the Evaluator throughout this report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Incorporate the financing option into existing program components instead of making it a distinct program component. Residential Financing is managed and evaluated as a distinct program. Because energy savings achieved by the projects completed with financial assistance from Residential Financing are accounted for under their respective program components, referring to it as a separate program can be misleading. The Evaluator recommends turning Residential Financing into an option available under Green Heat, Solar and HEA, rather than continuing to treat it as a program component.
	2 Increase awareness of the financing option. All 10 participants interviewed during this evaluation first heard about Residential Financing from their contractor after they had decided to take part in Solar, HEA or Green Heat. Many participants indicated that prior knowledge of the financing option would have further helped them decide on the feasible scope of home improvements. Also considering that most of the participants would have postponed their work if they had not been approved for ENSC financing, ENSC should increase the promotion of the Residential Financing component to help participants better plan their home improvements. In addition, ENSC should use this opportunity to provide more information on the terms and conditions of the financing option, including that it is offered across suppliers and contractors.
	3 Develop a formal communications timeline. The interviews with participants revealed a high level of satisfaction with communications given the frequency of contacts during the preapproval process and the quick preapproval. That said, nearly none of the participants interviewed had any communications with ENSC or the bank during the period from loan application preapproval until loan disbursement. To reassure participants and avoid confusion about the status of their participation process, participants recommended that ENSC give advance notice regarding the major communications scheduled. The Evaluator therefore recommends establishing henceforth a formal communications timeline for the application review and loan disbursement process, with clearly identified key milestones, as to provide the participant with a clear view of the communication process.

Sections	Recommendations
	4 Monitor the loan disbursement process and the time required for payments to be received. Interviews conducted with participants revealed that in two cases, the loan disbursement was mistakenly allocated to a participant instead of a contractor, and that in one case, there was a delay in loan disbursement to the contractor. Even though these issues were properly solved by ENSC, the Evaluator still recommends collecting the feedback of contractors and participants on the loan disbursement process, and monitoring the time required for payments to be received. To avoid issues or dissatisfaction among contractors or participants, assessing these two elements should be part of future evaluations and closely monitored.
Pilot Design and Evaluation	5 The Evaluator recommends that for internal control purposes, ENSC continue to collect information regarding the number of financing requests received per year, the number of accepted or rejected requests, the number of default payments, etc. to establish performance indicators.
Pilot Documentation	6 The lack of qualified participants because they have low creditworthiness ratings is one common barrier, which would be difficult to overcome. Even though ENSC is considering having participants obtain financing from local municipalities without having to go through credit checks and letting them repay their municipalities through property taxes, the Evaluator still recommends that this barrier be eliminated.

Appendix II **INTERVIEW GUIDE WITH THE BANK**

How to complete this form

This is a Word document that integrates some form features. To enter your answers, simply position your cursor on the shaded sections and begin typing. Since this is a form, you cannot write anywhere else in the document. For the boxes, just click on the one next to your answer. Click again to uncheck it.

Please complete this form within the next 48 hours, save the file and send it back to us at cperreault@cra.ca

Thank you!

Part A: General Questions

Please indicate your company name.

QA1a. How would you describe your role(s) as an Efficiency Nova Scotia Corporation (ENSC) partner for the Financing program?

QA1b. How long have you personally been involved in this role (specify months or years)?

Part B: Questions Specific to the Financing

QB1. On a scale from 1 to 10, where 1 is very poor and 10 is excellent, please rate your satisfaction in regard to the following aspects of the Financing program.

Aspects of the program	Score 1 = very poor 10 = excellent NA = not applicable	Reason Please share the reason(s) for your score
Your relationship with ENSC staff		
The timeliness of communications from ENSC		
The reporting requirements from ENSC		
The submission of credit application by ENSC on behalf of applicants		
The program marketing and outreach activities undertaken by ENSC		

QB1a. What difficulties, if any, have you encountered this year in your work on the Financing program?

QB1b. How, if at all, have you addressed those challenges?

QB1c. How, if at all, should ENSC help you address challenges you experienced as part of the Financing program?

QB2a. Do you believe that Efficiency Nova Scotia gives you sufficient opportunity to provide input on the Financing program?

☐ Yes

☐ No

QB2b. If you answered "No", what else can Efficiency Nova Scotia do to involve its program partners?

Part C: Incentive Level

QC1. There are discussions presently regarding the type of loans offered under the Financing program. While the program currently offers zero percent loans, some people think the program might be more successful if the zero interest loan was replaced by a low-interest loan combined with a rebate. The argument is that zero interest loans carry the perception of hidden fees, thus affording greater perceived value to a low interest loan.

In your opinion, should the Financing program continue to offer a zero percent interest loan or should it offer a low interest loan combined with a rebate?

☐ Zero percent interest loan

☐ Low interest loan combined with a rebate

QC2. Please explain your opinion.

Part D: General Comments

QD1. What other suggestions do you have to improve the Financing program performance?

Thank you very much for your time and co-operation.

Your answers will be treated in strict confidence—no names will ever be mentioned in the evaluation report. Our hope is that these results will contribute to improving program performance. You may be contacted by phone if we need to clarify your answers.

Date	
Your name	
Area code and phone number	
Email	

Appendix III

INTERVIEW GUIDE WITH PARTICIPANTS

Hello may I please speak with [INSERT NAME]?

IF Yes **[GO TO INTRODUCTION]**

IF No [SAY “Perhaps you can help me anyway.” **GO TO INTRODUCTION**]

INTRODUCTION

Hello, my name is _____ and I am with CRA (Corporate Research Associates), a Halifax-based survey research company. We are performing an evaluation of services and programs provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your household recently participated in Efficiency Nova Scotia Corporation’s **[PROGRAM]**. You would have received a letter from ENSC informing you of this research. We would appreciate your help in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about ten minutes. Is this a good time for you?

[IF REFUSED, ASK] Can we schedule a more convenient time for you to conduct this interview?

We understand that you participated in Efficiency Nova Scotia’s **[PROGRAM]**, and through that, opted for the zero percent financing option. Is that correct?

IF YES **[CONTINUE]**

IF NO **[PROMPT]** “Are you sure? Your household would have applied for financing to complete home improvements through **[PROGRAM]**, and you would have received a loan from the bank to cover the costs.” **RECODE AS “YES” IF THE PROMPT WORKS; IF RESPONDENT STILL SAYS NO:** “Is there someone else in the household who would know about having participated in the financing option of **[PROGRAM]**?”

IF YES **[ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]**

IF NO **[THANK & TERMINATE]**

Part A: Program Awareness

QA1. To begin, thinking about your participation in Efficiency Nova Scotia’s **[PROGRAM]**, did you do the home improvement work yourself, or did you hire a contractor?

- ☐ Self
☐ Contractor

Now I am going to ask you to think back to when you decided to apply for financial assistance through Efficiency Nova Scotia for home improvements you completed as part of the **[PROGRAM]**.

QA2. There are two incentive options for this program. Prior to today, were you aware of **[READ AND ROTATE]** offered for home improvements made through the **[PROGRAM]**?

- a) The rebate option
- b) The zero percent financing

QA3. Why did you choose the zero percent financing as the incentive for **[PROGRAM]** instead of the program rebate?

QA4. Did you consider other financing options to cover the home improvement costs? If so, which ones?

QA5. **[IF YES]** And why did you choose Efficiency Nova Scotia's financing option rather than another source of financing?

QA6. Which of the following is most important to you when choosing a financial loan option? Would you say...?

- ☐ The interest rate of the loan; or
- ☐ The loan period; or
- ☐ The monthly payment amount.

QA7. How did you first find out about the zero percent financing option from Efficiency Nova Scotia?

QA8. **[IF NOT MENTIONED]** Did Efficiency Nova Scotia provide you with written information about the financing option? Why? Please describe what information you received, in what format, how it was delivered, and when you received it.

Part B: Program Assessment

I am now interested in understanding your experience from the time you applied for financing up until now or to the time when your loan was paid back in full.

QB1. Using a scale from 1 to 5, where 1 means not at all satisfied and 5 means very satisfied, how would you rate your overall satisfaction with the zero percent financing option?

QB2. Why do you have that opinion?

QB3. Now I will ask you about each aspects of the financing option.

On a scale of 1 to 5, where 1 means not at all satisfied and 5 means very satisfied, how satisfied were you with each of the following aspects. If you did not have experience with one of the aspects please tell me. Why do you have this opinion?

Factor	a. Rating	b. Explanation
i. The financing application form and other paperwork you had to fill out		
ii. Interactions with Efficiency Nova Scotia staff		
iii. Information provided by Efficiency Nova Scotia regarding the financing option		
iv. Interaction with the bank		
v. Status communications during the application review process		
vi. The speed with which your application for financing was processed		
vii. The timeliness of receiving the loan amount once your request was approved		

QB4. What communications did you receive from Efficiency Nova Scotia or the bank from the time you applied for the loan to the time the loan was released, if any?

QB5. Was this information adequate? What was missing, if anything?

Part C: Loan Incentive

QC1. If you had not received the financing from Efficiency Nova Scotia, would you have paid yourself for the full cost of the energy efficiency measures you implemented in your home? Why?

QC2. There are discussions presently regarding the type of loans offered under the financing option. While the current offer is a zero percent interest loan, some people think the financing option might be more successful if the zero interest loan was replaced by a low-interest loan combined with a rebate.

Imagine you received a \$15,000 loan through the financing option to cover the cost of energy efficiency home upgrades. Which of the following payment scenario is most appealing to you personally? Would it be...?

- ☐ A monthly payment of \$250 over 5 years; or
- ☐ A monthly payment of \$222 over 7 years and a lump sum rebate amount of \$500

QC3. Please explain your opinion.

QC4. Are there situations where you would prefer **[INCENTIVE NOT MENTIONED IN QC2]** rather than **[INCENTIVE CHOSEN IN QC2]**? Please explain.

QC5. In conclusion, do you have additional recommendations for improving Efficiency Nova Scotia's financing option?

Thank you very much for your time and co-operation.

Your answers will be treated in strict confidence—no names will ever be mentioned in the evaluation report. Our hope is that these results will contribute to improving program performance.

Date	
Name	
Area code and phone number	



ECONOLER

BUSINESS ENERGY REBATES

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

BER	Business Energy Rebates
BES	Business Energy Solutions
BF	Ballast Factor
BNI	Business, Non-Profit and Institutional
CATI	Computer-Assisted Telephone Interviewing
COP	Coefficient of Performance
CRA	Corporate Research Associates
DLC	Design Lights Consortium
DSM	Demand-Side Management
DSMDS	Demand-Side Management Data System
ECM	Electronically Commutated Motor
EER	Energy Efficiency Ratio
ENSC	Efficiency Nova Scotia Corporation
FLH	Full Load Hours
HVAC	Heating, Ventilation and Air-Conditioning
HID	High Intensity Discharge
HSPF	Heating Seasonal Performance Factor
NEMA	National Electrical Manufacturers Association
NTGR	Net-to-Gross Ratio
PM	Program Manager
SEER	Seasonal Energy Efficiency Ratio
VSD	Variable Speed Drive

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.

Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VIII
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	3
2.1 Presentation of the Team	3
2.2 Evaluation Activities	3
2.2.1 Interview with Program Manager	4
2.2.2 Interviews with Distributors	4
2.2.3 Surveys	4
2.2.4 Unitary Savings Review for Instant Rebates	6
2.2.5 Project Review and On-site Visits	6
3 PROCESS EVALUATION	7
3.1 Participation in BER	7
3.2 Follow-up on 2012 and 2013 Evaluation Report Recommendations	7
3.3 Program Documentation and Design	11
3.4 Tracking System	12
4 MARKET EVALUATION	15
4.1 Partner Perspectives	15
4.2 Participant Perspectives	17
4.2.1 Previous Program Participation	17
4.2.2 Participant Motivations	18
4.2.3 Satisfaction with BER	19
5 IMPACT EVALUATION FOR BER MAIL-IN	21
5.1 Gross Savings	21
5.1.1 HVAC Measures	23
5.1.2 Commercial Lighting Measures	24
5.1.3 Commercial Refrigeration Measures	26
5.1.4 Motor and VSD Measures	26
5.1.5 Compressed Air Measures	28
5.1.6 Agricultural Measures	28
5.1.7 Commercial Kitchen Measures	29
5.1.8 Commercial Laundry Measures	29
5.1.9 Commercial Water Heating	29
5.1.10 Solar Measures	30
5.1.11 Diversity Factor	30
5.1.12 Revised Gross Savings	32

5.2	Net-to-Gross Ratio	33
5.2.1	Free-ridership	33
5.2.2	NTGR Calculation.....	34
5.3	Net Savings.....	34
6	IMPACT EVALUATION FOR BER INSTANT REBATES.....	38
6.1	Gross Savings	38
6.1.1	T8 Lamps (HP-T8 and RW-T8).....	38
6.1.2	High-performance Ballasts	39
6.1.3	T5 and T8 High Bay Fixtures	42
6.1.4	LED Technologies	42
6.1.5	Induction Technologies.....	44
6.1.6	LED Refrigeration Strip Lighting	45
6.1.7	Occupancy Sensors	45
6.1.8	Electronically Commutated Motors.....	47
6.1.9	Diversity Factor.....	47
6.1.10	Revised Gross Savings	47
6.2	Interactive Effects	50
6.3	Net-to-Gross Ratio	51
6.3.1	Free-ridership	51
6.3.2	NTGR Calculation.....	52
6.4	Net Savings.....	53
7	OVERALL BER RESULTS	57
APPENDIX I 2014 RECOMMENDATIONS		60
APPENDIX II INTERVIEW GUIDE WITH DISTRIBUTORS		64
APPENDIX III ANNUAL SURVEY QUESTIONNAIRE.....		71
APPENDIX IV ANNUAL SURVEY RESULTS		79
APPENDIX V QUARTERLY SURVEY QUESTIONNAIRE		87
APPENDIX VI QUARTERLY SURVEY RESULTS		95
APPENDIX VII ON-SITE VISIT SAMPLING AND PROTOCOL.....		101
APPENDIX VIII ALGORITHM FOR FREE-RIDERSHIP CALCULATION.....		127
APPENDIX IX CALCULATION EXAMPLE.....		128

LIST OF TABLES

Table 1: Distortion Effects and Net-to-gross Ratio.....	x
Table 2: Overall Comparison of Tracked and Evaluated Savings at the Generator for BER.....	xi
Table 3: Annual Survey Sample Size and Margin of Error	5
Table 4: Quarterly Surveys Sample Size and Margin of Error	5
Table 5: Implementation Status of Recommendations in 2012 and 2013 Executive Summaries.....	8
Table 6: Distributors' Satisfaction	15
Table 7: Previous Program Participation	17
Table 8: Reasons for Participating	18
Table 9: Satisfaction with BER.....	19
Table 10: Ease of Process to Participate in BER.....	19
Table 11: Recommendations to Improve BER.....	20
Table 12: Diversity Factors for BER Mail-in	31
Table 13: Evaluation Results – Revised Gross Savings – BER Mail-in	32
Table 14: Evaluation Results – Revised Net Savings – BER Mail-in	35
Table 15: Comparison of Tracked and Evaluated Savings at the Generator – BER Mail-in.....	36
Table 16: Tracked Unitary Savings for T8 Lamps.....	39
Table 17: Unitary Savings Values for High-performance Ballasts	40
Table 18: Revised Displaced Wattages for Each Ballast Type	41
Table 19: Revised Unitary Savings Values for High-performance Ballasts	41
Table 20: Evaluation Results – Gross Energy and Peak Demand Savings for Instant Rebates Products with Unitary Savings Values	48
Table 21: Evaluation Results – Gross Energy and Peak Demand Savings for All Other Instant Rebates Products.....	49
Table 22: Interactive Effects Factor for Indoor Lighting Products	50
Table 23: Free-ridership for BER Instant Rebates	52
Table 24: NTGRs for BER Instant Rebates	53
Table 25: Evaluation Results – Net Energy and Peak Demand Savings for Instant Rebates Products with Unitary Savings Values	54
Table 26: Evaluation Results – Net Energy and Peak Demand Savings for Other Instant Rebates Products	55
Table 27: Comparison of Tracked and Evaluated Savings at the Generator for Instant Rebates	56
Table 28: Overall Comparison of Tracked and Evaluated Savings at the Generator for BER.....	57

LIST OF FIGURES

Figure 1: Methodological Model.....	3
Figure 2: Participation in BER.....	7

EXECUTIVE SUMMARY

This report presents the results of the 2014 evaluation of Business Energy Rebates (BER), which is a component of the Business, Non-Profit and Institutional (BNI) Efficient Products Rebates program. The 2014 evaluation was conducted based on the information collected from in-depth interviews with the Program Manager (PM) and eight distributors, 58 on-site visits, one annual survey of 27 BER Mail-In participants, four quarterly surveys of 68 BER Mail-In participants, and one unitary savings review.

Program Component Overview

BER undertaken by Efficiency Nova Scotia Corporation (ENSC) provides financial incentives in the form of prescriptive rebates to BNI clients to encourage reducing electricity consumption and demand. BER offers mail-in rebates and instant rebates through electrical distributors across the province of Nova Scotia.

The prescribed measures eligible under BER Mail-In are divided into the following categories.

BER Mail-in Measure Categories

› Agricultural technologies	› Commercial laundry
› Commercial lighting	› Commercial kitchen
› Commercial refrigeration	› Commercial solar thermal heating
› Compressed air	› Commercial water heating
› Heating, ventilation and air-conditioning (HVAC)	› Motors and variable speed drives (VSDs)

For BER Instant Rebates, electrical distributors have a pre-approved list of products covering the following types of products.

BER Instant Rebates Product Types

› CEE electronic ballasts	› LED high bay fixtures
› CEE T8 lamps	› LED troffer
› High bay induction lamp fixtures	› LED outdoor wall pack fixtures
› Wall pack induction lamp fixtures	› LED strip lighting
› LED decorative walkways	› T5 high bay fixtures
› LED downlights	› T8 high bay fixtures
› LED docklights	› Lighting occupancy sensors
› LED garage canopy lighting	› LED tubes for fluorescent lighting

BER aimed to achieve net electrical energy savings of 27.0 GWh and peak demand savings of 4.8 MW in 2014.

Key Findings

The evaluation of BER demonstrated that a total of 307 participants took part in 583 projects in the mail-in rebate approach in 2014, which is a small increase compared to last year, and is in line with the continuous increase trend seen since the program's inception (270 participants in 2013, 175 in 2012 and 106 in 2011).¹ The mail-in rebate approach generated net energy savings of 11.073 GWh in 2014, an increase in comparison with 2013 (6.886 GWh), 2012 (7.779 GWh) and 2011 (7.002 GWh). While the number of participants increased slightly (198 regular participants and 122 promotional rebate participants – some participants being counted as both regular and promotional rebate participants), the savings have grown significantly.

For the instant rebate approach, the net energy savings were 13.537 GWh in 2014, which is a sizable decrease in comparison with last year, but is more comparable to the 2012 level (27.733 GWh in 2013, 14.079 GWh in 2012 and 7.954 GWh in 2011). This reduction can be largely attributed to the fact the sales of LED downlights were lower than in 2013, when a reduction in the rebate in February 2013 prompted distributors to sell a very large volume so that contractors could install many of those inexpensive bulbs.

Satisfaction

Survey results showed that participants were very satisfied with their experience with many aspects of BER, including their interactions and communications with contractors, distributors and consultants, rebate or incentive amounts and the time required to receive the rebate or incentive. For the most part, participants found it easy to participate in BER. For those who found the process difficult, they complained about the difficulty in getting the information that ENSC needed, the insufficient amount of information regarding the process, time-consuming process, difficulty in addressing eligibility and communication issues. Furthermore, the main recommendation made by participants to improve BER was to provide more information about the program. These results suggest that the process may have been overly cumbersome for some participants, and that information about the BER participation process is perhaps not quite adequate.

A similar issue was mentioned by distributors, as their dissatisfaction with BER primarily came from the administrative burden linked to tracking and processing rebates. While satisfaction with this aspect of BER has slightly improved compared to last year, distributors expressed dissatisfaction with the time required to record and report rebates, the financial responsibility resulting from rebate-processing errors and the complexity related to applying rebates. Once again this year, product approval proved time-consuming for distributors, but a central approved list of products, which took effect on January 1, 2015, should eliminate distributors' frustration with this aspect of BER.

¹ The level of participation is unknown for BER Instant Rebates.

On a positive note, distributors were pleased with their relationship with ENSC, the overall perceived effectiveness of the program in promoting energy efficiency and the impact of BER on their sales.

Impact on the Market

When asked about the impact of BER on their sales of some of the products rebated, distributors indicated a low impact on sales of T5 and T8 high bay fixtures, as the industry is naturally moving towards this technology. The perceived influence of the BER rebates on the choice of LED outdoor wallpacks and LED downlights was stronger, given that these are not yet as widely used as the T5 and T8 high bay fixtures.

Distributors believed that BER plays an important role in raising awareness of energy-efficient measures and products. Although it was mentioned that knowledge of rebated measures mainly came from other sources, BER has forced sales staff to keep abreast of technological changes.

Energy Savings

To calculate the net savings of the mail-in rebate approach in 2014, the Econoler team reviewed ENSC's estimate of gross savings by analyzing the results of 58 on-site visits and measuring the distortion effects associated with the mail-in rebate approach. The free-ridership level was established at 25 percent based on the information from the quarterly participant surveys, thus resulting in a net-to-gross ratio (NTGR) of 0.75. This result was applied to all measure categories, with the exception of LED tubes with promotional rebates, for which a NTGR of 1.00 was applied.

As for the instant rebate approach, the Econoler team calculated the free-ridership level of each of the three major product categories (i.e., T5 and T8 high bay fixtures, LED outdoor wallpacks and LED downlights) based on information from the distributor interviews. The free-ridership level estimated for each of these product categories is presented in the table below.

Table 1: Distortion Effects and Net-to-gross Ratio

	2014 Mail-in Rebate	2014 Instant Rebate		
		T5/T8 Fixtures	LED Outdoor Wallpacks	LED Downlights
Free-ridership Level	25%	46%	29%	35%
NTGR	0.75	0.54	0.71	0.65

Overall, the evaluation revealed that BER generated net energy savings of 24.610 GWh and peak demand savings of 4.880 MW at the generator in 2014.

Table 2: Overall Comparison of Tracked and Evaluated Savings at the Generator for BER

	Initial Gross Savings	Adjusted Gross Savings	Gross Savings Adjusted with Interactive Effects	NTGR*	Net Savings
Energy Savings					
Tracked Savings from ENSC	32.899 GWh	32.899 GWh	29.658 GWh	0.81	23.911 GWh
Evaluation Results	32.899 GWh	32.988 GWh	32.216 GWh	0.76	24.610 GWh
Peak Demand Savings					
Tracked Savings from ENSC	8.031 MW	8.031 MW	7.099 MW	0.81	5.728 MW
Evaluation Results	7.919 MW	6.668 MW	6.472 MW	0.75	4.880 MW

For BER Mail-in, the net energy savings established by this evaluation for 2014 were slightly higher than those tracked by ENSC, while evaluated peak demand savings were lower than their tracked counterparts by 16 percent. The evaluated gross energy savings were higher than the tracked value, because savings associated with the two biggest measure categories, e.g., HVAC and lighting, increased as a result of the adjustments that the Evaluator made to their savings calculations. A lower NTGR in 2014 reduced the evaluated net savings. The adjustment made to gross peak demand savings was downward, since diversity factors were not taken into account in the tracking sheet. This had a significant impact on some categories with high savings, such as lighting.

For BER Instant Rebates, the evaluated net energy savings were higher than the tracked savings, by three percent. This is in part due to the negative interactive effects, which are much lower than last year's calculated value (-13.3% for indoor lighting in 2013, compared with -5.6% in 2014). The adjusted gross peak demand savings were significantly lower than expected, because the diversity factor decreased to 83 percent in 2014. This can be explained by the fact that fewer outdoor lighting products were installed this year, and more products were installed in commercial facilities which would be turned off during peak demand hours. The NTGR was also significantly lower in 2014, in part because the highest-selling products in BER Instant Rebates, which were selected to establish the NTGR, have changed, and their respective NTGR have become lower.

Recommendations

Overall, the Evaluator finds that BER works well. The Evaluator thinks that the decrease in savings in comparison with last year was mainly due to the big savings achieved by BER Instant Rebates in 2013, and that the stable number of participants is a sign of the viability of the program. In addition to the general recommendations presented for all ENSC program components in the overall evaluation executive summary of the 2014 demand-side management (DSM) programs, the Evaluator makes

specific recommendations in this report, which aim at optimizing BER. Based on the evaluation results, here follow the most important recommendations:

2014 BER-R1. Review information provided to participants about BER to better assist them with the participation process. Survey results have shown that a smaller proportion of the participants found the BER participation process easy to complete. Difficulties encountered by participants included difficulties in getting the information that ENSC required, insufficient information about the process, time-consuming process and communication issues. Participants also mentioned the need to provide more information about the program as the main recommendation to improve BER. These results show a need for both enhanced and clearer information about the BER participation process. Thus, the Evaluator recommends reviewing current BER information to better assist participants.

2014 BER-R2. Continue with the efforts to simplify rebate tracking and reporting processes. In 2013, the Evaluator recommended that ENSC review the rebate tracking and reporting processes, with a particular focus on timeliness and structure. ENSC has made progress in this aspect of BER, which distributors have noticed as shown by their higher level of satisfaction with this in 2014. That said, rebate tracking and reporting remains the main source of dissatisfaction with the program among distributors. Distributors raised several issues regarding rebate processing, tracking and reporting, including the time required to record and report rebates, and the financial responsibility resulting from rebate processing errors, which were often caused by the complexity associated with applying rebates. The Evaluator recommends continuing to make efforts to improve the rebate tracking and reporting processes to reduce the distributors' administrative burden, thereby increasing their satisfaction with BER.

2014 BER-R3. Implement recommended changes to savings calculations in a timely manner. Once again this year, the Evaluator found that not many modifications to savings calculations recommended in last year's evaluation report were made. In fact, many recommendations on this matter made two years ago have not yet been implemented. This year, to avoid applying an adjustment ratio that would have been too big and would have caused an excessive margin of error, the Evaluator adjusted the tracked savings for peak demand and energy savings of air-source heat pumps to follow up on last year's recommendation. The Evaluator thinks that ENSC should have made such adjustments as part of its responsibilities.

- 2014 BER-R4. Collect additional information on the measures sold through BER Instant Rebate and continue improving the tracking system.** BER Instant Rebate tracking report has seen some significant improvements since last year. Most notably, the Masterlist tab, which lists all the unitary savings equations and values for all the approved products, can now be easily linked to the Reporting tab by using the unique code assigned to each product. Since the equation used for each transaction can now be validated, the Evaluator recommends that ENSC use those tools to collect information that can improve the accuracy of the savings calculated. For instance, the type of each approved occupancy sensor can be identified in the Masterlist. Since all the products sold through BER Instant Rebates are lighting products, their unitary savings can be calculated with a limited number of variables (baseline and efficient wattage, and hours of operation). It is therefore also recommended to present each of these three variables in a separate column so that they can be easily validated and used to allow energy and demand savings to be automatically calculated.
- 2014 BER-R5. Be proactive in addressing issues related to contractors.** In the 2013 evaluation of BER Mail-in, a quality issue with one contractor's work to install the electronically commutated motor (ECM) was identified. This issue caused a major reduction in the evaluated savings established for this measure category. Although ENSC took the time to contact the participants affected by this issue, it took no concrete measures to improve the quality of this contractor's installation work. As a result, similar problems occurred again with this contractor in 2014, and 22 projects had to be removed from the claimed savings.
- 2014 BER-R6. Re-assess the product offerings to consider the baseline improvement observed in the market.** In 2014, the free-ridership level increased to an average of 26 percent for BER. This was a significant increase compared to the 17 percent value established in the 2013 evaluation. The Evaluator believes that this is an indicator that some rebated products might have become closer to the current practice of the market. For example, BER Instant Rebates distributors reported that the market was naturally moving towards T5 and T8 high bay fixtures and LED downlights; the free-ridership levels for those products were respectively at 46 percent and 35 percent. The lighting market is changing rapidly, because the prices of new technologies are dropping and new regulations have recently been enacted. The Evaluator is of the opinion that ENSC should re-assess its product offerings to ensure that it is promoting products of higher efficiency than those used in the current practice.

1 PROGRAM DESCRIPTION

Business Energy Rebates (BER) provides financial incentives in the form of prescriptive rebates to business, non-profit and institutional (BNI) clients to encourage reducing electricity consumption and demand. All BNI customers in Nova Scotia are eligible.

The term “prescriptive rebate” refers to a particular rebate value that has been calculated prior to a customer submitting a proposal. If a given product or technology shows energy savings potential, then the product or technology along with its suggested rebate value can be “prescribed” universally for any eligible client.

BER offers mail-in rebates on a range of energy-efficient measures and instant rebates through electrical distributors within the province of Nova Scotia. The electrical distributors involved in BER Instant Rebates are part of a network of Efficiency Partners and play a key part in promoting qualified energy-efficient measures. These distributors also provide end-users with customer service in the form of product expertise, as well as assistance in completing mail-in applications.

To facilitate customer participation in BER Mail-in, a list of approved measures is available. It should be noted that the eligible measures are not limited to this list, which ensures that products designed by any manufacturer can be offered through BER Mail-in, provided they meet the specified criteria for that measure category. Specific criteria include industry standards, such as ENERGY STAR and National Electrical Manufacturers Association (NEMA), or minimum efficiency/efficacy values. The prescribed measures eligible under BER Mail-in are divided into the following categories.

BER Mail-in Measure Categories

› Agricultural technologies	› Commercial laundry
› Commercial lighting	› Commercial kitchen
› Commercial refrigeration	› Commercial solar thermal heating
› Compressed air	› Commercial water heating
› Heating, ventilation and air-conditioning (HVAC)	› Motors and variable speed drives (VSDs)

Some lighting products, such as LED high bay lights and LED garage canopy lights, were formerly rebated under the Instant Rebates component, but are now available under the Mail-in component.

For a limited period of time in the fall of 2014, Efficiency Nova Scotia Corporation (ENSC) doubled the rebate available under BER Mail-in for LED tubes for fluorescent lighting. Although these projects are very similar to the regular lighting projects, they were tracked in a separate report. The Evaluator therefore presented the savings for this initiative under a separate category called “Promotional Rebate”.

For BER Instant Rebates, electrical distributors have a pre-approved list of products, which are part of one of the following types of products.

BER Instant Rebates Product Types

› CEE electronic ballasts	› LED high bay fixtures
› CEE T8 lamps	› LED troffer
› High bay induction lamp fixtures	› LED outdoor wall pack fixtures
› Wall pack induction lamp fixtures	› LED strip lighting
› LED decorative walkways	› T5 high bay fixtures
› LED downlights	› T8 high bay fixtures
› LED docklights	› Lighting occupancy sensors
› LED garage canopy lighting	› LED tubes for fluorescent lighting

It should also be noted that all the lighting measures previously eligible through Custom Retrofit, with the exception of lighting redesign, are now to be submitted under BER.

BER aimed to achieve net electricity savings of 27.0 GWh and peak demand savings of 4.8 MW for 2014. Electrical energy savings generated by BER are accounted for under the BNI Efficient Products Rebates.

2 METHODOLOGY

This section presents the Econoler team and the methodology used and details the activities carried out for the BER evaluation.

2.1 Presentation of the Team

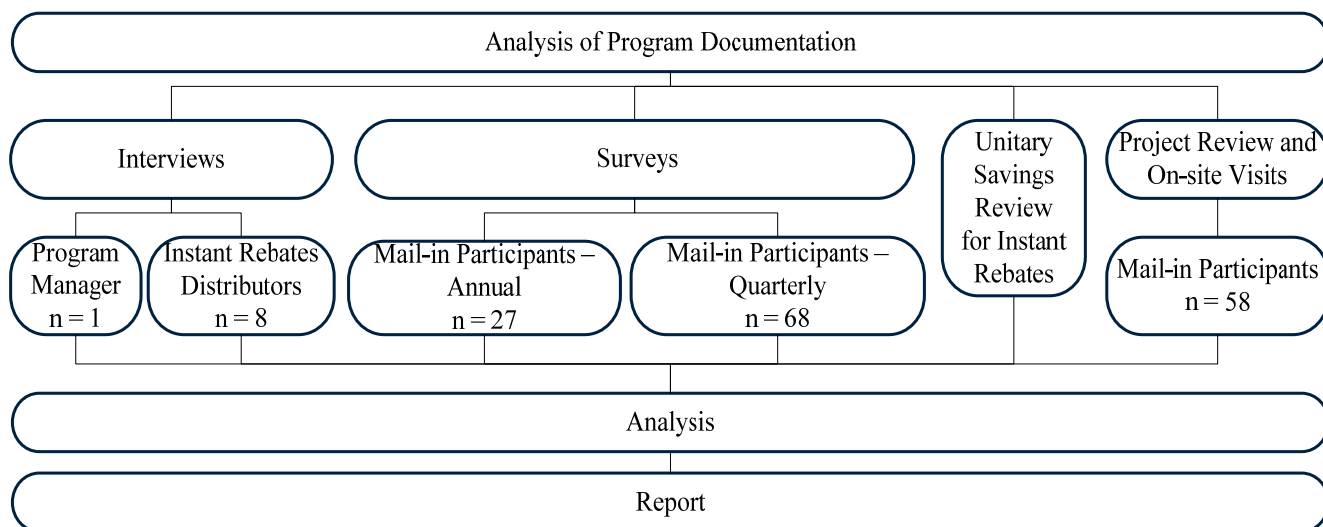
To carry out the 2014 evaluation, Econoler worked together with two partner entities: Corporate Research Associates (CRA) and Equilibrium Engineering. Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all deliverables.
- › CRA conducted the interviews with the distributors as well as performed the annual and quarterly telephone surveys. CRA analyzed and reported on the data collected from these activities.
- › Equilibrium Engineering conducted the on-site visits, reviewed the tracking sheet and assisted Econoler with certain parts of the impact evaluation. Equilibrium Engineering was also in charge of the analysis and reporting that followed these different activities.

2.2 Evaluation Activities

Figure 1 illustrates the research strategy and data collection activities used for the 2014 evaluation.

Figure 1: Methodological Model



Each step of this methodological model is further detailed in the following sub-sections.

2.2.1 Interview with Program Manager

The Econoler team conducted one interview with the project manager (PM) in September 2014. This interview was intended, among other things, to follow up on the 2012 and 2013 evaluation recommendations, as well as to understand the main changes that occurred in program delivery in 2014. Based on the information obtained in this interview, a list of questions and topics to include in the data collection tools was prepared.

2.2.2 Interviews with Distributors

In November and December 2014, eight interviews were conducted by CRA with the participating distributors for BER Instant Rebates. These interviews were mainly used to establish free-ridership levels by estimating how the market would have reacted without the program. As part of these interviews, the distributors were also asked about their satisfaction with the program.

The guide used for the interviews with the distributors is presented in Appendix II for reference.

2.2.3 Surveys

One annual survey with a total of 27 participants and four quarterly telephone surveys with a total of 68 participants were conducted by CRA staff in Halifax. Only participants who took part in the regular Mail-In process (and not the promotional rebate) were considered for this sample.

Annual Participant Survey

For the annual survey, the interviews were conducted in October and November 2014 using computer-assisted telephone interviewing (CATI) technology. The average length of the survey was eight minutes.

The annual survey was meant to generate feedback on the following aspects of BER Mail-in:

- › Previous program participation
- › Program awareness
- › Participant motivations and barriers
- › Satisfaction with the program and the measures implemented
- › Recommendations for improvement

The questionnaire and complete survey results are presented in Appendix III and Appendix IV respectively. The table below shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012 and 2014 annual telephone surveys.

Table 3: Annual Survey Sample Size and Margin of Error

Annual Survey	Mail-in Rebate Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
2014 Participants	198 ²	27	±14.7%
2012 Participants	175	56	±9.9%

Quarterly Participant Surveys

For the quarterly surveys, four series of interviews with a total of 68 participants were conducted in four periods in April, July, October and December 2014, using CATI technology. Such surveys were conducted to shorten the time gap between when participants started taking part in the program and when they were contacted for evaluation purposes. The average length of the survey was 9 minutes.

The quarterly surveys were meant to generate feedback on the following aspects of BER Mail-in:

- › Free-ridership
- › Satisfaction with the program

The questionnaire and the complete quarterly results are presented in Appendix V and Appendix VI. The table below shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2013 and 2014 quarterly surveys.

Table 4: Quarterly Surveys Sample Size and Margin of Error

Quarterly Survey	Mail-in Rebate Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
2014 Participants	198	68	±8.1%
2013 Participants	260	80	±7.7%

The margin of error is used to determine the level of precision³ of the measurement, and its associated confidence level indicates the probability for a measure to fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or biases, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

² The population of BER Mail-in participants for the 2014 annual survey was 88 at the time the survey was being conducted.

³ Precision refers to how close the measured values are to each other. However, it does not take into consideration how close the measured value is to the true value, which refers to accuracy.

2.2.4 Unitary Savings Review for Instant Rebates

To review the unitary savings values used in the tracking sheet, the Econoler team validated the parameters currently used in the tracked savings calculations by conducting a literature review of technical reference manuals and public evaluation reports of similar jurisdictions, and choosing the most recent and accurate data sources. When no reliable or representative source could be found in the literature, engineering calculations were made to estimate savings.

2.2.5 Project Review and On-site Visits

In the fall of 2014, 70 on-site visits were conducted at the facilities of participants who applied for BER Mail-in. These visits were conducted by Equilibrium. However, 12 visits were removed from the sample considered by the Evaluator. Five visits were conducted with participants who had installed the measures, but for whom ENSC had not yet completed the verification work. Since those projects were not claimed in 2014, they were removed from the sample. Seven additional visits had to be left out of the sample because they involved electronically commutated motors (ECMs), for which savings were not claimed in 2014 due to recurrent quality problems with the contractor (more details given on this matter in Sections 3.2 and 5.1.4).

The purpose of the on-site visits was to validate whether measures were properly implemented according to the information contained in the tracking sheet. Additionally, hours of operation, various conditions of operation and, whenever possible, old and new equipment characteristics (wattage, HP, efficiency, etc.) were validated during the on-site visits. These elements were used to revise gross savings, either by adjusting savings on individual projects or by applying an adjustment factor to all projects of a given category when the sample size was sufficient. A copy of the on-site visit sampling and protocol is included in Appendix VII.

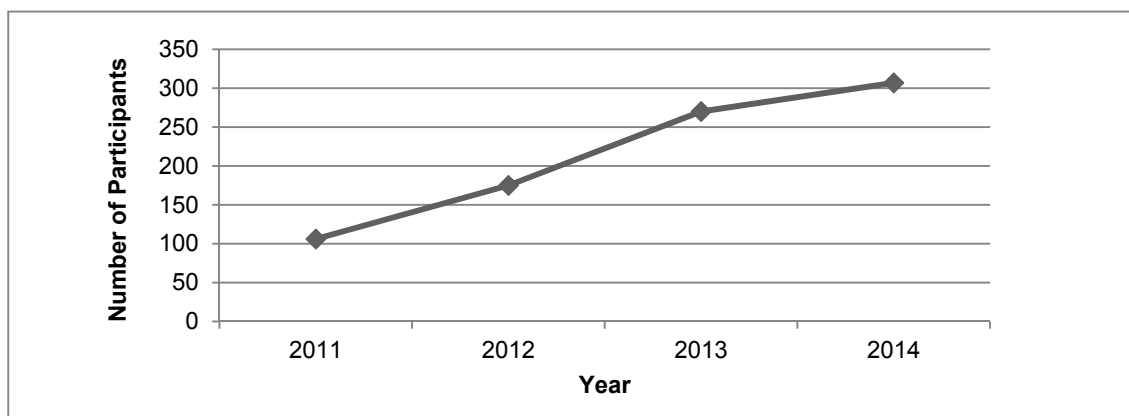
3 PROCESS EVALUATION

This section presents the findings of the 2014 BER process evaluation, which has been carried out based on the information gathered from the BER documentation and tracking system, as well as from an interview with the PM.

3.1 Participation in BER

In 2014, BER had a total of 296 participants, compared to 270 in 2013, 175 in 2012 and 106 in 2011. These 296 participants included 98 participants in the promotional rebate on LED tubes for fluorescent fixtures, which was not part of the regular BER Mail-In process. Figure 2 illustrates how participation in BER has evolved since its beginning in 2011. Because the number of participants for the promotional rebate was high, the total number of participants for BER Mail-In increased again this year. However, when looking at only the regular participants (198), the participation level has actually declined in comparison to 2013. This was partially due to the fact that all the participants who had an ECM installed by the contractor with quality issues were not counted, and therefore no savings were claimed in 2014. ECMs were a popular measure in the Motors and Drives category; as a result, 22 ECM projects were removed from the BER tracking system.

Figure 2: Participation in BER



3.2 Follow-up on 2012 and 2013 Evaluation Report Recommendations

This section reports on the progress made in acting on the recommendations made by the Evaluator in the 2012 and 2013 evaluation reports. The Evaluator follows up on recommendations from both 2012 and 2013 because only a partial process evaluation was conducted in 2013. This partial process evaluation did not include a review of the implementation status of the 2012 recommendations.

To monitor the progress in implementing the recommendations, the PM has been using a monitoring tool, namely a table that documents all the recommendations made and the corresponding

implementation status. This tool is an excellent initiative which serves to enhance the program memory principle.

The Evaluator analyzed the content of the file to determine whether ENSC followed up on the recommendations. The following table gives a brief summary of the implementation status of each recommendation presented in the executive summary section of the 2012 and 2013 evaluation reports.

Table 5: Implementation Status of Recommendations in 2012 and 2013 Executive Summaries

Recommendation	Status
2012 Recommendations	
2012 BER-R1 Analyze product offering to reduce duplicate rebates and program overlapping in the market	Implemented
2012 BER-R2 Improve the tracking sheet to facilitate effective validation of savings	Implemented
2012 BER-R3 Define different full load hours values according to building characteristics	Will not be implemented
2012 BER-R4 Introduce tighter control on some product requirements	Not implemented
2012 BER-R5 Move products from the instant rebate to the mail-in rebate	Implemented
2012 BER-R6 Standardize savings calculations for lighting products with typical baseline values	Implemented
2012 BER-R7 Ensure that the participant provides the motor specifications sheet	Implemented
2012 BER-R8 Develop a reference table with baseline and new wattage values for T5 and T8 high bay fixtures, LED technologies and induction technologies	Partially implemented
2012 BER-R9 Include interactive effects in calculating the tracked savings of all the indoor lighting products sold through the instant rebate approach	Implemented
2013 Recommendations	
2013 BER-R1 Collaborate more closely with distributors	Implemented
2013 BER-R2 Review current rebate tracking and reporting processes with an eye toward timeliness and structure	Implemented
2013 BER-R3 Implement some automation in the calculation of savings in the DSMDS and enter each variable separately	Implemented
2013 BER-R4 Ensure better completion of the project documentation	Implemented
2013 BER-R5 Implement a follow-up procedure and the Quality Assurance program to ensure that customers are satisfied with their BER Mail-in refrigeration projects	Partially implemented
2013 BER-R6 Consider demand savings only for heat pumps with a minimum outdoor temperature limit lower than the lowest temperature in Nova Scotia	To be implemented
2013 BER-R7 Implement the modifications suggested in the past two years for the savings calculations in BER Instant Rebates	Implemented

The following sections detail the actions that were taken by ENSC following these recommendations.

2012 Executive Summary Recommendations

The Evaluator noticed that seven of the nine recommendations were implemented by ENSC and allowed for overall program improvement. The implementation of these recommendations has resulted in a number of changes in BER. Among these, it was noted by the Evaluator during the 2012 that some eligible measures covered by the BER Instant Rebates approach were also covered by other BNI program components (Business Energy Solutions [BES] and Custom Retrofit). When analyzing the savings associated with the BER Instant Rebates back in 2012, Econoler found that 37 percent of the T8 lamps and 48 percent of the ballasts eligible for an instant rebate were already funded by another BNI program. Econoler recommended reviewing the product offering of the BNI program components and limiting instant rebates to specific products with low market penetration (2012 BER-R1). ENSC responded to this recommendation by removing most lighting products from Custom Retrofit and transferring them to BER. This change to Custom Retrofit was made official in 2014. However, prior to this, ENSC was already cautious as to avoid incentives being doubled over the same lighting measures under different programs. ENSC developed contract clauses forbidding any incentive overlapping over BER and BES. A new contract signed in 2013 with BES DAs specifically stated that they are not to submit any BER Instant Rebates request for the product they install. For Custom Retrofit, project managers have been instructed to review equipment bills and remove any savings associated with BER from the Custom savings.

During the 2012 evaluation, the Evaluator observed there could also be a similar issue with LED chandelier lamps and LED high bay fixtures. Econoler therefore recommended that these products be included in the mail-in rebate portion of the BER program so that ENSC has tighter control on eligibility criteria (2012 BER-R5). Following this recommendation, some products were moved from the instant rebate component to the mail-in rebate component, such as LED high bay lamps and LED canopy and parking garage lamps. LED chandelier lamps have however remained under the instant rebate component of BER as it is considered that their baseline of incandescent light bulbs has never changed.

As previously mentioned, two recommendations from the executive summary of the 2012 evaluation report were not implemented, the first one referring to the definition of different full load hours values according to building characteristics (2012 BER-R3). The 2012 on-site visits demonstrated 1) that very few participants were able to enter a reliable value in the “Full load hours” field of the HVAC worksheet; and 2) that full load hours could vary significantly depending on the building characteristics, such as the building type and the temperature set point. Econoler therefore recommended developing a reference table with full load hours values defined according to different factors that might affect them like, the building type (office building, retail stores, etc.) and the heating temperature set point of the building. ENSC did not implement this recommendation because it lacked the resources and it thought that it would take too much time to implement this recommendation without much certainty about achieving the targeted result.

The second recommendation not implemented by ENSC following the 2012 evaluation suggested the introduction of tighter control on some product requirements (2012 BER-R4). For lighting measures, one of the elements having a significant impact on the savings review is replacing non-eligible old lamps. To introduce tighter control on product requirements, the Evaluator recommended that participants be required to provide photographs of the lamps and/or fixtures they intend to replace, regarding lighting products with an eligibility criterion requiring the new product to replace a specific type of lamp or a minimum level of wattage. ENSC decided not to act on this recommendation to avoid increasing participant burden and making the participation process more difficult. Requiring participants to provide photographs of the products to replace would also require them to have a digital camera.

Two recommendations were only partially implemented. In fact, in 2012, Econoler recommended to “Develop a reference table with baseline and new wattage values for T5 and T8 high bay fixtures, LED technologies and induction technologies” (2012 BER-R8). The reason for making this recommendation was that in some cases, a low ballast wattage value was used for baseline fixtures, and that ENSC often only used the wattage of the lamp for new fixtures, rather than the whole system wattage (including the ballast). This resulted in inconsistent savings estimates. In 2014, in the BER Instant Rebate tracking sheet, ENSC added a new tab, which indicates the standard baseline wattage, hours of operation and equations to be applied for savings calculation of most types of T5 and T8 high bay fixtures, as well as of LED and induction technologies. The only element missing from this table is some reference values about the typical lamp and ballast consumption for the new fixture. Although the Evaluator thinks that the wattage of the actual product installed should be used whenever possible, it still believes those reference values will be useful for verification purposes, such as to verify whether the ballast’s consumption has been included in the total fixture consumption.

The other partially implemented recommendation is the application of the 2012-2013 changes to the BER Instant Rebates calculation methods (213-BER-R7). In fact, few operation hours or displaced wattage values have been updated in the past two years. This is further discussed in the Impact Evaluation section.

2013 Executive Summary Recommendations

Six of the seven recommendations were either implemented by ENSC or are in the process of being implemented. In acting on these recommendations, ENSC collaborated more closely with distributors and reviewed rebate tracking and reporting processes, while keeping an eye on timeliness and structure, among other things.

The short time frame for implementing new rebate structures proved problematic for distributors in 2013, in some instances requiring the distributor to absorb losses as a result of the late introduction of a rebate. The Evaluator recommended that ENSC be careful with its advanced notices and analyze the best way and time to provide distributors with information regarding any modifications affecting the delivery and levels of incentives (2013 BER-R1). Following this recommendation, a single event of low

market pricing undercutting the incentive caused a certain tension between distributors and ENSC, but that has been ironed out since.

Distributors also raised issues regarding rebate processing, tracking and reporting in 2013. The Evaluator recommended that ENSC review processes to determine if adjustments were necessary (2013 BER-R2). Rigid conformity requirements for rebate processing, tracking and reporting have been considerably loosened now that ENSC is a member of the Design Lights Consortium (DLC). A new approval process took effect on January 1, 2015 and allows distributors to refer to the DLC's product repertory, resulting in fewer approval procedures. All distributors have been introduced to and trained on this new approval process. That being said, ENSC will keep conducting random audits on product approvals for control purposes.

The BER-R5 recommendation was prompted by the fact that six of the 17 projects visited in the refrigeration category in 2013 experienced various malfunctioning problems with the new evaporator fan motors. It was therefore recommended that ENSC follow up with these participants to ensure that their refrigeration equipment was properly fixed and that they were satisfied with the solutions to their problems and the program itself. Furthermore, it was recommended that the installation contractors submit a report explaining the causes of the malfunctioning problems and the solutions provided to prevent similar problems from occurring again (2013 BER-R5). ENSC did try to contact all the participants who had an ECM installed in 2013. Although participants were provided with an opportunity to express their concerns, ENSC took no immediate action to follow up on the participants' feedback. The contractor responsible for the vast majority of the installation problems did not submit a report explaining the causes of the problems, as it was recommended in 2013. In 2014, similar issues arose with this contractor, which led to the removal of all the savings claimed for the measures that this contractor had installed. As of 2014, this contractor has been suspended from participating in BER. More details on this issue are provided in the BER Mail-in Impact Evaluation section.

3.3 Program Documentation and Design

As part of the evaluation, the Evaluator analyzed the program documentation and worked together with the PM to improve and revise the content of the program manual, the evaluation plan and the logic model, where applicable. More specifically, this revision work helped define relevant goals and barriers for BER that can also be easily assessed.

As an improvement to BER, ENSC has developed a project workflow checklist outlining the steps to be followed by the PM. Since every step in processing each new project proposal or application must be properly completed before moving onto the next step, this workflow incorporated into the Demand-side Management Data System (DSMDS) provides an excellent tool for ensuring that the administrative procedures for application processing are followed without having to depend on direct oversight. This tool can also prevent the occurrence of missing information in the database, which can undermine evaluation accuracy.

3.4 Tracking System

BER Mail-in

The review of the BER Mail-in tracking system included both the Excel sheet containing data exported from the DSMDS and the documentation stored in the DSMDS. In 2014, ENSC used only the DSMDS to manage the application process and technical data. Each project's savings calculations were made automatically in the Screening Tool, where all the savings equations are stored, and then copied into and stored in the project summary sheet. This year, the participants' information, the description of implemented measures and energy and demand savings calculations were provided in a single tab of the Excel report entitled "Project Summary". This has been a significant improvement compared with 2013, when the savings calculations and project information were presented in separate tabs. The DSMDS report also contains numerous other tabs reserved for use by ENSC only and therefore, these other tabs were not reviewed by the Evaluator.

The Project Summary tab includes all the following information: unique project database number, project name, customer information, facility information, contractor information, rate code, measure category, measure description and quantity installed. It also includes the algebraic equations for calculating demand and energy savings, along with two other fields: one field displaying the equations with the numeric values inserted and the other indicating all the values used for each algebraic variable. In addition, the calculation results of both the demand savings and the energy savings at the meter and at the generator are displayed for both the measure and the entire project. The measure's savings value is copied from the Screening Tool. The project's total savings value is entered either as a simple value, or as a formula that is the sum of all of the measure's savings for the entire project. The Evaluator recommends always using a formula to link the total savings value to the measure's savings value to avoid mistakes.

The Evaluator also saw a great improvement with respect to the quality of the information contained in the tracking system. For instance, 98 percent of the projects contained all three answers to the free ridership questions, compared to 91 percent last year. This ensures a greater accuracy of the free-ridership level calculation.

In addition to the information presented in the automatically generated report, the online DSMDS contains a Documents tab where all other documents that cannot be exported into the Excel sheet are available for download. For BER, those generally include the signed application form as well as the technical worksheets and product specifications. The information contained in those participant worksheets is vital to the impact evaluation and is also reviewed for completeness during the on-site visits.

The review of the information contained in the Documents tab revealed a number of issues. Similar to last year, the participants' worksheets for ECMs did not contain any information about either the existing equipment or the proposed equipment. Neither did the lighting worksheets provide the Evaluator with the existing-equipment data for many sampled projects. In addition, a few HVAC

projects with air-source heat pumps of a capacity below 65 kBtu/hr used the AHRI capacity data, in which the average capacity at the two testing temperatures was established and used in the savings calculation. This method is inaccurate, because the equations used in the Screening Tool are based on the nominal capacities. Also, for two motor VSD projects, the existing smaller motor sizes were added up and entered as one motor in the participant information, which made the on-site visit difficult for the Evaluator. It should be noted that the HVAC specifications sheets were made available on the DSMDS this year, which made the impact evaluation much easier to handle.

The Evaluator makes the following recommendations on the further improvement of the tracking system:

- › **Use a formula to calculate all the projects' total savings.** It was found that in some cases, the total savings of a given project were entered manually rather than calculated by a formula that would have added up all of the measure's savings. This method led to a few errors in the tracked savings. It is recommended that a formula be systematically used to calculate every project's total savings.
- › **Provide complete project documentation in the DSMDS.** While the documentation quality of some project categories has improved over the past few years, the Evaluator still found some projects, whose worksheets provided did not contain all the necessary information. This is especially true for ECMs and lighting projects. ENSC should continue to make efforts to ensure every project has complete documentation to facilitate the evaluation process.

BER Instant Rebates

BER Instant Rebates is currently not managed through the DSMDS on a day-to-day basis, which means the Evaluator reviewed the compilation of all the products sold at each participating distributor in the Excel sheet provided by ENSC. The review mainly consisted in evaluating the Masterlist, Reporting and Equations tabs.

The Masterlist tab presents all products that have been approved through BER Instant Rebates since program inception. It contains information on the vendor's name, the type of measure, the product description and code, the applied rebates, and the associated algebraic equations of energy and demand savings as well as their respective unitary savings values.

The Reporting tab lists all products sold by distributors in 2014, along with the vendor's name, category or class of measure, product code, quantity sold, unitary savings per product, interactive effects factor and transaction savings. The Evaluator found only a few cells with missing information. Each product is identified by a unique product code that matches the code in the Masterlist tab. This code identification system made it possible to retrieve the energy and demand savings equations from this year's products. Because of this, the Evaluator was able to accurately calculate the impact of any discrepancy in the savings equation on gross savings, which was not the case in past years when averages for the entire Masterlist had to be used. However, to allow for an easier verification of the calculated savings, ENSC could enter calculation variables (baseline and efficient wattage, hours of

operation) into separate columns. At present time, there is no way to validate that savings were calculated correctly other than verifying each entry manually.

The Equations tab was added to the tracking sheet this year. For each sub-category of products (e.g., 3, 4, 6 and 8-lamp T5 high bay fixtures), the tab presents the energy savings equation, which includes the baseline, efficient wattage and hours of operation. This clearly establishes the assumptions that should be used to calculate individual unitary savings for each new product, and the Evaluator commends ENSC for this improvement. One additional information that could be included in this tab, specifically for lighting products, is the considered baseline technology (for instance, T5 high bay fixtures generally replace metal halide fixtures). This way, the Evaluator could review the relevance of the baseline without having to guess how the baseline wattage was estimated.

In conclusion, the tracking sheet shows significant improvement over last year, specifically in terms of presenting all relevant information (both in the Masterlist and Reporting tabs) being included in a single Excel document. Small adjustments are required, however, to improve the ease of use of the tracking system. Therefore, the Evaluator makes the following recommendations:

- › **Separating the savings equation variables in distinct columns in the Masterlist tab.** As all products sold through BER Instant Rebates are lighting products, their unitary savings can be calculated with a limited number of variables (baseline and efficient wattage, and hours of operation). It would therefore be simple to present each of these three variables in a separate column so that they can be easily validated and used to calculate energy and demand savings automatically.
- › **Stating baseline assumptions in the Equations tab.** The Equation tab now indicates the baseline wattage for each product sub-category. However, it is often difficult for the Evaluator to understand how this value was defined; this might also pose a problem for ENSC, as assumptions are not documented for future revisions. Consequently, it is recommended that a new column be added to give more details about the baseline, including elements such as the technology used, number of lamps and ballast consumption, if applicable (e.g., 2x 32W T12 with magnetic ballast (20 W)).

4 MARKET EVALUATION

This section presents the findings of the 2014 BER market evaluation from the partner and participant perspectives.

4.1 Partner Perspectives

As part of the BER evaluation, eight distributors involved in BER Instant Rebates were interviewed about their satisfaction. What follows is an overview of distributors' ratings of satisfaction with BER overall, its support and communications, and its rebate processing, tracking and reporting.

Table 6: Distributors' Satisfaction

Aspect of BER	Mean (/10) (1= "Not at All Satisfied", 10= "Very Satisfied")	Sample Size*
BER Overall	6.4	8
BER Support and Communications	8.0	8
Rebate Processing, Tracking and Reporting	6.6	8

As shown in the table above, overall satisfaction with BER received an average score of 6.4 on a 10-point scale, where 10 meant "very satisfied". In 2014, of the interviewed distributors, two expressed a negative opinion, and six offered positive views, resulting in an average level of satisfaction lower than reported in the last two evaluations. The relationship with ENSC, the program's overall perceived effectiveness in promoting energy efficiency, and the impact of BER on distributors' sales were the main reasons for positive feedback. One distributor operating across Atlantic Canada also believed that ENSC has the best and most researched energy efficiency program in the region for BNI customers. Another distributor was pleased with the promotional event held in the early fall of 2014 providing a special incentive on LED linear replacement lamps, which resulted in a significant sales increase.

As revealed by the last evaluation, dissatisfaction was primarily due to the administrative burden linked to tracking and processing rebates, although it seemed that distributors' opinions have slightly improved in this regard. While there was dissatisfaction with the amount of time taken to record and report rebates, it was mentioned that ENSC reimbursed distributors in a timely fashion. That being said, distributors were left with the financial responsibility resulting from rebate processing errors, which were a frequent issue given the complex process of applying the rebates (based on product types and applications). Further, the complex process of applying rebates was quite confusing to the sales staffs, who could make mistakes by awarding rebates to ineligible products at the distributors' expenses. Finally, there was much frustration with the submission and approval process of products to be included for rebates under BER.

With an average of 8.0 on a 10-point scale, the aspects of support and communications received a higher rating in 2014 than the last evaluation. General interactions with ENSC as well as staff's friendliness, timeliness of contact, and helpfulness were most appreciated. Nearly all the distributors indicated that they were well-supported in their role as a partner in BER, and were pleased with ENSC's level of support. Only one distributor gave a low rating on this aspect due to the lengthy submission process for product approval. One distributor mentioned that they were required to obtain extensive product information from the manufacturer to complete ENSC's product approval form, which they found quite time-consuming. Despite these common issues perceived by the partners, many distributors were optimistic that solutions to these issues would not be far off, as they were recently informed that a central approved list of products would be made available in 2015, thereby eliminating the need for distributors to go through the long and cumbersome product-approval process.

Overall, distributors gave an average score of 6.6 on a 10-point scale for the rebate processing, tracking and reporting. A number of administrative aspects were identified as concerns, even by those who gave this aspect a good rating. For the most part, distributors have realized that they have to bear the financial risks by extending the rebates to customers when quoting new projects in the future, without being assured that the rebates will be honoured by ENSC weeks or months later when customers finalize their product purchases. Further, the industry practice of incorporating rebates into the quoted sales prices rather than showing them separately has created bigger price sensitivities. Although these are self-imposed challenges within the industry, it was recommended that ENSC modify rebate processing by offering an end-user rebate rather than an instant rebate.

Distributors generally believed that BER had a moderate influence on customers' purchases of the three categories of products discussed during the interviews, namely T5 and T8 high bay fixtures, LED outdoor wallpacks and LED downlights. There was the smallest perceived impact on T5 and T8 high bay fixtures, because the industry is naturally moving towards this technology. The perceived influence of the BER rebates on the choice of LED outdoor wallpacks and LED downlights was bigger, given that these technologies are not yet as widely used as the T5 and T8 high bay fixtures. It was mentioned that BER largely contributed to raising awareness about these products' energy efficiency, although customers have come to expect an ongoing rebate, thus reducing the perceived value it provides.

Regarding the program's impact on sales staff's knowledge of rebated products, distributors believed that BER has required sales staffs to keep informed about these technologies to be able to properly handle customers' queries. That said, the staffs gained product knowledge primarily from manufacturers or internal training sessions.

4.2 Participant Perspectives

An annual participant survey was conducted as part of the BER Mail-in evaluation. In addition to the questions designed for impact evaluation purposes, survey participants were asked questions related to program awareness, barriers and satisfaction.

4.2.1 Previous Program Participation

Before participating in BER, nearly four in 10 participants had previously taken part in an ENSC program. These programs included Custom Retrofit, BES and BER.

Table 7: Previous Program Participation

Other Program Participation	2012 (%)	2014 (%)
<i>Sample Size</i>	56	27
Yes	30%	37%
No	66%	63%
Don't know	4%	-
Program Participation*	2012 (#)	2014 (#)
<i>Sample Size**</i>	17	10
Custom Retrofit	5	2
Small Business Energy Solutions/Business Energy Solutions	2	2
Lighting Upgrades	-	2
Business Energy Rebates	-	2
Smart Lighting Choices	7	-
Commercial Direct Install	2	-
Solar	2	-
Energy Assessment	-	1
Others	3	1
Don't know	-	1
*Base: Respondents who previously participated in programs **Multiple responses		

4.2.2 Participant Motivations

Participants were asked about their motivations for participating in BER. Again, this year's strongest motivation was to save on energy costs, followed by taking advantage of program incentives and rebates.

Table 8: Reasons for Participating

Motivations	2012		2014	
	Most Important Motivation	Second Most Important Motivation	Most Important Motivation	Second Most Important Motivation
<i>Sample Size</i>	56	56	27	27
Save on energy costs/bills	55%	32%	59%	26%
Take advantage of program incentives/rebates	20%	30%	22%	11%
Update equipment	7%	4%	7%	4%
Environment	-	7%	-	11%
Reduce maintenance costs	2%	2%	-	4%
Quality of efficiency products	-	-	-	4%
Replace non-working equipment	4%	-	-	-
Improve existing lighting conditions	2%	9%	-	-
Already planning project	2%	-	-	-
Recommended by contractor	-	2%	-	-
Others	9%	9%	11%	4%
None/No other reason	-	4%	-	37%
Don't know	-	2%	-	-

4.2.3 Satisfaction with BER

As shown in the table below, there was a high level of satisfaction with BER, with 85 percent of participants offering a rating of 5 or 4 in terms of overall satisfaction. Other aspects of BER were also highly rated, including interactions and communications with contractors, distributors and consultants, rebate or incentive amounts, time required to receive the rebate or incentive, program application, forms and paperwork, and the initial confirmation of eligibility. Among the small number of participants who were dissatisfied with BER (n=4), reasons mentioned included that it took too long to get the rebate, there was too much paperwork, staff was not helpful, or the rebate/incentive was too small.

Table 9: Satisfaction with BER

Satisfaction with BER	2012		2014	
Aspect of BER*	Sample Size**	% Satisfied	Sample Size**	% Satisfied
Interactions and communications with contractors, distributors or consultants	56	91%	25	88%
Program overall	56	95%	27	85%
Rebate or incentive amounts	56	82%	26	85%
Time required to receive rebate or incentive	55	89%	26	81%
Program application, forms and paperwork	56	89%	25	80%
Initial confirmation of eligibility	55	89%	8	(#) 5***
*Those giving a rating of 5 or 4 on a scale where 5 = Very satisfied and 1= Not at all satisfied **Don't know/Refused/Not applicable and removed from calculations ***Five respondents (63%) gave a response of '5' or '4'				

For the most part, participants found it easy to participate in BER. Overall, 69 percent of respondents gave a rating of 5 or 4. For those who found the process difficult (n=8), comments included: (i) difficulty to get the information that ENSC needed, (ii) insufficient amount of information on the process, (iii) time-consuming process, (iv) hard to ensure eligibility, and (v), communication issues. It does sound like the process may have been overly cumbersome for some participants, with comments such as “It was difficult to make a list of all the areas and items that were included” or “It took a month to figure out”.

Table 10: Ease of Process to Participate in BER

Ease of Process to Participate	2012	2014
Sample Size*	55	26
5 Very easy	51%	27%
4	36%	42%
3	7%	27%
2	2%	-
1 Very difficult	4%	4%
*Don't know/Refused and removed from calculations		

Just one participant faced a barrier during participation, which was related to the different types of information required by various parties. Quite positively, no participant interviewed through the survey experienced any problems with measures they had installed through BER. That said, results from the on-site visits have shown that some participants had issues with ECMs (see Section 5.1.4 for details).

The majority of participants are unable to provide any recommendation to improve BER. A small number still mentioned they would like more information, better communication or better marketing. Two participants noted that they would like more products rebated, but when asked what specifically they would like to see rebated, they were unable to provide an answer.

Table 11: Recommendations to Improve BER

Suggestions to Improve BER	2012*	2014
<i>Sample Size</i>	56	27
Provide more information/information sessions	11%	7%
Better marketing/awareness	11%	7%
Offer more products rebated	7%	7%
Better communication	-	7%
Increase/better rebates	-	4%
Make forms more user-friendly	9%	-
More direct contact between customer and program staff/more contact people/better communication	5%	-
Increase/improve rebates	5%	-
ENSC staff should be more knowledgeable	4%	-
Good program/Continue good work	4%	-
Instant rebate at point of purchase	2%	-
Others	5%	7%
None/No recommendations/Don't know	54%	63%
*Multiple responses		

5 IMPACT EVALUATION FOR BER MAIL-IN

The objective of the 2014 impact evaluation for BER Mail-in was to determine the gross and net energy savings. Both electrical energy and peak demand savings were estimated by analyzing the following parameters:

- › Savings calculation methodology for each category of measure;
- › Installation rates;
- › Old and new equipment features;
- › Hours of operation;
- › Load factor;
- › Diversity factor; and
- › Free-ridership.

Since interactive effects were included in the gross savings calculations for lighting measures, and no interactive effects were applied to the other measures, this parameter was not analyzed this year.

As a result of the documentation review and on-site visits, the following parameters were established:

- › Adjustment ratios for the gross energy savings calculated in the tracking sheet; and
- › Diversity factors to evaluate the peak demand savings.

5.1 Gross Savings

In 2014, the BER Mail-In tracking sheet contained a total of 446 projects implemented by 198 participants across 10 different measure categories. In addition to the regular measure categories, 137 projects with promotional rebates for LED tubes were conducted by 122 participants. The Econoler team reviewed ENSC's gross savings estimates by using the "2014 BER – Measure Equations Tool (Version 1.3)" and the information collected from 58 on-site visits.

Initially, 70 on-site visits were planned. However, 12 visits were removed from the sample considered by the Evaluator. Five visits were conducted with participants who had installed the measures, but for which ENSC had not yet completed the verification work. Since those projects were not claimed in 2014, they were removed from the sample.

In addition to these 5 projects, the savings associated with ECM measures, installed by one specific contractor, were also removed from the overall analysis. An independent investigation into this contractor's business practices and quality of customer service was considered inappropriate. During both the 2013 and 2014 impact evaluations, it was discovered that many of the installed ECMs had either prematurely failed or had created so much ice build-up on walk-in freezer evaporator coils that the refrigeration unit shut down. In many such cases, the contractor refused to replace the ECM, and

was very difficult to reach by phone or email. Therefore, the Evaluator decided that their associated savings should be removed from the 2014 evaluation. A total of 22 projects were removed for this reason, including 7 projects from the sample and 15 other projects from the final tracking system.

The algorithms in the BER – Measure Equations Tool have been found to be relatively accurate, except for the calculations of zero-energy doors, water heating measures, and HVAC hotel occupancy sensors. Similar to 2013, the demand savings calculation for the zero-energy door measure omitted the number of doors; nevertheless, this variable was included in the savings calculation of every occurrence of this measure in the tracking system. The “HRS” parameter definition in the demand savings calculation for the water heater measure did not match the variables included in the algorithm. The definition states that HRS equates to hours per year; however, the algorithm indicates “HRS * days/year”, though the tracking system indicates the hours per year value. The quantity was also missing from the HVAC hotel occupancy sensor algorithm, but there were no claimed projects for this measure in 2014.

A number of errors were also discovered in some of the algorithm default parameters listed or included in the sample calculation shown under each measure. These included the following:

- › ECMs. The default value for annual operating hours was listed as 5,255 hours, instead of the recommended value of either 8,760 hours for coolers or 8,273 hours for freezers as per the 2013 Vermont TRM⁴.
- › Compressed air. The default value of 4.179 used for the compressor output per compressor’s nominal motor horsepower appeared as “4,179” in the parameter description.
- › Air source heat pumps. The default values for heating and cooling full-load hours were listed as 2,200 hours and 800 hours respectively, instead of the values of 2,750 hours and 400 hours respectively recommended by the 2013 evaluation.
- › VSD for milk vacuum pumps. The sample calculation was incorrect because P_e did not equal to 0.6 as shown. This parameter is actually $P_e = 0.6 * P_b$.
- › Kitchen demand controlled ventilation. The default values for the demand savings factor and the energy savings factor were reversed in the parameter descriptions.

The compiled data from the 58 projects was analyzed in detail to recalculate the energy and demand savings using the algorithms in the BER Screening Tool. Subsequently, the ratio between the savings found in the tracking sheet and the savings calculated by the Evaluator was established for each category based on the on-site visit results. Those ratios were applied to all the savings of the categories, for which the error margin was acceptable (i.e., below 10%). For the categories whose number of projects sampled did not allow for a reasonable margin of error, the necessary adjustments were only made on the gross energy savings values of the projects for which the on-site visit was conducted.

⁴ Efficiency Vermont, *Technical Reference User Manual (TRM) – Measure Savings Algorithms and Cost Assumptions*, September 8, 2013, p. 152.

The following sections present the adjustments calculated for each measure category.

5.1.1 HVAC Measures

A total of 15 on-site visits were conducted for the HVAC measure category this year, but only 13 projects were included in the final analysis because two incomplete projects were removed from the sample. All the completed projects visited were heat pump installations. The on-site visits were used to verify whether both old and new equipment's capacities, quantities and operation schedules corresponded to those claimed in the documentation. This information was used to calculate the savings and ensure that BER guidelines had been followed. Heat pump specifications, such as the coefficient of performance (COP), the heating seasonal performance factor (HSPF), the energy efficiency ratio (EER), and the seasonal energy efficiency ratio (SEER), were researched for each heat pump, if not given on the equipment specifications sheets disclosed in the DSMDS. This information collected on site and through desktop research was used to verify the tracked energy and demand savings of each measure, and calculate the necessary adjustments.

Either a positive or negative adjustment was made to the tracked energy and/or demand savings of each of the 13 projects. There were two common adjustments made to the heat pump measures. The first adjustment was the number of full-load hours (FLH). The second adjustment was the claimed heating capacity. Adjustments were made to only three projects to either the total of their cooling savings and/or to the claimed quantities.

The most common correction made to the tracked heat pump energy savings was the number of FLH hours. As stated in the 2013 evaluation report, the AHRI Standard 210/240⁵ has set the equivalent full-load hours in Region V at 2,750 hours per year.

In fact, this adjustment had to be made for every air-source heat pump measure submitted through BER Mail-in. The Evaluator therefore decided to make this adjustment in the tracking system report, and not to include it in the adjustment ratio for the HVAC category. It is recommended that ENSC use this value in its tracking system, unless the heat pump is used for a specific application that requires a custom value for FLHs.

Similar to 2013, the Evaluator also adjusted the capacity listed in the project documentation to the nominal heating capacity of the heat pump. The capacity listed in BER participant worksheets is typically the nominal cooling capacity. Therefore, each heat pump's specifications sheet was reviewed to determine its nominal heating capacity, which was then used in the revised savings calculations. Half of the heat pump measures visited was adjusted for this reason.

⁵ AHRI. ANSI/AHRI Standard 210/240, *2008 Standard for Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment*.

Specifications, such as the HSPF, occasionally had to be adjusted to match the Nova Scotia climate (Region V). This showed improvement over the 2013 results. It should also be noted that the majority of the projects sampled included equipment specifications sheets.

It was discovered that some of the equations in the tracking sheet included user input errors, which also resulted in savings adjustments.

As stated in the 2013 evaluation report, some models of heat pumps installed will exceed their working limits at a temperature significantly higher than the typical minimum temperature encountered in Nova Scotia. Last year, the Evaluator did not make any adjustment to the calculation; it was however recommended that ENSC only consider heat pump demand savings for those with temperature limits lower than the minimum temperature encountered in Nova Scotia. This recommendation was not implemented by ENSC in 2014. Therefore, the Evaluator conducted research into weather data of the province to determine the lowest temperature recorded from 5 p.m. to 7 p.m., and estimated the minimum temperature at -15°C. The COP and capacity at -15°C was obtained from capacity tables for each heat pump model. Those values were applied to calculate the revised demand savings using the following equation:

$$\text{Demand Savings} = \text{Cap}_{-15^{\circ}\text{C}} [\text{kW}] \times \left(1 - \frac{1}{\text{COP}_{-15^{\circ}\text{C}}}\right)$$

The ratio between the revised demand savings and the ENSC's results (using nominal capacity and HSPF) was obtained, based on all the heat pumps included in the projects visited by the Evaluator. This average ratio of 48 percent was applied to the tracked demand savings of all ASHP measures in the HVAC category, and therefore this adjustment was not included in this category's adjustment ratio. The capacity and COP of heat pumps at -15°C should be taken into account for tracked peak demand savings in the future.

Among the 13 projects, 11 were used to establish the adjustment ratio applied to the tracked energy and demand savings. The other two projects were excluded as they were considered as outliers due to their high adjustment ratios. For the tracked energy savings, the adjustment ratio was established at 1.098, while that for demand savings was set at 1.405.

5.1.2 Commercial Lighting Measures

A total of 25 on-site visits were conducted for the lighting measures category; however, as mentioned above, three projects were eliminated from the data analysis because they were incomplete at the time of the visit. Energy and demand savings were calculated for this category using variables validated during the on-site visits. These variables included, but were not limited to, fixture and/or lamp quantity, displaced wattage, hours of operation, and heating and cooling systems. The on-site heating and cooling systems were used to determine the interactive effects factor that can be applied to the savings.

The tracked savings values claimed were adjusted for 20 of the 22 projects. These adjustments were determined based on a number of factors, including a variation in wattage validated versus wattage claimed, a difference in the hours of operation declared by the participants, as well as the omission of the ballast consumption for existing and proposed fixtures. Unitary wattage values per lamp, as claimed by the participant, were relatively accurate, but the values used in the tracking sheet for measures with a fixture change should always include the ballast factor and ballast consumption.

More than 80 percent of the projects sampled this year involved implementing LED measures, particularly LED tubes for T8 fixtures. For LED tubes, the ballast consumption was ignored in the calculation adjustments, because the ballast remained unchanged. The tracked savings for lamp replacements were solely based on the wattage differences between the existing and the new lamp types, which is similar to the procedure used in BES. In reality, the ballast factor (BF) plays a significant role in the system wattage. The actual power consumed by a lamp can thus be expressed by the following expression:

$$\text{Lamp power consumption} = BF \times \text{lamp nominal wattage}$$

In most cases, the ballast factor is below 1. This means that calculations using only the nominal wattages of the existing and proposed measures without considering the ballast factor may result in an overestimation of energy savings. For this reason, the Evaluator recommends using the following equation to calculate the savings of the T8 to LED re-lamp installed:

$$\text{Energy Savings} = BF \times (W_{\text{lamp}_{\text{base}}} - W_{\text{lamp}_{\text{ee}}})$$

Where:

W_{lamp} represents the nominal wattage of the lamp.

It should be noted that for some LED products, the specification sheet presents the wattage of the lamp based on a given ballast factor, in which case the ballast factor is already included in this value and should not multiply the wattage twice. The assumption underlying this method is that the ballasts in both the existing and proposed measures consume the same amount of power.

In terms of the validated quantities installed, adjustments were made to 3 of the 22 projects to take into account of the various sorts of new information collected on-site and provided by the site contacts.

Adjustments were made to the hours of operation used in 18 of the 22 projects. These corrections were required because the information in the worksheet (i.e., hours of operation per week) did not provide a complete picture of the annual usage of the lighting equipment. For example, for businesses that operate at different levels of capacity during the year, this variation was not taken into account when determining the weekly hours of operation. The Evaluator suggests adding questions to the worksheet regarding seasonal variations in operating hours, and following up on this matter with participants who indicated that they did operate at different levels of capacity in a year so as to obtain a more accurate value.

To sum up, 18 projects were used to calculate the overall measure-category adjustment ratios. This led to an adjustment ratio of 1.035 applied to tracked energy savings; the tracked demand savings were adjusted by a ratio of 0.777. When including the individual adjustments made to the remaining three sampled projects, this resulted in an overall upward adjustment of 4.3 percent to lighting energy savings, and a downward adjustment of 22.4 percent to lighting demand savings.

As mentioned previously, additional lighting projects (including promotional rebates for LED tubes) were presented in a separate tracking report. The same adjustment ratios of 1.035 and 0.777 for energy savings and demand savings respectively were applied to this category. Also, the same diversity factor and line loss factor as applied to the BER Mail-In lighting measure category was used.

5.1.3 Commercial Refrigeration Measures

Three commercial refrigeration projects were sampled as part of the 2014 evaluation. The tracked energy savings were underestimated for all the three projects, and the tracked demand savings were underestimated for two projects.

Two projects containing the outdoor air economizer measure were implemented at the same facility, and had the same discrepancies. In the tracked energy savings calculation, a smaller value was used for the evaporator fan than both the value found in the worksheet and the value identified during the site visit. In addition, there were no economizer fans, as the system relied on natural air movement through actuated louvers. As a result, a portion of the energy savings algorithm, which accounted for the economizer fan's energy use, was removed. Thus, there was an increase in the revised energy savings and the revised demand savings.

The differences observed in the third project were caused by a wrongly applied equation. The tracked savings were established using the Intelligent Defrost Controls algorithm, which applies to freezers only. During the on-site visit, the Evaluator was shown the control unit for the walk-in cooler, which matched the information provided in the invoice included in the project documentation. The savings calculation algorithms for evaporator fan controls were used for this project since the control unit had a dual function (e.g., defrost and evaporator fan control).

Due to the small sample size, no measure-category adjustment ratio was calculated. Adjustments were only made to the individual projects. The tracked energy savings for this category totalled 0.097 GWh, and increased to 0.128 GWh following the review of the three sampled projects, representing an overall increase of 31.2 percent. The tracked demand savings totalled 0.028 MW, and increased to 0.035 GW following the review, representing a 27.3 percent increase.

5.1.4 Motor and VSD Measures

Originally, the motor and VSD measure category was evaluated by conducting twelve on-site visits. As previously mentioned, seven projects were eliminated from the sampled visits because the measure installed was ECM, which was removed for the claimed savings in 2014. Some adjustments were

made to the tracked energy and/or demand savings of five remaining projects because new data was collected on site and/or new default values from the 2013-2015 Massachusetts TRM were applied.

In total, 22 ECM projects (including the seven projects from the sample) were removed from the final tracking system savings due to the recurrent problems in the ECM projects' installation carried out by a single contractor. As a matter of fact, the seven projects removed from the 2014 sample were all installed by this contractor, who once again caused various problems, such as missing ECMs or fans broken as a result of the incorrect installation of an ECM. The Evaluator believes that not claiming the savings from projects installed by this contractor is the correct way to address the issue. If ENSC wants to claim those savings next year, a comprehensive review of all the 22 projects should be made by conducting a phone interview with every participant affected by installation problems to validate the information provided in the participants' files (old equipment, new equipment, the application for which it was installed, etc.) and to find out whether the equipment works properly. For all those projects that do not function properly as expected, a site visit should be conducted to validate what was modified to the initial installation and calculate the savings based on the new setup.

Only one project this year included one redundant motor, and the VSD measure savings were reduced. To prevent this from occurring in the future, the Evaluator recommends adding a specific question about redundancy into the worksheet.

The other major adjustments were the energy savings factor and demand savings factor default values. The default values for these energy and demand savings factors listed in the CIRx tool are based on specific applications (e.g., supply fan and boiler feedwater pump), and come from the 2008 Vermont TRM, which is no longer the most recent version. The Evaluator considered the methodologies used in various jurisdictions, and found that the Massachusetts 2013-2015 TRM⁶ provided more detailed calculations, based on a study that is also cited in many other TRMs. The advantage of this methodology is that it takes into account the efficiency of the motor controlled, as well as adapts the energy and demand savings factors to the building type and the function of the equipment controlled (and implicitly, to the hours of operation and the load factor of the motors). This methodology was used to calculate the revised savings for all VSD projects sampled. It should also be noted that at the moment, ENSC does not collect the efficiency of the motor controlled; since this is a variable in the Massachusetts methodology, it will have to be added to the information required in the application package and worksheets.

While the calculations presented in the Massachusetts TRM are not limited to smaller motors (below 10 HP), as was the case for the Vermont TRM, they are limited to HVAC applications in buildings. The Evaluator found some instances of VSDs installed under BER Mail-in for industrial applications (e.g., to control conveyors). For those applications, neither the Vermont methodology nor the Massachusetts methodology is inadequate. ENSC has been working on a tool that calculates customized energy and

⁶ Massachusetts Electric and Gas Energy, *Massachusetts Technical Reference Manual for Estimating Savings from Energy Efficiency Measures, 2013-2015 Program Years*, 2012, p. 269-271.

demand savings for VSD projects submitted through Custom Retrofit. The Evaluator therefore recommends that the savings for VSDs used for other applications than HVAC be calculated using this tool. The Evaluator also suggests that ENSC consider moving such projects to the Custom Retrofit component. For VSD applications that were not covered by the Massachusetts TRM, the Evaluator has kept the tracked savings.

Due to the elimination of seven of the 12 projects, it was not possible to make an overall measure-category adjustment. Therefore, only the remaining 5 projects were adjusted according to the revised energy and demand savings calculated. The total tracked energy savings were decreased by an insignificant amount (less than 1 MWh), while demand savings were increased by 0.018 MW (an increase of 9.9%).

5.1.5 Compressed Air Measures

The compressed air measure category was evaluated by conducting four on-site visits. Adjustments were made to the tracked energy and demand savings of three of the four projects. Similar to 2013, the hours of operation for the three projects were different than those claimed in the tracked energy savings calculations. Consequently, one project's energy savings were increased by 66 percent, while the other project had a 47 percent decrease. The third project was adjusted to take account of its differences in hours of operation and the airflow values. For this project, the actual CFM measurements that were recorded before and after implementation were used, rather than the default values listed in the CIRx tool.

The number of visits was insufficient to allow establishing an appropriate adjustment ratio, which would have been applied to all the projects of this category. Therefore, the savings of only the visited projects were adjusted. The tracked energy savings of 0.180 GWh were reduced to 0.167 GWh; the tracked demand savings of 0.040 MW were reduced to 0.037 MW.

In terms of the overall impact of these adjustments made to project savings, there has been a decrease of 7.1 percent to the total energy savings, and a decrease 6.1 percent to the total demand savings.

5.1.6 Agricultural Measures

The agricultural measure category was evaluated by conducting five on-site visits in 2014. The number of cows was decreased for two of the projects. For one project, the reduction was made because the number of dry cows had been mistakenly included in the number of milking cows. For the other project, the reduction was made because the number of cows claimed by the farm was wrong; the participant entered the farm's herd size forecast for the near future, instead of the actual number on site.

Two other significant adjustments were made for different reasons. For one project, the tracking system claimed two VSDs installed on the two vacuum pumps. However, there was only one VSD on site. In addition, the total milking hours per year given in the tracking system was the CIRx Screen

Tool default value of 3,000 hours per year. The site visit revealed the actual milking time to be two hours per day, and 730 hours per year. And also, the algorithm entered in the tracking system did not include the P_b term. This element missing from the equation affected both the energy and demand savings. Therefore, this project had a significant reduction in savings.

The adjustment made to the other project was relatively small in comparison to the project just mentioned. The on-site visit revealed that the livestock water feeders use heat recovery from the milk refrigeration process rather than the electric element, and that there was an existing pre-cooler. Although the savings associated with the livestock water feeders were increased, the reduction in savings due to the decrease in the number of cows and the existing pre-cooler resulted in an overall adjustment ratio of 0.85.

In the end, the number of visits was insufficient to allow establishing an appropriate adjustment ratio applicable to all the projects in this category. Therefore, the adjustments were made to the visited projects only. The claimed tracked energy savings of 0.362 GWh were revised as 0.334 GWh (an overall reduction of 7.8%). The total tracked demand savings of 0.109 MW were revised as 0.099 MW. The overall reduction in demand savings was 8.6 percent.

5.1.7 Commercial Kitchen Measures

Commercial kitchen measures were evaluated by conducting five on-site visits. Only one project validated had its tracked savings values matching the revised values. The most prevalent problem was errors in the tracked savings calculation algorithms. Three of the five projects either had equations that were incorrectly chosen for the identified measure, or required elements were missing from the equation. The element missing from the algorithm for calculating the tracked savings accounted for idle time for the dishwasher measure. Also, the equation applied to the hot food holding cabinet measure was incorrect.

The number of visits was insufficient to allow establishing an appropriate adjustment ratio, which would have been applied to all the projects of this category. Therefore, adjustments were made to the savings of only the projects visited. The tracked energy savings of these specific projects were increased by 0.045GWh, while the tracked demand savings was increased by 0.051 MW. Overall, the total energy savings and demand savings were increased by 15.4 percent and 45.6 percent respectively.

5.1.8 Commercial Laundry Measures

One commercial laundry project was validated in 2014. No adjustments were needed, as the data was complete and accurate. The tracked energy savings were 965 kWh, and the tracked demand savings were 3.46 kW.

5.1.9 Commercial Water Heating

There was only one commercial water heating project in 2014, and no site visit was conducted. Therefore, no adjustment ratio was applied to this category.

5.1.10 Solar Measures

One solar thermal project was implemented in 2014. The RETScreen® file provided for the project indicated a 50 percent occupancy rate. The participant declared that the building would be utilized all year round this year. So, the Evaluator considered the 100 percent occupancy rate to be more appropriate. This resulted in an adjustment ratio of 1.310, which increased the tracked energy savings from 0.004 GWh to 0.005 GWh. The tracked demand savings were not affected by the change in the occupancy rate and remained at 0.008 MW.

5.1.11 Diversity Factor

Similar to previous years' evaluations, the electricity-demand peak period in Nova Scotia is between 7 a.m. - 12 p.m., and 4 p.m. - 11 p.m. in December, January, and February during weekdays.⁷ The period of 5 p.m. - 7 p.m. was used as the peak demand period for this year's evaluation.

To evaluate the peak demand savings, the hours of operation were collected during each of the 58 on-site visits. For each measure category, the percentage of total demand savings occurring during the peak demand period was established. These percentages were used to determine the specific diversity factor associated with each measure category.

The HVAC diversity factor was established at 98 percent, since all the projects involved the air-source heat pump, which are supposed to run at maximum capacity in the coldest days of winter. Only one heat pump did not provide heating, which explains why the factor has not been set at 100 percent.

The lighting diversity factor was significantly lower in 2014 than in 2013, at 84 percent. Contrary to last year, few projects with outdoor lighting, which would have been turned on between 5 and 7 p.m. all winter, were visited this year. Instead, the majority of lighting projects were found in commercial spaces that were mostly closed at 5 p.m., resulting in a low diversity factor for many projects.

The diversity factor for compressed air was again low this year because 75 percent of the sampled projects did not operate during the peak period. This was also the case with the refrigeration measure category. There was only one sampled project in Commercial Laundry; therefore, the diversity factor was low.

⁷ Nova Scotia Power, *Domestic Service Time-Of-Day Tariff*
<<http://www.nspower.ca/en/home/aboutnspi/ratesandregulations/electricityrates/domesticservicetimeofdaytariffoptional.aspx>>

The diversity factor established for each measure category is presented in Table 12.

Table 12: Diversity Factors for BER Mail-in

Category of Measure	Diversity Factor
HVAC	98%
Commercial Lighting	84%
Commercial Refrigeration	84%
Motors and VSDs	72%
Compressed Air	39%
Agricultural	80%
Commercial Kitchen	96%
Water Heating	100%
Commercial Laundry	34%
Solar Thermal	100%
LED Promotion	84%

5.1.12 Revised Gross Savings

The savings achieved by every category of BER Mail-in measure are presented in Table 13. Both the energy and demand savings were revised by incorporating the adjustments discussed in the previous sections. Using the diversity factor calculated for each category of measure, the peak demand savings were also established.

The savings at the generator were calculated using a line loss factor of 1.068, which compensates for electricity losses occurring between the meter and the generator. This value is a weighted average of the line loss factors, which Nova Scotia Power Inc. provided for each rate code, and the corresponding energy savings generated by all the BER Mail-In projects and the LED promotion listed in the final tracking sheets.

The total gross energy savings for BER Mail-in are 12.902 GWh at the meter and 13.780 GWh at the generator. The total gross peak demand savings have been estimated at 1.988 MW at the meter and 2.123 MW at the generator.

Table 13: Evaluation Results – Revised Gross Savings – BER Mail-in

Category of Measure	HVAC	Lighting	Refrige- ration	Motors and VSDs	Compressed Air	Agricultural
Tracking System Savings						
Tracked Energy Savings (GWh)	2.837	4.588	0.097	1.269	0.180	0.362
Tracked Demand Savings (MW)	0.548	0.771	0.028	0.176	0.040	0.112
Evaluated Energy Savings						
Adjustment Ratio	1.062	1.043	1.312	1.000	0.929	0.922
Total Gross Energy Savings – at Meter (GWh)	3.013	4.786	0.128	1.269	0.167	0.334
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	1.068
Total Gross Energy Savings – at Generator (GWh)	3.218	1.068	0.136	1.068	0.178	0.356
Evaluated Peak Demand Savings						
Adjustment Ratio	1.371	0.776	1.273	1.099	0.939	0.916
Total Gross Demand Savings – at Meter (MW)	0.751	0.598	0.035	0.194	0.037	0.103
Diversity Factor	98%	84%	84%	72%	39%	80%
Total Gross Peak Demand Savings – at Meter (MW)	0.736	0.503	0.030	0.139	0.014	0.082
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	1.068
Total Gross Peak Demand Savings – at Generator (MW)	0.786	0.537	0.032	0.149	0.015	0.088

(Continued)

Category of Measure	Kitchen	Water Heating	Laundry	Solar	LED Promotion	Total for All Categories
Tracking System Savings						
Tracked Energy Savings (GWh)	0.309	0.057	0.003	0.004	2.671	12.376
Tracked Demand Savings (MW)	0.106	0.007	0.005	0.008	0.486	2.286
Evaluated Energy Savings						
Adjustment Ratio on Energy Savings	1.217	1.000	1.000	1.308	1.035	-
Total Gross Energy Savings – at Meter (GWh)	0.376	0.057	0.003	0.005	2.765	12.902
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	-
Total Gross Energy Savings – at Generator (GWh)	0.401	0.061	0.003	0.005	2.952	13.780
Evaluated Peak Demand Savings						
Adjustment Ratio on Demand Savings	1.456	1.000	1.001	1.000	0.777	-
Total Gross Demand Savings – at Meter (MW)	0.155	0.007	0.005	0.008	0.377	2.270
Diversity Factor	96%	100%	34%	100%	84%	-
Total Gross Peak Demand Savings – at Meter (MW)	0.150	0.007	0.002	0.008	0.317	1.988
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	-
Total Gross Peak Demand Savings – at Generator (MW)	0.160	0.007	0.002	0.008	0.339	2.123

5.2 Net-to-Gross Ratio

The NTGR evaluation is based on a self-report approach which relies on a series of questions designed to measure the influence of BER Mail-in on the participants' decision to implement eligible energy efficiency upgrades and measures.

This section presents the methodology used to transform responses to survey questions into a NTGR. It includes the assessment of only one distortion effect: free-ridership.

5.2.1 Free-ridership

In the case of BER Mail-in, free-ridership can occur when participants would have still implemented the energy efficiency upgrades and measures in the absence of the program. The free-ridership level was measured through the quarterly surveys using a sample of 62 participants with the same algorithm as in previous evaluations. The algorithm behind the free-ridership calculation is presented in Appendix VIII.

The 2014 survey results revealed a global free-ridership level of 25 percent for BER Mail-in. This free-ridership level slightly higher to that obtained during the evaluations of the last three years, i.e., 18 percent in 2013, 18 percent in 2012 and 17.6 percent in 2011.

One of the reasons that explain this increase is the fact that all of the ECM projects (5 in total) were removed from the survey sample, as ENSC did not claim the savings for this type of project in 2014. The free-ridership level of those projects was typically lower than the average.

Another reason is the fact that the lighting measure category has increased its proportion of savings by a sizable amount since last year (17% of gross savings in 2013 vs. 39% in 2014). Lighting measures tend to have a free-ridership rate higher than the average of the BER Mail-in categories, and their influence over the total free-ridership was more significant this year.

One exception for the application of this free-ridership level are the LED tubes that were offered with a promotional rebates in the fall of 2014. Indeed, those projects were not included in the sample for the free-ridership questionnaire because they were conducted too late in the year. Additionally, the promotional rebate for this product, at about 75 percent of the retail price, was significantly higher than for other BER products, for which rebates are capped at about 50 percent of the retail price. Therefore, it is expected that the free-ridership level for those projects would be lower than the average BER Mail-in projects. For those reasons, the Evaluator considered the free-ridership for promotional rebate projects to be nil.

5.2.2 NTGR Calculation

The NTGR is calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership})$$

Using the free-ridership level established for BER Mail-in, the NTGR value is estimated at 0.75, with the exception of promotional rebates LED tubes, for which the NTGR value applied is 1.00.

5.3 Net Savings

The net savings for BER Mail-in were estimated using the NTGR. Since interactive effects were already included in the gross savings calculations of the lighting projects, no other factor had to be applied. The following equation was used to calculate the program net savings.

$$\text{Net Savings} = \text{Revised Gross Savings} \times NTGR$$

This equation was used for both peak demand and energy savings. The results obtained for each category of measures are presented in Table 14. For 2013, the total net energy and peak demand savings amounted to 10.368 GWh and 1.570 MW respectively at the meter, and 11.073 GWh and 1.677 MW respectively at the generator.

Table 14: Evaluation Results – Revised Net Savings – BER Mail-in

Category of Measure	HVAC	Lighting	Refrige- ration	Motors and VSDs	Compressed Air	Agricultural
Energy Savings						
Total Gross Energy Savings – at Meter (GWh)	3.013	4.786	0.128	1.269	0.167	0.334
NTGR	0.75	0.75	0.75	0.75	0.75	0.75
Total Net Energy Savings – at Meter (GWh)	2.260	3.590	0.096	0.952	0.125	0.250
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	1.068
Total Net Energy Savings – at Generator (GWh)	2.413	3.834	0.102	1.017	0.134	0.267
Peak Demand Savings						
Total Gross Peak Demand Savings – at Meter (MW)	0.736	0.503	0.030	0.139	0.014	0.082
NTGR	0.75	0.75	0.75	0.75	0.75	0.75
Total Net Peak Demand Savings – at Meter (MW)	0.552	0.377	0.022	0.104	0.011	0.062
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	1.068
Total Net Peak Demand Savings – at Generator (MW)	0.590	0.403	0.024	0.111	0.012	0.066

(Continued)

Category of Measure	Kitchen	Water Heating	Laundry	Solar	LED Promotion	Total
Energy Savings						
Total Gross Energy Savings – at Meter (GWh)	0.376	0.057	0.003	0.005	2.765	12.902
NTGR	0.75	0.75	0.75	0.75	1.00	-
Total Net Energy Savings – at Meter (GWh)	0.282	0.043	0.002	0.004	2.765	10.368
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	-
Total Net Energy Savings – at Generator (GWh)	0.301	0.046	0.002	0.004	2.952	11.073
Peak Demand Savings						
Total Gross Peak Demand Savings – at Meter (MW)	0.150	0.007	0.002	0.008	0.317	1.988
NTGR	0.75	0.75	0.75	0.75	1.00	-
Total Net Peak Demand Savings – at Meter (MW)	0.112	0.005	0.001	0.006	0.317	1.570
Line Loss Factor	1.068	1.068	1.068	1.068	1.068	-
Total Net Peak Demand Savings – at Generator (MW)	0.120	0.005	0.001	0.006	0.339	1.677

Table 15 presents comparisons between the energy and peak demand savings established by this evaluation for the mail-in rebate approach and those calculated in the 2014 tracking system.

Table 15: Comparison of Tracked and Evaluated Savings at the Generator – BER Mail-in

	Initial Gross Savings	Adjusted Gross Savings	NTGR	Net Savings
Energy Savings				
Tracked Savings from ENSC	13.218 GWh	13.218 GWh	0.82	10.839 GWh
Evaluation Results	13.218 GWh	13.780 GWh	0.80	11.073 GWh
Peak Demand Savings				
Tracked Savings from ENSC	2.441 MW	2.441 MW	0.82	2.022 MW
Evaluation Results	2.441 MW	2.123 MW	0.79	1.677 MW

In 2014, the evaluated gross energy savings exceeded the tracked savings. This was mainly due to positive adjustments made to the calculations for the two largest measure categories, i.e. HVAC and lighting. In spite of the decrease of the NTGR in 2014, net energy savings were also higher than ENSC's tracked values by one percent.

The adjustment made to gross peak demand savings was downward, since diversity factors were not taken into account in the tracking sheet. The Econoler team used the data collected during on-site visits to establish the percentage of total demand savings occurring during the peak demand period and applied this factor to the gross demand savings. This had a significant impact on some high savings categories, such as lighting.

6 IMPACT EVALUATION FOR BER INSTANT REBATES

The objective of the 2014 impact evaluation for BER Instant Rebates was to determine the gross and net energy savings. Both electrical energy and demand savings were estimated by analyzing the following parameters:

- › Savings calculation methodology for each product type
- › Diversity factor
- › Interactive effects
- › Free-ridership

6.1 Gross Savings

This section presents the tracked and revised savings for each product category rebated under BER Instant Rebates. This year, the Evaluator reviewed the consistency of hours of operation and equations used for all the products.

For T8 lamps and CEE-listed ballasts, the baseline wattage was revised based on Canadian regulations and a literature review of the values used by other Canadian utilities. For other products, the Evaluator did not find much representative data: on one hand, the baseline values used by other Canadian utilities were either unavailable or seemed outdated; on the other hand, regulations for a variety of lighting products have changed in the past few years in the United States. Although some baselines presented in other jurisdictions' technical reference manuals are much more sophisticated than those currently used by ENSC, they are not applicable to the Nova Scotian market. Therefore, the Evaluator did not update the baseline wattage, but still made recommendations on improving energy savings equations and assumption documentation.

Given the current situation, the Evaluator recommends investigating the current commercial lighting practice as part of the next program evaluation. Furthermore, the lighting products offered in Canada are likely to rapidly change in the next years, as the Canadian government is starting to implement Amendments 13 and 14 to the Energy Efficiency Regulations. These amendments will impact products such as general service incandescent lamps, fluorescent lamps, fluorescent lamp ballasts and metal halide ballasts, and will generally be aligned with U.S. regulations that are in effect or are about to take effect. Therefore, a close monitoring of the changes in the market baseline will be required to accurately calculate energy savings.

6.1.1 T8 Lamps (HP-T8 and RW-T8)

Tracked Savings

In the 2013 impact evaluation, the Evaluator considered the displaced wattages used for HP-T8 and RW-T8 lamps to be valid. The baseline lamp is still a 34-watt T12 lamp, with the more efficient lamps

having wattages of 25, 28, or 32 watts. The hours of operation used by ENSC was validated in 2012 through a metering study completed under the BES program.

Table 16: Tracked Unitary Savings for T8 Lamps

Type of T8 Lamps	Displaced Wattage	Hours of Operation	Unitary Savings
HP-T8-32 W	34 W – 32 W = 2 W	3,400 hrs/year	6.8 kWh
RW-T8-28 W	34 W – 28 W = 6 W		20.4 kWh
RW-T8-25 W	34 W – 25 W = 9 W		30.6 kWh

Revised Savings

The types of T8 products sold through BER Instant Rebates are identical to last year's products. Therefore, the Evaluator considers the displaced wattages to be valid for this year. As no new metering activity was conducted this year, the annual hours of operation and the unitary savings values remain unchanged.

It is recommended to closely monitor the evolution of the market in future years, as the HPT8 may become the baseline, either because of new Canadian regulations or because of inexpensive and more efficient products to be made available. This baseline shift has already started to make itself felt in both the BER Mail-In on-site visits and the BES on-site visits, which showed that the LED T8 replacement lamp has been gaining momentum since 2013.

6.1.2 High-performance Ballasts

Tracked Savings

The tracked unitary savings are based on the results of last year's evaluation, which were established based on the different ballast displaced wattage values and the proportion accounted for in the 2013 total sales by each new ballast and lamp system.

The wattage of a high-performance ballast combined with various quantities and types of T8 lamps is subtracted from the baseline wattage of a magnetic ballast and various quantities of 34-watt T12 lamps. Based on the proportion of each type of T8 lamp, a weighted average for each lamp/ballast combination (1, 2, 3, or 4-lamp) is calculated. This weighted average excludes the savings associated with the energy-efficient lamps. Following is the calculation equation:

$$\begin{aligned}
 &\text{Unitary ballast wattage savings } (W) = \\
 &\quad (\text{Baseline ballast and lamp } W - \text{New ballast and lamp } W) - \\
 &\quad (\text{Unitary } W \text{ savings for the lamp} \times \text{Number of lamps per ballast})
 \end{aligned}$$

The table below details the unitary savings values calculated for each type of ballast (1-lamp, 2-lamp, 3-lamp and 4-lamp ballasts).

Table 17: Unitary Savings Values for High-performance Ballasts

Type of Ballast	Demand Savings (W)	Hours of Operation (hrs/year)	Energy Savings (kWh/year)
1-lamp ballast	13.46	3,400	45.76
2-lamp ballast	13.46	3,400	45.76
3-lamp ballast	24.38	3,400	82.89
4-lamp ballast	27.38	3,400	93.09

Revised Savings

Similar to previous years' evaluations, the revised displaced wattage for each ballast type was calculated using the proportion of each type of T8 lamp accounted for in the total sales through the BER Instant Rebate initiative. The baseline wattages adopted since 2012 are still used. An investigation was undertaken to determine if the baseline and the new wattages were still valid. The Evaluator consulted the Canadian regulation regarding fluorescent lamp ballasts⁸ (revised in March 2014), and determined the baseline values used since 2012 are still representative of the minimum performance ballasts available on the market. However, it should be noted that in light of the changes to efficiency standards planned for future years, ENSC should continue to closely monitor the market to adjust the baseline, if necessary.

⁸ Natural Resources Canada, *Fluorescent Lamp Ballasts Energy Efficiency Regulations*, updated March 21, 2014, available at < <http://www.nrcan.gc.ca/energy/regulations-codes-standards/products/6897>> (Last accessed January 21, 2015)

Table 18: Revised Displaced Wattages for Each Ballast Type

New Ballast and Lamp Systems	Baseline Wattage	New Wattage	Lamp ΔW	Ballast ΔW	Proportion of T8 Lamps*	Average Ballast ΔW
1-lamp ballast with HP-T8-32 W lamp	43	27	2	14	61.4%	13.61
1-lamp ballast with RW-T8-28 W lamp	43	24	6	13	38.4%	
1-lamp ballast with RW-T8-25 W lamp	43	21	9	13	0.2%	
2-lamp ballast with HP-T8-32 W lamps	72	54	4	14	61.4%	13.61
2-lamp ballast with RW-T8-28 W lamps	72	47	12	13	38.4%	
2-lamp ballast with RW-T8-25 W lamps	72	42	18	12	0.2%	
3-lamp ballast with HP-T8-32 W lamps	112	80	6	26	61.4%	24.84
3-lamp ballast with RW-T8-28 W lamps	112	71	18	23	38.4%	
3-lamp ballast with RW-T8-25 W lamps	112	63	27	22	0.2%	
4-lamp ballast with HP-T8-32 W lamps	144	107	8	29	61.4%	27.84
4-lamp ballast with RW-T8-28 W lamps	144	94	24	26	38.4%	
4-lamp ballast with RW-T8-25 W lamps	144	84	36	24	0.2%	

To the table below shows the revised unitary values calculated for 2014; in these calculations, the same “annual hours of operation” value for T8 lamps as used in 2013 was still used, namely 3,400 hrs/year. Using this annual operation hours value and the displaced wattages calculated in the previous table, the Evaluator revised the unitary savings values for every ballast type.

Table 19: Revised Unitary Savings Values for High-performance Ballasts

Type of Ballast	Demand Savings (W)	Hours of Operation (hrs/year)	Energy Savings (kWh/year)
1-lamp ballast	13.61	3,400	46.27
2-lamp ballast	13.61	3,400	46.27
3-lamp ballast	24.84	3,400	84.46
4-lamp ballast	27.84	3,400	94.66

6.1.3 T5 and T8 High Bay Fixtures

Tracked Savings

The savings values documented in the 2014 tracking sheet for T5 and T8 high bay fixtures were calculated by applying: (1) the differences between the real wattages of the new fixtures installed and the typical baseline wattages; and (2) the “annual hours of operation” value of 3,400 hours per year.

Revised Savings

Last year’s evaluation showed that the method used by ENSC might have underestimated and overestimated the savings, and should be improved. The Evaluator suggested making an analysis by comparing the baseline wattage values currently being used with those used by other jurisdictions, such as the Ontario Power Authority (OPA), and adjusting ENSC’s values accordingly. The Evaluator also recommended separating the ballast wattage from the lamp wattage in the equations presented in the Master Product Code List so as to ensure that the ballast factor of the new fixtures is factored into the equations.

Then, the Master Product Code List and the Equation tab were reviewed to determine whether last year’s recommendations had been implemented. The Evaluator has concluded that no changes have been made to the savings calculations for T5 and T8 high bays. The Evaluator again recommends adjusting the baseline values for both lamps and ballasts, in a manner consistent with other jurisdictions’ baseline values. Also, a ballast factor of the new fixtures should be applied in the calculations. Consequently, the general equation for T5 and T8 high bay fixtures should be revised as follows:

$$ES = Qty * (P_{base} + Ballast_{base} - P_{ee} - Ballast_{ee}) * Hours\ per\ Year / 1000$$

Again in this year’s evaluation, no adjustment was made since specific savings values were calculated for each model of high bay fixture sold through the program, and these savings values were calculated in one cell, which made it impossible to correct or calculate an adjustment factor. Therefore, since ENSC’s calculations savings have been conservative, the Evaluator has decided to keep the savings values for T5 and T8 high bay fixtures as they were in the tracking sheet.

6.1.4 LED Technologies

Tracked Savings

BER Instant Rebates included various LED products, such as downlights, outdoor wall packs, decorative lighting, garage lighting, high and low bay fixtures, strip lighting and troffers.

For each LED product category, the savings calculations were based on the difference between the new wattage of the product installed and a baseline wattage established according to the type of application and an equivalent light output level. The hours of operation used were listed as

3,500 hours per year for 53 percent of the entries, 4,000 hours per year for 39 percent of the entries, and the hours of operation value varied for the remaining entries. These “hours of operation” values were not those recommended in last year’s evaluation.

Revised Savings

In 2013, the Evaluator suggested that the baseline wattage of all LED downlights be adjusted to account for CFL and LED replacements. To evaluate this base case wattage, the Evaluator suggested in 2013 that distributors collect the information on their customers’ intended replacement use for the products sold, and include it in their monthly report. Since the LED downlights are by far the type of product accounting for the largest share of savings in BER Instant Rebates, the Evaluator made this suggestion to ensure a more precise calculation of the savings and reduce the incidence of overestimation. This recommendation was not adopted in 2014. As this approach did not seem feasible for ENSC the Evaluator rather recommends that for next year, the baseline be based on the results of on-site visits that will be conducted as part of the 2015 evaluation of the Business Energy Solution (BES) component. Indeed, LED downlights are also a popular product under BES, and the Evaluator could select their visit sample projects to include a sufficient quantity of LED downlights to establish the light bulbs that they generally replace in commercial, institutional and industrial facilities.

When examining the Master Product Code List, the Evaluator verified the consistency between specific products and their associated baselines and found widespread discrepancies. Identical products of a specific power rating sold at different retail locations were assigned different comparative baselines. This issue was discovered for each LED lighting measure type, and across all the retail vendors.

There should also be more consistency in the annual hours of operation used for the savings calculations. The hours of operation per year should only vary by application: for example, whether the product is intended to be installed indoors, outdoors or in refrigeration applications. Consequently, this year, the Evaluator separately presented the savings for those three applications.

As for the hours of operation, the Evaluator once again applied the same adjustments made in last year’s report:

- › For all LED indoor fixtures, the hours of operation should be 3,400 hours per year. This figure will ensure consistency throughout lighting measures across multiple commercial programs. This resulted in an adjustment of 0.978 for indoor fixtures, which include: LED tube lamps, downlights, high bay fixtures, low bay fixtures, troffers and wall washers.
- › Similar to last year, the Evaluator applied an additional adjustment to take into account the proportion of LED downlights installed in residential applications; it has been assumed that residential applications make up 10 percent of all LED downlights. Thus, for these LED downlights, the hours of operation were revised by: (1) using a weighted average established based on the residential “hours of operation” value and the previously recommended commercial

“hours of operation” value (9.32 hrs/day is equivalent to 3,400 hrs/year) and (2) applying the following equation:

$$\text{Overall hours of operation} = \left(10\% \times 2.7 \frac{\text{hrs}}{\text{day}}\right) + \left(90\% \times 9.32 \frac{\text{hrs}}{\text{day}}\right) = 8.66 \frac{\text{hrs}}{\text{day}}$$

An adjustment factor of 0.930 was thus determined and applied to all the LED downlight savings. As for other types of LED lighting, it was assumed that all lamps were installed in commercial applications and so their hours of operation remained at 3,400 hours per year. The resulting overall adjustment factor for indoor LED lamps has been established at 0.913.

- › As for LED outdoor wall packs, the hours of operation should be 4,380 hours per year. The Evaluator considers it more accurate to establish the annual operation hours on the basis of a daily usage of 12 hours. This change was made for outdoor fixtures, which include: LED decorative walkways, docklights and outdoor wall packs. For garage canopy lighting, the hours of operation were adjusted to 8,760 hours per year, as recommended in the 2013 Savings Verification Study. Those changes have resulted in an adjustment factor of 1.116 for outdoor fixtures.
- › No adjustments were made to strip lighting in refrigeration applications because ENSC implemented last year’s recommendation of using 5,720 hours per year.

The overall adjustment factor established for the LED measure category was 1.034 for 2014.

6.1.5 Induction Technologies

Tracked Savings

The induction technologies eligible for rebates this year included: induction wall packs and high bay fixtures. The tracked savings for each type of induction lighting product were determined based on the difference between the new wattage and the baseline wattage, which was established according to the type of application and an equivalent light output level. The baseline wattages have remained unchanged since 2013.

ENSC used the following values of annual hours of operation: for induction wall packs, 4,000 hrs/year; for induction high bay fixtures, 3,500 hrs/year; for garage canopy lighting, 4,500 hrs/year. All these values indicate that no changes have been made to the savings calculations since last year’s evaluation.

Revised Savings

Since the tracked savings parameters were not modified this year to reflect last year’s evaluation results, the same recommendations made in the last evaluation still apply this year:

- › The baseline wattage values should be revised to ensure that ballast power consumption of replacement fixtures is included.

- › For induction high bay fixtures, their annual hours of operation should be adjusted to 3,400 hours per year to be consistent with the “annual hours of operation” value established in a previous metering study. Based on this change, the Evaluator established the energy-savings adjustment factor at 0.776.
- › As described in the preceding section on LED technologies, 4,380 hrs/year should be used for induction wall packs to reflect 12 hours of operation per day in Nova Scotia. Applying this change to all induction wall packs has increased their energy savings by 9.5 percent.

The adjustments just described have resulted in a 16.7 percent reduction in the overall measure-category savings of the induction technologies eligible under BER.

6.1.6 LED Refrigeration Strip Lighting

Tracked Savings

The LED refrigeration strip lighting savings were established based on the length, the wattage per unit of length, and a baseline wattage of 12 W/ft. Energy savings were calculated by multiplying the displaced wattage by 5,720 hours of operation per year.

Revised Savings

Like last year, the methodology and parameters used for the savings calculation were reviewed. The calculations and assumptions are aligned with the BER Mail-In procedure, and are thus considered adequate.

6.1.7 Occupancy Sensors

Tracked Savings

For 2014, for over 99 percent of the sensors sold, the tracked unitary savings value used for occupancy sensors was 171.52 kWh and the demand savings value used was of 49 W. These values are not those recommended in last year’s evaluation report, which recommended use 173.3 kWh for unitary savings and 47.6 W for demand savings. The tracked energy savings were established using the following equation:

$$\begin{aligned} \text{Energy Savings} = & \\ & \text{Occupancy Factor} * \text{Controlled Wattage} * \text{Operating Hours} * (1 + \\ & \text{Heating Penalty}\% - \text{Cooling Bonus}\%) = 0.33 \times 0.15\text{kW} \times 3500\text{hr} \times (1 + 15.6\% - 8.8\%) \end{aligned}$$

Revised Savings

In last year's evaluation, the revised savings were established using the following equation, which is consistent with the Screening Tool.

$$\text{Energy Savings} = \text{Occupancy Factor} * \text{Controlled Wattage} * \text{Operating Hours}$$

Actually, since 2013, the interactive effects have not been included in the gross savings calculations; instead, the interactive effects have been entered in a separate column of the tracking sheet. This year again, the Evaluator corrected the gross savings value to ensure that it did not include interactive effects. The hours of operation were also modified to correspond to the value used for most commercial lighting measures, i.e., 3400 hrs/year.

Last year, the Evaluator recommended collecting information regarding the intended uses of occupancy sensors sold through BER Instant Rebates to apply the correct occupancy factors (which were found in an Illumination Engineers Society study on different types of rooms). However, ENSC has not yet been able to provide such information in the tracking sheet. Without having new information to allow improving the accuracy of this calculation, the Evaluator used the results of the average energy savings associated with occupancy sensors reported by another study, without distinguishing the types of rooms in which they were installed.

Published by the Lawrence Berkeley National Laboratory, this study is entitled *A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings*⁹. This study has analyzed the accumulated knowledge from 88 other lighting control studies published over the years, and consolidates the savings figures to reflect the real energy savings by lighting control measures actually installed, such as occupancy sensors. The study has determined that occupancy sensors installed in a variety of institutional and commercial buildings yield on average 24 percent savings. After reviewing this study and deciding that its methodology was thorough and sound, the Evaluator chose to apply the 24 percent value as the occupancy sensors' savings percentage factor. Therefore, using the equation mentioned above with an occupancy factor of 24 percent, a controlled wattage of 150 W and 3,400 hours of operation, the unitary savings values have been established at 122 kWh and 36.0 W.

However, it should be noted that the controlled wattage value of 150 W seems to be too low, when compared to values used in other jurisdictions. In fact, technical reference manuals of Illinois, Pennsylvania and Vermont cite values of 73 W to 587 W per occupancy sensor, depending on the type of sensor (e.g., wall mounted, remote or fixture). ENSC started collecting information about the sensor type in June 2014, but this information was available for too few products. So, the Evaluator has decided to continue to use the conservative value currently applied by ENSC. It is recommended that the controlled wattage be adjusted in 2015, based on the type of sensor and the values from Vermont's TRM.

⁹ Erik Page and Associates, Inc. "A Meta-Analysis of Energy Savings from Lighting Controls in Commercial Buildings", Energy Analysis Department, Lawrence Berkeley National Laboratory, September 2011.

6.1.8 Electronically Commutated Motors

ENSC discontinued offering this product in 2014, but some motors purchased in 2013 were returned to the distributors in 2014. As a result, last year, the unitary savings of 954 kWh and 109 W were applied to account for the negative savings to BER Instant Rebates in 2014.

6.1.9 Diversity Factor

As no on-site visits were conducted for BER Instant Rebates, no specific diversity factor could be established. Hence, the diversity factor of 83 percent used by the BER Mail-In approach to lighting products was also applied to BER Instant Rebates. Due to the similarity of products sold by both initiatives, the Evaluator considered this diversity factor to be valid.

6.1.10 Revised Gross Savings

Energy and demand savings associated with the instant rebate approach were calculated using the unitary savings values revised under this evaluation. Savings at the generator were also calculated using a line loss factor of 1.067 between the meter and the generator. This value corresponds to the line loss factor used for BER Mail-in.

The total savings established for each product are presented in Table 20. For the instant rebate approach, gross energy savings amounted to 18.002 GWh at the meter and 19.209 GWh at the generator. The total peak gross demand savings were estimated at 4.260 MW at the meter and 4.545 MW at the generator.

Table 20: Evaluation Results – Gross Energy and Peak Demand Savings for Instant Rebates Products with Unitary Savings Values

Product Category	HP-T8- 32 W Lamps	RW-T8- 28 W Lamps	RW-T8- 25 W Lamps	1-Lamp HP Ballasts	2-Lamp HP Ballasts	3-Lamp HP Ballasts	4-Lamp HP Ballasts	Lighting Occ. Sensors	Motors
Program Tracking Sheet									
Number of Units	93,192	58,343	240	538	18,588	3,657	6,856	3,497	-373
Evaluated Energy Savings									
Unitary Savings (kWh)	6.8	20.4	30.6	46.27	46.27	84.46	94.66	122.00	954.00
Total Gross Energy Savings – at Meter (GWh)	0.634	1.190	0.007	0.025	0.860	0.309	0.649	0.427	-0.356
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067
Total Gross Energy Savings – at Generator (GWh)	0.676	1.270	0.008	0.027	0.918	0.330	0.692	0.455	-0.380
Evaluated Peak Demand Savings									
Unitary Savings (W)	2.0	6.0	9.0	13.61	13.61	24.84	27.84	35.88	109.0
Total Gross Demand Savings – at Meter (MW)	0.186	0.350	0.002	0.007	0.253	0.091	0.191	0.125	-0.041
Diversity Factor	83%	83%	83%	83%	83%	83%	83%	83%	86%
Total Gross Peak Demand Savings – at Meter (MW)	0.155	0.291	0.002	0.006	0.210	0.075	0.158	0.104	-0.035
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067
Total Gross Peak Demand Savings – at Generator (MW)	0.165	0.310	0.002	0.006	0.224	0.080	0.169	0.111	-0.037

Table 21: Evaluation Results – Gross Energy and Peak Demand Savings for All Other Instant Rebates Products

Product Category	T5 and T8 High Bays	LED Downlights	Other Indoor LED Lamps	Outdoor LED Wallpacks	Other Outdoor LED Lamps	LED Ref. Strip Lighting	Induction High Bays	Induction Wall Packs	Total for All Products
Program Tracking Sheet									
Number of Units in the Program Tracking Sheet	3,087	53,756	1,215	10,444	82	37	8	4	253,171
Tracked Energy Savings (GWh)	2.444	6.666	0.396	4.743	0.041	0.016	0.011	0.002	-
Tracked Demand Savings (MW)	0.719	1.917	0.114	1.203	0.009	0.003	0.003	0.001	-
Energy Savings									
Adjustment Ratio on Energy Savings	1.000	0.909	0.979	1.111	1.712	1.000	0.776	1.095	-
Total Gross Energy Savings – at Meter (GWh)	2.444	6.060	0.387	5.270	0.069	0.016	0.009	0.003	18.002
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	-
Total Gross Energy Savings – at Generator (GWh)	2.608	6.466	0.413	5.623	0.074	0.017	0.009	0.003	19.209
Demand Savings									
Adjustment Ratio on Demand Savings	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-
Total Gross Demand Savings – at Meter (MW)	0.719	1.917	0.114	1.203	0.009	0.003	0.003	0.001	5.134
Diversity Factor	83%	83%	83%	83%	83%	83%	83%	83%	-
Total Gross Peak Demand Savings – at Meter (MW)	0.597	1.591	0.095	0.999	0.008	0.002	0.002	0.000	4.260
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	-
Total Gross Peak Demand Savings – at Generator (MW)	0.528	1.409	0.084	0.884	0.007	0.002	0.002	0.000	4.545

6.2 Interactive Effects

As in past year's evaluations, the Evaluator based the calculation of the interactive effects on a study conducted in 1992 by ADS for Hydro-Québec. The interactive effects factor is calculated by using a weighted proportion of commercial buildings that are electrically heated and the proportion that are air-conditioned.

As the BER Instant Rebates evaluation does not include on-site visits or the collection of the building's heating and cooling systems, the Evaluator used the information gathered during the 2014 BES on-site visits to determine the interactive effects. This proportion of buildings data was deemed appropriate for BER Instant Rebates due to the similarities between the two initiatives in terms of eligible products sold.

The table below presents the proportion of buildings from this year's BES evaluation and the associated interactive effects factor. As a result lighting products sold through BER Instant Rebates, and installed indoors, were assigned an interactive effects factor of -5.6 percent. This is significantly less than the 2013 value of -13.0 percent, mostly because the proportion of buildings with air conditioning has seen an important increase with respect to last year (only 41% of buildings had AC in the 2013 sample, and 67% did in 2014), while the proportion of buildings without electric heating has increased from 61 percent to 69 percent.

Table 22: Interactive Effects Factor for Indoor Lighting Products

Parameters	Proportion of Buildings	Interactive Effects ¹⁰
Electric heating with air conditioning	10%	-43.4%
Electric heating without air conditioning	3%	-49.0%
Heating and cooling via heat pump	18%	-10.6%
No electric heating with air conditioning	38%	5.7%
No electric heating without air conditioning	31%	0.0%
Weighted interactive effects factor	100%	-5.6%

There were no interactive effects factor applied to outdoor lighting products, including LED wall pack, LED garage, and induction wall pack fixtures. In 2013, an interactive effects factor of +17 percent was applied to LED strip lighting for refrigeration applications. However this year's calculation in the tracking sheet does not account for any interactive effects. The Evaluator researched this value to determine an appropriate level of refrigeration savings attributed to less heat extraction from the lighting upgrade. Both the 2015 Pennsylvania Public Utility Commission TRM¹¹ and the 2010 New

¹⁰ ADS ASSOCIÉS, "Évaluations des effets énergétiques combinés des mesures d'économies d'énergie – secteur commercial," Hydro-Québec, 1992.

¹¹ Pennsylvania Public Utility Commission TRM, Draft June 2015.

York TRM¹² concur and utilize an interactive effects factor of +41 percent for coolers and +52 percent for freezers. However, the 2013 Vermont TRM¹³ states fewer savings by applying +29 percent for coolers and +50 percent for freezers. The Evaluator has elected to apply the more conservative value of +29 percent, as the location of the installed LED strip lighting is unknown.

6.3 Net-to-Gross Ratio

For BER Instant Rebates, the NTGR evaluation includes the assessment of only one distortion effect: free-ridership. Since the instant rebates are offered all year long through the program and spillover and market effects are therefore expected to be null, they were not included in this year's evaluation.

6.3.1 Free-ridership

For BER Instant Rebates, free-ridership corresponds to the natural market trend. Thus, the free-ridership assessment aims to estimate what would have been the sales of energy-efficient products in a market that evolves naturally, i.e., without the program's intervention.

The free-ridership level was measured through in-depth interviews with distributors, using the same approach as in the 2012 and 2013 evaluations. Three specific products were targeted by this evaluation:

- › LED downlights, including LED screw-in, pin-based, chandelier and recessed/integrated lamps
- › LED outdoor wallpacks
- › T5-T8 high bay fixtures

These products represent 63 percent of all the gross energy savings generated by BER Instant Rebates.

Free-ridership was assessed using a series of questions aimed at identifying the influences that the program had on the market as well as other factors that might have influenced it. The in-depth interviews with the distributors included questions to estimate:

- › The percentage of their energy-efficient products that would not have been sold in the absence of the program
- › The percentage of customers who would still have bought the products in the absence of the program
- › The program influence (on a scale of 0 to 10) on customers' decisions to purchase the targeted energy-efficient lighting products

¹² New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs, October 2010.

¹³ Vermont Technical Reference Manual, 2013.

The results of the in-depth interviews were then transposed into a level of free-ridership for each product. In-depth interview results revealed the following levels of free-ridership for BER Instant Rebates:

Table 23: Free-ridership for BER Instant Rebates

Product	2012 Free-ridership Level	2013 Free-ridership Level	2014 Free-ridership Level
LED downlights	11%	24%	35%
LED outdoor wallpacks	-	-	29%
T5-T8 high bay fixtures	-	-	46%

Regarding the LED downlights, the free-ridership level has increased once again this year, to reach a value of 35 percent. This may be due to the steadily decreasing prices of LED lighting, which was mentioned by many distributors as one of the reasons why LED downlights sales have increased significantly in the past few years. Furthermore, the rebate offered by ENSC dropped from an initial amount of 15 dollars in early 2013 to 3 to 5 dollars since March 2013. Hence, it is possible that the smaller value of the rebate has less impact on the sales of this product in 2014. Nevertheless, various distributors mentioned the important role played by the program to raise customer awareness on the qualities of this product as well as to stimulate a wider and better offering of LED lamp models.

The free-ridership level of LED outdoor wallpacks was evaluated for the first time in 2014, since they became one of the products generating the most savings this year. Based on the answers provided by distributors, free-ridership was estimated at a level of 29 percent. When asked about the level of influence of the program on this product's sales, all distributors said that it had a significant impact. All distributors estimated the percentage of customers who would buy LED outdoor wallpack without the rebate to be between 20 and 60 percent. Some distributors said that they do not quote high intensity discharge (HID) lamps unless specifically told to, and that LED outdoor wallpacks are a much superior product compared to HID lamps, which makes up for part of the price difference. Those elements could explain the moderately high free-ridership.

T5 and T8 high bay fixtures were another product added to the free-ridership evaluation in 2014. Even though those products were not part of the top three savings generating products in previous years, it is a well-established technology. Distributors had diverging opinions on the impact of the program on their sales: some said it led to higher sales, while other mentioned that the T5 and T8 high bay technology has already taken over the old products (such as T12 high bay fixtures). This product had the highest free-ridership levels of all three products surveyed, at 46 percent.

6.3.2 NTGR Calculation

The NTGR is calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership})$$

Using the free-ridership levels established for BER Instant Rebates, the NTGR established for each product included in the analysis:

Table 24: NTGRs for BER Instant Rebates

Product	NTGR
LED downlights	0.65
LED Outdoor wallpacks	0.71
T5-T8 high bay fixtures	0.54

For the other products sold through the instant rebate approach, an NTGR of 1.0 was used.

6.4 Net Savings

Net energy savings for BER Instant Rebates were estimated by adding the interactive effects and the NTGR to the gross energy savings using the following equation:

$$\text{Net energy savings} = \text{Gross energy savings} \times (1 + \text{Interactive effects factor}) \times \text{NTGR}$$

Net energy savings were first calculated separately for each product because the interactive effects factor and NTGR differed from one product to another. Table 25 presents the details of the calculation.

Overall, the total net energy and peak demand savings amounted to 12.687 GWh and 3.002 MW respectively at the meter, and 13.537 GWh and 3.203 MW respectively at the generator.

Table 25: Evaluation Results – Net Energy and Peak Demand Savings for Instant Rebates Products with Unitary Savings Values

Category of Product	HP-T8- 32 W lamps	RW-T8- 28 W lamps	RW-T8- 25 W lamps	1-Lamp HP Ballasts	2-Lamp HP Ballasts	3-Lamp HP Ballasts	4-Lamp HP Ballasts	Lighting Occ. Sensors	Motors
Energy Savings									
Total Gross Energy Savings – at Meter (GWh)	0.634	1.190	0.007	0.025	0.860	0.309	0.649	0.427	-0.356
Interactive Effects Factor	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	0.0%
NTGR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Net Energy Savings – at Meter (GWh)	0.598	1.124	0.007	0.024	0.812	0.292	0.613	0.403	-0.356
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067
Total Net Energy Savings – at Generator (GWh)	0.638	1.199	0.007	0.025	0.866	0.311	0.654	0.430	-0.380
Peak Demand Savings									
Total Gross Peak Demand Savings – at Meter (MW)	0.155	0.291	0.002	0.006	0.210	0.075	0.158	0.104	-0.035
Interactive Effects Factor	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	-5.6%	0.0%
NTGR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Net Peak Demand Savings – at Meter (MW)	0.146	0.274	0.002	0.006	0.198	0.071	0.150	0.098	-0.035
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067
Total Net Peak Demand Savings – at Generator (MW)	0.156	0.293	0.002	0.006	0.211	0.076	0.160	0.105	-0.037

Table 26: Evaluation Results – Net Energy and Peak Demand Savings for Other Instant Rebates Products

Category of Product	T5 and T8 High Bays	LED Downlights	Other Indoor LED Lamps	Outdoor LED Wallpacks	Other Outdoor LED Lamps	LED Ref. Strip Lighting	Induction High Bays	Induction Wall Packs	Total for all products
Energy Savings									
Total Gross Energy Savings – at Meter (GWh)	2.444	6.060	0.387	5.270	0.069	0.016	0.009	0.003	18.002
Interactive Effects Factor	-5.6%	-5.6%	-5.6%	0.0%	0.0%	29.0%	-5.6%	0.0%	-
NTGR	0.54	0.65	1.00	0.71	1.00	1.00	1.00	1.00	-
Total Net Energy Savings – at Meter (GWh)	1.246	3.718	0.366	3.742	0.069	0.020	0.008	0.003	12.687
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	-
Total Net Energy Savings – at Generator (GWh)	1.330	3.967	0.390	3.992	0.074	0.022	0.009	0.003	13.537
Peak Demand Savings									
Total Gross Peak Demand Savings – at Meter (MW)	0.597	1.591	0.095	0.999	0.008	0.002	0.002	0.000	4.260
Interactive Effects Factor	-5.6%	-5.6%	-5.6%	0.0%	0.0%	29.0%	-5.6%	0.0%	-
NTGR	0.54	0.65	1.00	0.71	1.00	1.00	1.00	1.00	-
Total Net Peak Demand Savings – at Meter (MW)	0.304	0.976	0.089	0.709	0.008	0.003	0.002	0.000	3.002
Line Loss Factor	1.067	1.067	1.067	1.067	1.067	1.067	1.067	1.067	-
Total Net Peak Demand Savings – at Generator (MW)	0.325	1.042	0.095	0.757	0.008	0.003	0.002	0.001	3.203

Table 27: Comparison of Tracked and Evaluated Savings at the Generator for Instant Rebates

	Initial Gross Savings	Adjusted Gross Savings	Adjusted Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings					
Tracked Savings from ENSC	19.681 GWh	19.681 GWh	16.440 GWh	0.80	13.152 GWh
Evaluation Results	19.273 GWh	19.209 GWh	18.400 GWh	0.73	13.537 GWh
Peak Demand Savings					
Tracked Savings from ENSC	5.590 MW	5.590 MW	4.658 MW	0.80	3.726 MW
Evaluation Results	5.478 MW	4.545 MW	4.349 MW	0.74	3.203 MW

For BER Instant Rebates, the evaluated net energy savings are higher than the tracked savings, by 3 percent. This was due in part to the negative interactive effects, which are now much lower (-13.3% for indoor lighting in 2013, compared to -5.6% in 2014). The adjusted gross peak demand savings were significantly lower than expected, as the diversity factor decreased to 83 percent in 2014. This can be explained by the fact that fewer outdoor lighting products were installed this year, and more products were installed in commercial facilities which would be turned off during peak demand hours. The NTGR was also significantly lower in 2014, in part because the most popular products in BER Instant Rebates, which were selected for the evaluation of the NTGR, have changed, and their respective NTGR has become lower.

7 OVERALL BER RESULTS

This section summarizes the overall results of the impact evaluation of BER. With combined net savings generated from both the mail-in rebate and the instant rebate approaches, the total energy and peak demand savings amounted to 24.610 GWh and 4.880 MW respectively. The table below presents the total gross and net savings established by the impact evaluation of BER.

Table 28: Overall Comparison of Tracked and Evaluated Savings at the Generator for BER

	Initial Gross Savings	Adjusted Gross Savings	Adjusted Gross Savings with Interactive Effects	NTGR*	Net Savings
Energy Savings					
Tracked Savings from ENSC	32.889 GWh	32.889 GWh	29.658 GWh	0.81	23.991 GWh
Evaluation Results	33.889 GWh	32.988 GWh	32.216 GWh	0.76	24.610 GWh
Peak Demand Savings					
Tracked Savings from ENSC	8.031 MW	8.031 MW	7.099 MW	0.81	5.728 MW
Evaluation Results	7.944 MW	6.668 MW	6.472 MW	0.75	4.880 MW
* The NTGR was different for each component. The NTGRs presented in this table match the rounded averages obtained by dividing the net savings by the installed gross savings (with interactive effects).					

CONCLUSION

The 2014 evaluation of BER demonstrated that most of the recommendations pertaining to process issues made in the previous evaluations have been implemented. The Evaluator commends ENSC on its efforts in improving and optimizing BER. Among the improvements, the Evaluator noticed the efforts made to improve the tracking system, analyze the product offerings to reduce duplicate rebates and implement some automated calculations of savings in the DSMDS. Furthermore, ENSC has deployed efforts to collaborate more closely with distributors by reducing the burden associated with product approval. In fact, ENSC is now a member of the DLC, which will allow distributors to refer to the DLC's product repertory, resulting in fewer product approval procedures. However, the impact evaluation has shown that few improvements have been made to the savings calculations since the past two evaluations conducted by the Econoler team. This is an aspect of the program which ENSC should focus on in the future.

Survey results showed that participants were very satisfied with their experience with BER, including their interactions and communications with contractors, distributors and consultants, rebate or incentive amounts and the time required to receive the rebate or incentive. For the most part, participants found it easy to participate in BER. That said, a smaller proportion of the participants found the BER participation process easy to complete for reasons such as difficulty in obtaining the information that ENSC needed, insufficient amount of information regarding the process, time-consuming process, eligibility hard to ensure and communication issues. Participants also recommended that more information be provided about the program.

Similar to last year, distributors expressed dissatisfaction with the rebate tracking and reporting processes. While satisfaction with this aspect of BER has slightly improved compared to last year, distributors were dissatisfied with the time required to record and report rebates, the financial responsibility resulting from rebate processing errors and the complexity related to applying rebates. This proved to be the main source of dissatisfaction with BER among distributors, whose overall satisfaction with the program has decreased since last year.

To calculate the net savings of BER in 2014, the Evaluator reviewed the gross savings estimated by ENSC based on 58 on-site visits and a literature review, and took into consideration the free-ridership level for each rebate approach. A free-ridership level of 25 percent was established through the quarterly participant surveys, resulting in an NTGR of 0.75 for the mail-in approach, with the exception of LED tubes with a promotional rebates, for which the NTGR was of 1.00. For the instant rebate approach, the Evaluator calculated the respective free-ridership levels of the three major product categories (i.e., T5 and T8 high bay fixtures, LED outdoor wallpacks and LED downlights) based on the distributor interviews, and applied a zero free-ridership level to other products. This resulted in an overall NTGR of 0.73 for energy savings of this component.

The evaluation revealed that overall BER generated net energy savings of 24.610 GWh and peak demand savings of 4.880 MW at the generator in 2014, compared to 34.169 GWh and 9.367 MW respectively in 2013, and 21.858 GWh and 6.285 MW respectively in 2012¹⁴. While these overall results represent a significant decrease in savings compared to last year, it should be noted that the BER Mail-In component results have much improved. However, BER Instant Rebates generated far less savings (13.537 GWh in 2014 vs. 37.557 GWh in 2013). This has largely been due to the fact that the 2013 sales of LED downlights were too high because of a special event in February which led to gross savings of more than 9 GWh being claimed by two distributors for this single product.

¹⁴ 2011 net energy savings include Business Energy Rebates (BER) and Smart Lighting Choices (SLC) results.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix summarizes all the recommendations made by the Evaluator throughout this report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Review information provided to participants about BER to better assist them with the participation process. Survey results have shown that a smaller proportion of the participants found the BER participation process easy to complete. Difficulties encountered by participants included difficulties in getting the information that ENSC required, insufficient information about the process, time-consuming process and communication issues. Participants also mentioned the need to provide more information about the program as the main recommendation to improve BER. These results show a need for both enhanced and clearer information about the BER participation process. Thus, the Evaluator recommends reviewing current BER information to better assist participants.
	2 Continue with the efforts to simplify rebate tracking and reporting processes. In 2013, the Evaluator recommended that ENSC review the rebate tracking and reporting processes, with a particular focus on timeliness and structure. ENSC has made progress in this aspect of BER, which distributors have noticed as shown by their higher level of satisfaction with this in 2014. That said, rebate tracking and reporting remains the main source of dissatisfaction with the program among distributors. Distributors raised several issues regarding rebate processing, tracking and reporting, including the time required to record and report rebates, and the financial responsibility resulting from rebate processing errors, which were often caused by the complexity associated with applying rebates. The Evaluator recommends continuing to make efforts to improve the rebate tracking and reporting processes to reduce the distributors' administrative burden, thereby increasing their satisfaction with BER.
	3 Implement recommended changes to savings calculations in a timely manner. Once again this year, the Evaluator found that not many modifications to savings calculations recommended in last year's evaluation report were made. In fact, many recommendations on this matter made two years ago have not yet been implemented. This year, to avoid applying an adjustment ratio that would have been too big and would have caused an excessive margin of error, the Evaluator adjusted the tracked savings for peak demand and energy savings of air-source heat pumps to follow up on last year's recommendation. The Evaluator thinks that ENSC should have made such adjustments as part of its responsibilities.
	4 Collect additional information on the measures sold through BER Instant Rebate and continue improving the tracking system. BER Instant Rebate tracking report has seen some significant improvements since last year. Most notably, the Masterlist tab, which lists all the unitary savings equations and values for all the approved products, can now be easily linked to the Reporting tab by using the unique code assigned to each product. Since

Sections	Recommendations
	the equation used for each transaction can now be validated, the Evaluator recommends that ENSC use those tools to collect information that can improve the accuracy of the savings calculated. For instance, the type of each approved occupancy sensor can be identified in the Masterlist. Since all the products sold through BER Instant Rebates are lighting products, their unitary savings can be calculated with a limited number of variables (baseline and efficient wattage, and hours of operation). It is therefore also recommended to present each of these three variables in a separate column so that they can be easily validated and used to allow energy and demand savings to be automatically calculated.
	5 Be proactive in addressing issues related to contractors. In the 2013 evaluation of BER Mail-in, a quality issue with one contractor's work to install the electronically commutated motor (ECM) was identified. This issue caused a major reduction in the evaluated savings established for this measure category. Although ENSC took the time to contact the participants affected by this issue, it took no concrete measures to improve the quality of this contractor's installation work. As a result, similar problems occurred again with this contractor in 2014, and 22 projects had to be removed from the claimed savings.
	6 Re-assess the product offerings to consider the baseline improvement observed in the market. In 2014, the free-ridership level increased to an average of 26 percent for BER. This was a significant increase compared to the 17 percent value established in the 2013 evaluation. The Evaluator believes that this is an indicator that some rebated products might have become closer to the current practice of the market. For example, BER Instant Rebates distributors reported that the market was naturally moving towards T5 and T8 high bay fixtures and LED downlights; the free-ridership levels for those products were respectively at 46 percent and 35 percent. The lighting market is changing rapidly, because the prices of new technologies are dropping and new regulations have recently been enacted. The Evaluator is of the opinion that ENSC should re-assess its product offerings to ensure that it is promoting products of higher efficiency than those used in the current practice.
Tracking System	7 Use a formula to calculate all the projects' total savings. It was found that in some cases, the total savings of a given project were entered manually rather than calculated by a formula that would have added up all of the measure's savings. This method led to a few errors in the tracked savings. It is recommended that a formula be systematically used to calculate every project's total savings.
	8 Provide complete project documentation in the DSMDS. While the documentation quality of some project categories has improved over the past few years, the Evaluator still found some projects, whose worksheets provided did not contain all the necessary information. This is especially true for ECMs and lighting projects. ENSC should continue to make efforts to ensure every project has complete documentation to facilitate the evaluation process.

Sections	Recommendations
	9 Stating baseline assumptions in the Equations tab. The Equation tab now indicates the baseline wattage for each product sub-category. However, it is often difficult for the Evaluator to understand how this value was defined; this might also pose a problem for ENSC, as assumptions are not documented for future revisions. Consequently, it is recommended that a new column be added to give more details about the baseline, including elements such as the technology used, number of lamps and ballast consumption, if applicable (e.g., 2x 32W T12 with magnetic ballast (20 W)).
Impact Evaluation Mail-In	10 To better estimate the peak demand savings of heat pumps, the Evaluator conducted research into weather data of the province to determine the lowest temperature recorded from 5 p.m. to 7 p.m., and estimated the minimum temperature at -15°C. The COP and capacity at -15°C was obtained from capacity tables for each heat pump model, and those values were applied to calculate the revised demand savings. This adjustment should be taken into account for tracked peak demand savings in the future.
	11 One project this year included one redundant motor, for which the VSD measure savings were reduced. To prevent this from occurring in the future, the Evaluator recommends adding a specific question about redundancy into the worksheet.
	12 At the moment, ENSC does not collect the efficiency of the motor controlled; since this is a variable in the Massachusetts methodology, it will have to be added to the information required in the application package and worksheets.
	13 The Evaluator recommends that the savings for VSDs used for other applications than HVAC be calculated using the custom calculation tool developed by ENSC. The Evaluator also suggests that ENSC consider moving such projects to the Custom Retrofit component.
Impact Evaluation Instant Rebates	14 For T8 lamps and CEE-listed ballasts, the baseline wattage was revised based on Canadian regulations and a literature review of the values used by other Canadian utilities. For other products, the Evaluator did not find much representative data: on one hand, the baseline values used by other Canadian utilities were either unavailable or seemed outdated; on the other hand, regulations for a variety of lighting products have changed in the past few years in the United States. Although some baselines presented in other jurisdictions' technical reference manuals are much more sophisticated than those currently used by ENSC, they are not applicable to the Nova Scotian market. Therefore, the Evaluator did not update the baseline wattage, but still made recommendations on improving energy savings equations and assumption documentation. Given the current situation, the Evaluator recommends investigating the current commercial lighting practice as part of the next program evaluation. Furthermore, the lighting products offered in Canada are likely to rapidly change in the next years, as the Canadian government is starting to implement Amendments 13 and 14 to the Energy Efficiency Regulations.

Sections	Recommendations
	15 The Evaluator recommends again this year adjusting the baseline values for both lamps and ballasts, in a manner consistent with other jurisdictions' baseline values. Also, a ballast factor of the new fixtures should be applied in the calculations
	16 The Evaluator recommends that for next year, the baseline for LED downlights be based on the results of on-site visits that will be conducted as part of the 2015 evaluation of the Business Energy Solution (BES) component.
	17 The currently used controlled wattage value of 150 W for occupancy sensors seems to be too low, when compared to values used in other jurisdictions. In fact, technical reference manuals of Illinois, Pennsylvania and Vermont cite values of 73 W to 587 W per occupancy sensor, depending on the type of sensor (e.g., wall mounted, remote or fixture). ENSC started collecting information about the sensor type in June 2014. It is recommended that the controlled wattage be adjusted in 2015, based on the type of sensor and the values from Vermont's TRM

APPENDIX II

INTERVIEW GUIDE WITH DISTRIBUTORS

Hello, may I please speak with _____?

[INTRODUCTION]

Hello, my name is _____, from Corporate Research Associates Inc., a marketing survey research firm. I am calling on behalf of Efficiency Nova Scotia Corporation to gather your opinion about the impact of the Business Energy Rebates Program.

IDENTIFICATION AND SCREENING OF RESPONDENT

11. According to our records, your company/store has participated in the Business Energy Rebates Program from Efficiency Nova Scotia. Corporate Research Associates and Econoler have been mandated by Efficiency Nova Scotia to conduct an evaluation of this program. We have a few questions about your company/store's participation in this program. I'd like to speak with someone in your company/store who is knowledgeable about the stocking and supplying of specific products that were rebated by the program. These products are T5 and T8 high bay fixtures, LED outdoor wallpacks, and LED downlights, including LED screw-in lamps, LED pin-based lamps, LED chandelier lamps and LED recessed/integrated lamps. Would that person be you?
- › Person responsible available [CONTINUE]
 - › Person responsible currently unavailable [ARRANGE CALL BACK WITH THE RIGHT PERSON]
 - › No person responsible for stocking or management of products [CONTINUE INTERVIEW WITH STORE MANAGER/HEAD OFFICE CONTACT - CONTINUE]
 - › Don't know [CONTINUE INTERVIEW WITH STORE MANAGER/HEAD OFFICE CONTACT - CONTINUE]
 - › Refused [THANK AND TERMINATE]

Confidentiality

Please note that your responses will be kept strictly confidential and that we will not share the information you provide with any other party in a way that could identify your individual or corporate responses.

Recording of the Interview

Please note that the interview will be recorded for transcription purposes only. The recording will remain strictly confidential.

T5 AND T8 HIGH BAY FIXTURES

ASK IF T5 AND T8 HIGH BAY FIXTURES WERE REBATED THROUGH THE PROGRAM

I have a few questions about your sales of **T5 and T8 high bay fixtures** that are promoted by the Business Energy Rebates Program. Our records indicate that your total sales of T5 and T8 high bay fixtures up to September 2014 amounted to _____ products. Furthermore, your sales for 2013 amounted to _____ products.

Ask if there is a significant difference (plus or minus 25%) between sales in 2014 (expected) and 2013.

- T1. If the current trend is maintained, the number of T5 and T8 high bay fixtures you will sell in 2014 will be significantly [FROM SAMPLE: lower/higher] than for the previous year. Does that sound accurate? If so, what explains this difference? [PROBE: market trend, more competitors offering these products, etc.]
- T2. In 2014, the Business Energy Rebates Program provided an incentive of \$60 and \$45 for each T5 and T8 high bay fixture sold in your store(s), respectively. If this incentive had not been available, do you think that your 2014 sales, in number of units, of T5 and T8 high bay fixtures would have been about the same or lower?
1. Same [GO TO T4]
 2. Lower [GO TO T2a]
 98. (Don't know) [GO TO T4]
 99. (Refused) [GO TO T4]

[IF ANSWERED SAME] I just want to make sure I understand well. Without the program and its incentive, you would have sold the same number of **T5 and T8 high bay fixtures**?

- T2a. By what percentage do you estimate the number of T5 and T8 high bay fixtures sold in your store would have been lower in 2014 if the Business Energy Rebates Program incentive was not available?

RECORD PERCENTAGE ____%

RECORD EXPLANATION:

- T2b. And since its inception in 2011, what impact, if any, has the program had on...
- › the number of T5 and T8 high bay fixtures sold in your store?
 - › your staff's overall knowledge of these products?

- T4. I am interested in understanding the impact of the Business Energy Rebates program on customers' product choice. Using a scale from 0 to 10, where 0 is "not at all important" and 10 is "extremely important", to what extent do you believe that the Business Energy Rebates program influenced your customers to purchase T5 or T8 high bay fixtures instead of metal halide or high pressure sodium fixtures this year?

RECORD RATING: _____

RECORD EXPLANATION:

- T5. If the program stopped and the incentive was no longer available, what percentage of customers do you think would still buy T5 and T8 high bay fixtures?

RECORD PERCENTAGE: _____%

RECORD EXPLANATION:

(If percentage is too different from percentage given at T2, validate both, and if they remain the same, try to get an explanation)

- T6. Do you think that the \$60 or \$45 incentive provided to clients for each T5 or T8 high bay fixture purchased is adequate, too low, or too high? What would be a more appropriate amount? Why?

LED OUTDOOR WALLPACKS

ASK IF LED OUTDOOR WALLPACKS WERE REBATED THROUGH THE PROGRAM

I have a few questions about your sales of **LED outdoor wallpacks** that are promoted by the Business Energy Rebates Program. Our records indicate that your total sales of LED outdoor wallpacks up to September 2014 amounted to _____ products. Furthermore, your sales for 2013 amounted to _____ products.

Ask if there is a significant difference (plus or minus 25%) between sales in 2014 (expected) and 2013.

- E1. If the current trend is maintained, the number of LED outdoor wallpacks you will sell in 2014 will be significantly [FROM SAMPLE: lower/higher] than for the previous year. Does this sound accurate? If so, what explains the difference? [PROBE: market trend, more competitors offering these products, etc.]

E2. In 2014, the Business Energy Rebates Program provided an incentive between \$25 and \$125, depending on the wattage, for each LED outdoor wallpack sold in your store(s). If this incentive had not been available, do you think that your sales of LED outdoor wallpacks in 2014 would have been about the same or lower?

1. Same [GO TO E4]
2. Lower [GO TO E2a]
98. (Don't know) [GO TO E4]
99. (Refused) [GO TO E4]

[IF ANSWERED SAME] I just want to make sure I understand well. Without the program and its incentive, you would have sold the same number of **LED outdoor wallpacks**?

E2a. By what percentage do you estimate the number of LED outdoor wallpacks sold in your store would have been lower in 2014 if the Business Energy Rebates Program incentive was not available?

RECORD PERCENTAGE ____%

RECORD EXPLANATION:

E2b. And since its inception in 2011, what impact, if any, has the program had on...

- › the number of LED outdoor wallpacks sold in your store?
- › - your staff's overall knowledge of these products?

E4. I am interested in understanding the impact of the Business Energy Rebates program on customers' product choice. Using a scale from 0 to 10, where 0 is "not at all important" and 10 is "extremely important", to what extent do you believe that the Business Energy Rebates program influenced your customers to purchase LED outdoor wallpacks instead of metal halide or high pressure sodium fixtures this year?

RECORD RATING: _____

RECORD EXPLANATION:

E5. If the program stopped and the incentive was no longer available, what percentage of customers do you think would still buy LED outdoor wallpacks?

RECORD PERCENTAGE: _____%

RECORD EXPLANATION:

(If percentage is too different from percentage given at E2, validate both, and if they remain the same, try to get an explanation)

E6. Do you think that the incentive between \$25 and \$125, depending on the wattage, provided to the client per LED outdoor wallpack purchased is adequate, too low, or too high? What would be a more appropriate amount? Why?

LED DOWNLIGHTS**ASK IF LED DOWNLIGHTS WERE REBATED THROUGH THE PROGRAM**

I have a few questions about your sales of LED downlights that are promoted by the Business Energy Rebates Program. LED downlights include LED screw-in lamps, LED pin-based lamps, LED chandelier lamps and LED recessed/integrated lamps. Our records indicate that your total sales of LED downlights up to September 2014 amounted to _____ products. Furthermore, your sales for 2013 amounted to _____ products.

Ask if there is a significant difference (plus or minus 25%) between sales in 2014 (expected) and 2013.

- L1. If the current trend is maintained, the number of LED downlights you will sell in 2014 will be significantly [FROM SAMPLE: lower/higher] than for the previous year. Does this sound accurate? If so, what explains this difference? [PROBE: market trend, more competitors offering these products, ability to purchase LEDs at a good price, etc.]
- L1a. What percentage of the LED downlights you sold through the program was purchased by contractors or end users for residential application so far in 2014?
- L2. In 2014, the Business Energy Rebates Program provided an incentive between \$3 and \$5 for each LED downlight sold in your store(s). If this incentive had not been available, do you think that your 2014 sales of LED downlights would have been about the same or lower?
- 1. Same [GO TO L4]
 - 2. Lower [GO TO L2a]
 - 98. (Don't know) [GO TO L4]
 - 99. (Refused) [GO TO L4]

[IF ANSWERED SAME] I just want to make sure I understand well. Without the program and its incentive, you would have sold the same number of LED downlights compared to standard lights?

- L2a. By what percentage do you estimate the number of LED downlights sold in your store would have been lower in 2014, if the Business Energy Rebates Program incentive had not been available?

RECORD PERCENTAGE ____%

RECORD EXPLANATION:

- L2b. And since its inception in 2011, what impact, if any, has the program had on...
- › the number of LED downlights sold in your store?
 - › your staff's overall knowledge of these products?

- L4. I am interested in understanding the impact of the Business Energy Rebates program on customers' product choice. Using a scale from 0 to 10, where 0 is "not at all important" and 10 is "extremely important", to what extent do you believe that the Business Energy Rebates program influenced your customers to purchase LED downlights instead of incandescent, halogen or compact fluorescent lamps, this year?

RECORD RATING: _____

RECORD EXPLANATION:

- L5. If the program stopped and the incentive was no longer available, what percentage of customers do you think would still buy LED downlights?

RECORD PERCENTAGE: _____%

RECORD EXPLANATION:

(If percentage is too different from percentage given at L2, validate both, and if they remain the same, try to get an explanation)

- L6. Do you think that the \$3-\$5 incentive provided to clients for each LED downlights purchased is adequate, too low, or too high? What would be a more appropriate amount? Why?
- L7. LED downlights sold through the program may replace CFLs, incandescent or halogen lamps. How do you know which lamp is replaced with the LED downlight you sell within the BER program?
- L1b. Were any of the LED downlights you sold through the program in 2014 purchased specifically to replace old LED lamps? If yes, what percentage of the LED downlights were sold through the program for this application?

SATISFACTION AND RECOMMENDATION

ASK ALL RESPONDENTS

- S1. On a scale from 1 to 10 (where 1 = not at all satisfied and 10 = very satisfied)...
- 18 how would you rate your satisfaction with each of the following aspects?
- 19 Please share the reason(s) for your score.

Aspects of the program	a. Score	b. Reason
S1. The overall program		
S2. The program support and communications		
S3. The rebate processing, tracking and reporting		

- S4. Finally, do you have any suggestions to improve the program?

☐ No

☐ Yes

S4a. If “Yes,” please explain the nature of the improvement(s):

Those are all the questions I have for you today. Would you like to add anything else regarding the program or talk about any other topic that was not covered during the interview?

X. Corporate Research Associates is currently doing a short study on the introduction of new Codes and Standards in the Nova Scotia market. It's possible that one of my colleagues may call you about this subject. Would that be alright with you?

Y. We are also looking to speak with contractors to assess the program's influence on their clients' decision to install energy-efficient products. Would you be able to recommend any contractors that may qualify?

RECORD NAME AND CONTACT INFO OF CONTRACTORS: _____

THANK YOU FOR TAKING THE TIME TO RESPOND TO THIS INTERVIEW.

APPENDIX III ANNUAL SURVEY QUESTIONNAIRE

Could I speak with **[INSERT NAME]**?

1. Yes **[GO TO INTRODUCTION]**
2. No **[SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]**

[INTRODUCTION]

Hello, I am with CRA (Corporate Research Associates), and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your firm recently participated in Efficiency Nova Scotia Corporation's Business Energy Rebates Program. We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about fifteen minutes. Is this a good time for you?

Verification and Recall (V Series)

- V1. Our records indicate that your company or organization would have received a mail-in rebate for an energy efficiency measure that was installed as part of Efficiency Nova Scotia's Business Energy Rebates Program. Is this correct?
1. Yes (Go TO V3)
 2. No
- V2. Is there someone else at your company or organization who would know about your company / organization's participation in Efficiency Nova Scotia's Business Energy Rebates Program?
1. Yes (Ask for name: _____ and telephone #: _____) (Thank and terminate; schedule interview with best contact)
 2. No (Thank and terminate)
- V3. Are you the person in your company or organization who is most knowledgeable about your experience with the Business Energy Rebates Program?
1. Yes (if YES go to P1)
 2. No

- V4. We would like to talk to the person who is the most knowledgeable about your experience with the Business Energy Rebates Program. Could you give me the name and telephone number of this person? [Probe if respondent is unsure who best to forward the call to. This individual may be an engineer, equipment contractor, or utility account manager].

Name: _____

Telephone #: _____

(Note: Thank and terminate call. Schedule interview with best contact regarding experience with the program.)

- V5. According to our information, through its participation in the Business Energy Rebates Program, your company or organization received a rebate of [REBATE] in the month of [DATE COMPLETED IN DSMDS] to install [MEASURE CATEGORY] measures. When answering the survey questions, please take into account this specific application.

Program Awareness and Participation (P Series)

- P1. Did your company or organization participate in any other Nova Scotia Power or Efficiency Nova Scotia programs before the Business Energy Rebates Program?

1. Yes
2. No (Go to P4)
98. (Don't know) (Go to P4)
99. (Refused) (Go to P4)

- P2. [IF P1 = 1] Which programs did your company or organization participate in prior to the Business Energy Rebates Program? (DO NOT READ. If respondent cannot recall the program names record a short description verbatim.)

1. (Custom Retrofit)
2. (Business Energy Solutions (BES))
96. (Other, please specify: _____)
98. (Don't know)
99. (Refused)

- P4. How did your company first learn about the Business Energy Rebates Program? Probe: Anything else? [DO NOT READ - MULTIPLE RESPONSES]

1. Media advertising
2. Someone at Efficiency Nova Scotia contacted the business
3. Through a third-party contractor

4. The business contacted Efficiency Nova Scotia about the program
5. Word-of-mouth
6. Efficiency Nova Scotia website
7. Facebook or other social media
97. Other [SPECIFY:]
98. Cannot recall

P5. What was the SINGLE most important reason your company or organization chose to participate in the Business Energy Rebates program? (DO NOT READ – accept one response)

1. (to take advantage of program rebates)
2. (this was part of an already planned project)
3. (to save on energy/to save on energy costs)
4. (to reduce maintenance costs)
5. (to improve existing lighting conditions)
6. (to find ways to reduce carbon footprint)
7. (to help protect the environment)
8. (to replace non-working equipment)
9. (recommended by a contractor)
10. (past participation in another utility program)
96. (Other: Please Specify: _____)
98. (Don't know) (Go to S Series)
99. (Refused) (Go to S Series)

P6. [DO NOT POSE IF 98 OR 99 IN Q.P5] What was SECOND most important reason your company or organization chose to participate in the program? (DO NOT READ – accept one response – SAME LIST AS P5)

- 96 No other reason

Satisfaction [S series]

S1. On a scale of 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how was your company or organization's experience with each OF THE FOLLOWING aspects of the Business Energy Rebates Program? If your company / organization did not have experience with one of the aspects please tell me. [DO NOT RANDOMIZE] [97 = Not Applicable, 98 = Don't know, 99 = Refused] DO NOT ACCEPT A RANGE

- a. The Program application, forms and associated paperwork
- b. Interaction and communication with contractors, distributors or consultants

- c. [ASK IF PRE-APPROVED DATE IN SAMPLE] Initial confirmation of eligibility
 - d. Rebate or incentive amounts
 - e. Time required to receive rebate or incentive
 - f. The program overall
- S2. [IF DISSATISFIED—S1= 1, 2 or 3] You indicated a score of [ANSWER S1] on a 5-point scale for your overall satisfaction with the program. For what reasons were you not satisfied with the program overall? [DO NOT READ. PROBE FOR SPECIFIC REASONS. ACCEPT MULTIPLE]
1. (Too difficult to sign up/too much work)
 2. (Rebate/incentive is too small)
 3. (Too long before getting rebate)
 4. (I don't like the products/measures rebated)
 5. (ENS Staff were not helpful)
 96. (Other) [SPECIFY _____]
 98. (Don't know)
 99. (Refused)
- S3. Using a 5-point scale, where '1' is very difficult and '5' is very easy, how would you rate the process to participate in the program? [1-5 scale, 98 = Don't know/Don't recall, 99 = Refused]
- S4. [IF S3 = 1, 2 or 3] What was difficult about participating in the program? [MULTIPLE RESPONSE – RECORD VERBATIM] Probe: Anything else?
97. (Record answer)
 98. (Don't know)
 99. (Refused)
- S5. And based on your experience, how likely are you to recommend the Business Energy Rebates program offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend this program to others? [CODE ONE ONLY]
1. Definitely
 2. Probably
 3. Probably not
 4. Definitely not
- VOLUNTEERED
98. (Don't know)
 99. (Refused)
- S6. On a scale of 1 to 5, where 1='not at all likely' and 5='very likely', how likely will your company or organization be to purchase energy efficient products, including but not limited to energy efficient lighting, when installing or replacing energy-using products for your business in the

future? [1-5 scale, 98 = Don't know/Don't recall, 99 = Refused] [CODE ONE ONLY] [DO NOT ACCEPT A RANGE]

- S10. Thinking of when you completed and sent your post-install mail-in rebate application to ENSC, how long, in weeks, was it before you received your mail-in rebate? [RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

Barriers to Actions and Recommendations for Improvements [B Series]

- B1. Were there any challenges or barriers that you faced in implementing the energy efficient measures for which you received a rebate from the Business Energy Rebates Program?
1. Yes
 2. No (SKIP TO B8)
 98. (Don't know) (SKIP TO B8)
 99. (Refused) (SKIP TO B8)
- B2. What was the SINGLE most important challenge or barrier? (DO NOT READ - ACCEPT ONE RESPONSE)
1. (lack of information about the program to make an informed decision)
 2. (rebate/incentive was too little)
 3. (paperwork/process required too much work)
 5. (approval takes too long)
 6. (lack of financing)
 7. (energy efficient equipment does not meet payback requirements)
 8. (decision made elsewhere)
 9. (do not own building – have to work through owner)
 10. (lack of technical knowledge)
 11. (lack of time / too busy)
 12. (focused on core business)
 13. (difficulty finding a contractor)
 96. (Other – SPECIFY: _____)
 98. (Don't know) (Go to B8)
 99. (Refused) (Go to B8)
- B3. What was the SECOND most important challenge or barrier? (DO NOT READ - ACCEPT ONE RESPONSE – SAME LIST AS B2)

- B8. Did you encounter any problems with the [MEASURE CATEGORY] measure you implemented as part of the Business Energy Rebates program?
1. Yes
 2. No (SKIP TO B6)
 98. (Don't know) (SKIP TO B6)
 99. (Refused) (SKIP TO B6)
- B9. [ASK IF B8=YES] Was/were this/these problems resolved to your satisfaction?
1. Yes
 2. No
 98. (Don't know)
 99. (Refused)
- B10. [ASK IF B9=NO] What could have been done to resolve this/these problems? [RECORD ANSWER. 98 = Don't know, 99 = Refused]
- B6. Do you have any suggestions on how to improve the Business Energy Rebates Program? Consider all aspects of the program: process, measures covered, marketing, interactions with program staff, and program forms. PROBE: Anything else?
1. (Provide more information/information sessions)
 2. (Better marketing/awareness)
 3. (More direct contact with customer)
 4. (Increase/better rebates)
 5. (Clarify which products are eligible for rebates)
 6. (Make forms more user-friendly)
 7. (ENS staff should be more knowledgeable)
 8. (No recommendation)
 9. (Offer more measures eligible to rebates) [GO TO B7]
 96. (Other – SPECIFY: _____)
 98. (Don't know)
 99. (Refused)
- B7. [ASK IF B6=9] Which energy efficiency measures would you like to have covered by the program? PROBE: Anything else? [PROBE FOR SPECIFIC UPGRADES; ACCEPT MULTIPLE]
- 1 _____; 2 _____; 3 _____
98. Don't know
 99. Refused

Firmographics [F Series]

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

F1. What is the main activity of your company? [DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]

1. Education
2. Food Sales (grocery)
3. Food Service (restaurant)
4. Health Care - Inpatient
5. Health Care - Outpatient
6. Lodging
7. Mercantile— Retail (Enclosed and Strip Malls)
8. Mercantile – Retail (Other than Mall)
9. Office
10. Public Assembly
11. Public Order and Safety
12. Religious Worship
13. Service
14. Warehouse / storage
15. Manufacturing
16. Building is vacant
17. Agriculture
18. Other (SPECIFY: _____)
98. (Don't know)
99. (Refused)

F3. Approximately how many full-time equivalent workers DOES YOUR COMPANY OR ORGANIZATION employ at all locations within Nova Scotia? DO NOT READ, CODE APPROPRIATE CATEGORY

1. Fewer than 5
2. 5 to 9
3. 10 to 19
4. 20 to 49
5. 50 to 99
6. 100 to 249
7. 250 or more
98. (Don't know)
99. (Refused)

F5. Is your company independent, or part of a larger company?

- 1. Independent
- 2. Part of a larger company
- 96. Other (_____)
- 98. (Don't know)
- 99. (Refused)

F6. How many business locations does your organization have in Nova Scotia? [RECORD A NUMBER 1-99; 998 = Don't know, 999 = Refused]

END. Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

APPENDIX IV ANNUAL SURVEY RESULTS

The BER Mail-in participant survey results are presented in the following tables.

P1. Did your company or organization participate in any other Nova Scotia Power or Efficiency Nova Scotia programs before the Business Energy Rebates Program?

P2. Which programs did your company or organization participate in prior to the Business Energy Rebates Program?

Other Program Participation	2012 (%)	2014 (%)
<i>Sample Size</i>	56	27
Yes	30%	37%
No	66%	63%
Don't know	4%	-
Program Participation*	2012 (#)	2014 (#)
<i>Sample Size**</i>	17	10
Custom	5	2
Small Business Energy Solutions (SBES)/Business Energy Solutions	2	2
Lighting upgrades	-	2
Business Energy Rebates	-	2
Smart Lighting Choices (SLC)	7	-
Commercial Direct Install (CDI)	2	-
Solar	2	-
Energy Assessment	-	1
Others	3	1
Don't know	-	1
*Base: Respondents who previously participated in programs **Multiple responses		

P5. What was the single most important reason your company or organization chose to participate in the Business Energy Rebates program?

P6. What was second most important reason your company or organization chose to participate in the program?

Motivations	2012		2014	
	Most Important Motivation	Most Important Motivation	Most Important Motivation	Most Important Motivation
<i>Sample Size</i>	56	56	27	27
Save on energy costs/bills	55%	32%	59%	26%
Take advantage of program incentives/ rebates	20%	30%	22%	11%
Update equipment	7%	4%	7%	4%
Environment	-	7%	-	11%
Reduce maintenance costs	2%	2%	-	4%
Quality of efficiency products	-	-	-	4%
Replace non-working equipment	4%	-	-	-
Improve existing lighting conditions	2%	9%	-	-
Already planning project	2%	-	-	-
Recommended by contractor	-	2%	-	-
Others	9%	9%	11%	4%
None/No other reason	-	4%	-	37%
Don't know	-	2%	-	-

S1. On a scale of 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how was your company or organization's experience with each of the following aspects of the Business Energy Rebates Program?

Satisfaction with BER	2012		2014	
Aspect of BER*	Sample Size**	Satisfied (%)	Sample Size**	Satisfied (%)
Interactions and communication with contractors, distributors or consultants	56	91%	25	88%
Program overall	56	95%	27	85%
Rebate or incentive amounts	56	82%	26	85%
Time required to receive rebate or incentive	55	89%	26	81%
Program application, forms and paperwork	56	89%	25	80%
Initial confirmation of eligibility	55	89%	8	(#) 5***
*Those giving a rating of 5 or 4 on a scale where 5= "Very satisfied" and 1= "Not at all satisfied" **Don't know/Refused/Not applicable removed from calculations ***Five respondents (63%) gave a response of '5' or '4'				

S2. You indicated a score of [answer from S1] on a 5-point scale for your overall satisfaction with the program. For what reasons were you not satisfied with the program overall?

Reasons for Dissatisfaction*	2012 (#)	2014 (#)
<i>Sample Size**</i>	3	4
Too long before getting rebate	-	2
Too difficult to sign up/too much work	1	2
ENSC staff were not helpful	2	1
Rebate/incentive is too small	-	1
*Base: Respondents who were dissatisfied with the program (as indicated by a rating of '1', '2' or '3')		
**Multiple responses		

S3. Using a 5-point scale, where '1' is very difficult and '5' is very easy, how would you rate the process to participate in the program?

Ease of Process to Participate	2012	2014
<i>Sample Size*</i>	55	26
5 "Very easy"	51%	27%
4	36%	42%
3	7%	27%
2	2%	-
1 "Very difficult"	4%	4%
*Don't know/Refused removed from calculations		

S4. What was difficult about participating in the program?

Reasons Process Difficult*	2012 (#)	2014 (#)
<i>Sample Size**</i>	7	8
Getting the needed information for ENSC	-	3
Not enough information on process	3	1
Timely process/Took too long	2	1
Ensuring you were qualified	-	1
Communication/trying to get a hold of someone	-	1
Too much paperwork	4	-
Don't know	-	1
*Base: Respondents who found process difficult, '1', '2', or '3' rating, where '5' = "Very easy" and 1 = "Very difficult"		
**Multiple responses		

S10. Thinking of when you completed and sent your post-install mail-in rebate application to ENSC, how long, in weeks, was it before you received your mail-in rebate?

Length of Time to Receive Rebate	2014 (#)
<i>Sample Size*</i>	17
3-4 weeks	7
5-8 weeks	9
52 weeks	1
Average	8.5 weeks
*Don't know responses removed from calculations	

S6. On a scale of 1 to 5, where 1='not at all likely' and 5='very likely', how likely will your company or organization be to purchase energy efficient products, including but not limited to energy efficient lighting, when installing or replacing energy-using products for your business in the future?

Likelihood of Energy-Efficient Upgrades when Installing/Replacing Equipment in the Future	Sample Size	Rating: 5= "Very likely" and 1 = "Not at all likely"				
		5	4	3	2	1
2012	55	78%	18%	2%	2%	-
2014	26	85%	15%	-	-	-
*Don't know/Refused excluded from calculations						

B1. Were there any challenges or barriers that you faced in implementing the energy efficient measures for which you received a rebate from the Business Energy Rebates Program?

Barrier Faced	2012	2014
<i>Sample Size</i>	56	27
No	89%	89%
Yes	11%	4%
Don't know	-	7%

B2. What was the single most important challenge or barrier?

B3. What was the second most important challenge or barrier?

Specific Barriers to Participation	2012		2014	
	Most Important Barrier (#)	Second Most Important Barrier (#)	Most Important Barrier (#)	Second Most Important Barrier (#)
<i>Sample Size</i>	6	6	1	1
Different information from various parties	-	-	1	-
Lack of information to make an informed decision	2	-	-	-
Paperwork/process required too much work	2	-	-	-
Approval takes too long	1	1	-	-
Others	1	-	-	-
None/no other reasons	-	4	-	1
Don't know	-	1	-	-

B6. Do you have any suggestions on how to improve the Business Energy Rebates Program? Consider all aspects of the program: process, measures covered, marketing, interactions with program staff, and program forms.

Suggestions to Improve BER	2012*	2014
<i>Sample Size</i>	56	27
Provide more information/information sessions	11%	7%
Better marketing/awareness	11%	7%
Offer more products rebated	7%	7%
Better communication	-	7%
Increase/better rebates	-	4%
Make forms more user-friendly	9%	-
More direct contact between customer and program staff/more contact people/better communication	5%	-
Increase/better rebates	5%	-
ENSC staff should be more knowledgeable	4%	-
Good program/Continue good work	4%	-
Instant rebate at point of purchase	2%	-
Keep focus on retrofits	-	-
Clarify which products are eligible for rebates	-	-
Others	5%	7%
None/No recommendations/Don't know	54%	63%
*Multiple responses		

B8. Did you encounter any problems with the [MEASURE CATEGORY] measure you implemented as part of the Business Energy Rebates program?

Encounter Problems with Measures Implemented Through BER	2014
<i>Sample Size</i>	27
No	100%
Yes	-

F1. What is the main activity of your company?

Principal Building Activity	2012	2014
<i>Sample Size</i>	56	27
Farming/Agriculture	23%	22%
Food service (restaurant)	4%	22%
Manufacturing	4%	7%
Property management	13%	7%
Lodging	4%	7%
Service	7%	4%
Mercantile/Retail (enclosed and strip malls)	2%	4%
Religious worship	2%	4%
Transportation	4%	4%
Food sales (grocery)	2%	4%
Food processing/manufacturing	9%	4%
Retail (other than mall)	2%	-
Public assembly	-	-
Government	4%	-
Automotive repair	4%	-
Education	4%	-
Health care – inpatient	2%	-
Electrical distribution	-	-
Office	4%	-
Health care – outpatient	-	-
Warehouse/storage	-	-
Others	11%	11%

F3. Approximately how many full-time equivalent workers DOES YOUR COMPANY OR ORGANIZATION employ at all locations within Nova Scotia?

Full-Time Employees	2012	2014
<i>Sample Size</i>	56	27
Fewer than 5	32%	44%
5 to 9	14%	7%
10 to 19	14%	7%
20 to 49	18%	22%
50 to 99	4%	7%
100 to 249	4%	4%
250 or more	13%	4%
Don't know	2%	4%

F5. Is your company independent, or part of a larger company?

Type of Company	2012	2014
<i>Sample Size</i>	56	27
Independent	80%	85%
Part of a larger company	16%	15%
Don't know	4%	-

F6. How many business locations does your organization have in Nova Scotia?

Number of Locations	2012	2014
<i>Sample Size</i>	56	27
1-5	86%	81%
6 or more	13%	4%
Don't know	2%	15%
Average*	10.9	1.7
*Don't know removed from calculation		

APPENDIX V QUARTERLY SURVEY QUESTIONNAIRE

Could I speak with **[INSERT NAME]**?

1. Yes **[GO TO INTRODUCTION]**
2. No **[SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]**

[INTRODUCTION]

Hello, I am with CRA (Corporate Research Associates), and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your firm recently participated in Efficiency Nova Scotia Corporation's Business Energy Rebates Program. We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about five minutes. Is this a good time for you?

Verification and Recall (V Series)

- V1. Our records indicate that your company or organization participated in Efficiency Nova Scotia's Business Energy Rebates Program. Is this correct?
1. Yes **(GO TO V3)**
 2. No
- V2. Is there someone else at your company or organization who would know about your company / organization's participation in Efficiency Nova Scotia's Business Energy Rebates Program?
1. Yes **(Ask for name: _____ and telephone #: _____)** (Thank and terminate; schedule interview with best contact)
 2. No **(Thank and terminate)**
- V3. Are you the person in your company or organization who is most knowledgeable about your experience with the Business Energy Rebates Program?
1. Yes **(IF YES GO TO V5)**
 2. No

- V4. We would like to talk to the person who is the most knowledgeable about your experience with the Business Energy Rebates Program. Could you give me the name and telephone number of this person? [Probe if respondent is unsure who best to forward the call to. This individual may be an engineer, equipment contractor, or utility account manager].

Name: _____

Telephone #: _____

(Note: Thank and terminate call. Schedule interview with best contact regarding experience with the program.)

- V5. According to our information, through its participation in the Business Energy Rebates Program, your company or organization received a rebate of **[Rebate]** in the month of **[DATE COMPLETED IN DSMDS]** to install **[MEASURE CATEGORY]** measures. When answering the survey questions, please take into account this specific application.

Satisfaction (S Series)

- S1. How did your company first learn of the programs offered by Efficiency Nova Scotia? **[DO NOT PROVIDE RESPONSE CATEGORIES]. [CODE AS MANY AS APPLICABLE].**

1. Media advertising
2. Someone at Efficiency Nova Scotia contacted the business
3. Through a third-party contractor
4. The business contacted Efficiency Nova Scotia about the program
5. Word-of-mouth
6. Efficiency Nova Scotia website
7. Facebook or other social media
97. Other **[SPECIFY: _____]**
98. Cannot recall

- S2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent? **[CODE ONE ONLY].**

1. Directly with Efficiency Nova Scotia
2. Third-party contractor or agent → **SKIP TO S28**
3. Both
- 8 Don't know **CONTINUE**

S4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with **[READ AND ROTATE. CODE ONE RESPONSE FOR EACH STATEMENT]**

- a. The technical expertise of employees related to the program
- b. The responsiveness of employees to your requests and enquiries in a timely manner
- e. The speed in which the application was approved
- g. The value of the program relative to the time and cost involved
- j. The ability to provide estimates of the savings or return on investment associated with the program.

___ Response ___ 98 Don't Know ___ 99 Refused

S5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with your business?

___ Response ___ 98 Don't Know ___ 99 Refused

S6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

IF YES IN S6, CONTINUE, OTHERWISE SKIP TO S28.

S7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

S9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**

- a. Service attitude
- b. Knowledge of programs available
- c. Ability to provide advice

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied

VOLUNTEERED

- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

S28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia? **[CODE ONE ONLY]**

- 1 Definitely
- 2 Probably
- 3 Probably not
- 4 Definitely not

VOLUNTEERED

- 7 (Not eligible to any other programs)
- 8 (Don't know)
- 9 (Refused)

S29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others? **[CODE ONE ONLY]**

- 5. Definitely
- 6. Probably
- 7. Probably not
- 8. Definitely not

VOLUNTEERED

- 100. (Don't know)
- 101. (Refused)

Free-Ridership (FR Series)

FR1. Did your company or organization decide to implement the energy-efficient **[MEASURE CATEGORY]** measure before participating in the Business Energy Rebates Program?

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

FR1a. **IF FR1= YES, THEN ASK:** I just want to make sure I understand - Before you decided to participate in the Efficiency Nova Scotia Business Energy Rebate Program, you had already made the decision to install the energy efficient **[MEASURE CATEGORY]** measure.

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Business Energy Rebates Program.

If your company or organization had not participated in the Business Energy Rebates Program, what is the likelihood that you would have taken one of the following actions. Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely **Would Not** Have Taken the Action,” and a 10 indicating that you “Definitely **Would Have** Taken the Action.” **AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: “AND NEXT, In the absence of the Program, would you have ...: DO NOT ACCEPT A RANGE – POSE FR2 SEQUENCE IN ORDER/DO NOT RANDOMIZE**

FR2a. ... installed exactly the same energy-efficient **[MEASURE CATEGORY]** equipment that you installed through the Program?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2b. ... installed standard **[MEASURE CATEGORY]** equipment instead of energy-efficient **[MEASURE CATEGORY]** equipment?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2c. ... installed the energy-efficient **[MEASURE CATEGORY]** equipment that you installed through the Program but at a later date?

___ Response ___ 98 Don't Know ___ 99 Refused

IF FR2c > 5, then ask:

FR2d. DO NOT POSE FR2d IF DON'T KNOW OR REFUSED IN Q.FR2c You indicated in your response to a previous question that if the Business Energy Rebates Program had not been available there was an [FR2c] in 10 likelihood that you would have installed the same equipment but at a later date. Approximately how many months later would you have installed this equipment? **DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE**

- 1. _____ months later
- 97. (At the same time)
- 98. (Don't Know)
- 99. (Refused)

IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2d ANSWER IN MONTHS, READ:

Would it have been within...

- 1. The last 6 months?
- 2. 6 months to less than 1 year later?
- 3. 1 to less than 2 years later?
- 4. 2 to less than 3 years later?
- 5. 3 to less than 4 years later?
- 6. 4 or more years later?

VOLUNTEERED

- 7. (Never)
- 98. (Don't Know)
- 99. (Refused)

FR3. Efficiency Nova Scotia paid your company or organization \$[REBATE VALUE FROM SAMPLE BY CATEGORY] for the energy-efficient [MEASURE CATEGORY] measure. If your company had not received the rebate from Efficiency Nova Scotia, would you have paid for the full cost of the energy-efficient [MEASURE CATEGORY] measure, including the portion covered by the rebate? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely **Would Not Have Paid**” and a 10 indicating that you “Definitely **Would Have Paid.**” **PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE**

____ Response ____98 Don't Know ____99 Refused

FR4. Next, I'm going to ask you to rate the importance of factors that might have influenced your decision to implement the energy-efficient [MEASURE CATEGORY] measure you implemented through the Business Energy Rebates Program. Using a scale from 0 to 10, where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to implement the energy-efficient [MEASURE CATEGORY] measure you implemented through the Program.

Factor (READ AND RANDOMIZE)	Responses		
a. The Efficiency Nova Scotia rebate(s)	___ Response	___ 98 Don't Know	___ 99 Refused
b. Information received during the initial contact by the program representative.	___ Response	___ 98 Don't Know	___ 99 Refused
c. Information provided through the Business Energy Rebates Program outreach and marketing activities	___ Response	___ 98 Don't Know	___ 99 Refused
d. Your company or organization's corporate policy or guidelines regarding the purchase of equipment	___ Response	___ 98 Don't Know	___ 99 Refused
e. The standard practice in your industry	___ Response	___ 98 Don't Know	___ 99 Refused
f. Previous experience with the Business Energy Rebates Program, or a similar program either from Efficiency Nova Scotia or Nova Scotia Power	___ Response	___ 98 Don't Know	___ 99 Refused

Firmographics (F Series)

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

F1. What is the main activity of your company? **[DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]**

1. Education
2. Food Sales (grocery)
3. Food Service (restaurant)
4. Health Care - Inpatient
5. Health Care - Outpatient
6. Lodging
7. Mercantile— Retail (Enclosed and Strip Malls)
8. Mercantile – Retail (Other than Mall)
9. Office
10. Public Assembly

- 11. Public Order and Safety
- 12. Religious Worship
- 13. Service
- 14. Warehouse / storage
- 15. Manufacturing
- 16. Building is vacant
- 17. Agriculture
- 18. Other (SPECIFY: _____)
- 98. (Don't know)
- 99. (Refused)

F2. Approximately how many full-time equivalent workers DOES YOUR COMPANY OR ORGANIZATION employ at all locations within Nova Scotia? DO NOT READ, CODE APPROPRIATE CATEGORY

- 1. Fewer than 5
- 2. 5 to 9
- 3. 10 to 19
- 4. 20 to 49
- 5. 50 to 99
- 6. 100 to 249
- 7. 250 or more
- 98. (Don't know)
- 99. (Refused)

END. Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

APPENDIX VI

QUARTERLY SURVEY RESULTS

The BER Mail-in participant quarterly survey results are presented in the following tables.

S1. How did your company first learn of the programs offered by Efficiency Nova Scotia?

Sources of Awareness	2012** (%)	2013 (%)	2014 (%)
<i>Sample Size*</i>	30	80	68
Through a third-party contractor	17%	29%	41%
ENSC website	7%	16%	15%
Respondent was contacted directly by ENSC	10%	11%	12%
Media advertising	23%	19%	9%
Word of mouth	23%	18%	6%
NS Power bill insert	-	-	6%
Respondent contacted ENSC directly	13%	3%	4%
Previous experience with ENSC	-	10%	3%
Agriculture bulletin/newsletter	-	4%	1%
Department of Agriculture	-	4%	1%
Internet/website (unspecified)	3%	-	1%
Trade show	-	-	1%
Facebook or other social media	3%	-	-
Others	3%	10%	7%
Cannot recall	7%	1%	1%
*Multiple responses **Source: 2012 C-Sat Commercial Study			

S2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent?

Contact with ENSC	2012* (%)	2013 (%)	2014 (%)
<i>Sample Size</i>	30	80	68
Directly with ENSC	67%	43%	60%
Third-party contractor or agent	20%	39%	26%
Both	13%	14%	12%
Don't know	-	5%	1%
*Source: 2012 C-Sat Commercial Study			

S4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where "1" is not at all satisfied and "10" is completely satisfied, how satisfied were you with...

S5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with your business?

Satisfaction with Overall Performance	2012***		2013		2014	
	<i>Sample Size*</i>	Satisfied	<i>Sample Size*</i>	Satisfied	<i>Sample Size*</i>	Satisfied
Mean (1 =not at all satisfied, 10 =completely satisfied)**						
ENSC's overall performance in working with your company	24	8.7	49	8.8	50	9.0
The value of BER relative to the time and cost involved	24	8.8	49	8.7	49	9.0
The responsiveness of ENSC employees to your requests and enquiries in a timely manner	24	8.9	47	8.9	50	8.9
The technical expertise of ENSC employees related to BER	24	8.6	43	8.7	46	8.9
The ability to provide estimates of the savings or return on investment associated with BER	24	8.2	47	8.3	40	8.7
The speed in which the application was approved	24	8.5	48	8.2	50	8.3
*Base: Number of respondents who had contact with ENSC staff **Mean excludes 'refused' and 'don't know' responses ***Source: 2012 C-Sat Commercial Study						

S6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

Contact with ENSC Contact Centre Staff	2014 (%)
<i>Sample Size*</i>	50
Yes	84%
No	10%
Don't know	6%
*Base: Number of respondents who had contact with ENSC staff	

S7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

S9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's...

Satisfaction with Overall Performance	2014	
	<i>Sample Size*</i>	Satisfied**
Service attitude	42	100%
Ability to provide advice	42	100%
Overall level of service provided by ENSC contact centre staff	42	98%
Knowledge of programs available	41	98%
*Base: Number of respondents who had contact with ENSC staff **Percentage of respondents who gave a rating of completely or mostly satisfied where 5 = 'Very satisfied' and 1 = 'Not at all satisfied'; Don't know removed from calculations		

S28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia?

Would Recommend BER to Other Businesses/Companies	2012** (%)	2013 (%)	2014 (%)
<i>Sample Size*</i>	30	80	67
Definitely	77%	78%	82%
Probably	23%	18%	15%
Probably not	-	1%	1%
Definitely not	-	4%	1%
*Don't know/refused have been removed from calculations **Source: 2012 C-Sat Commercial Study			

S29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others?

Would Participate in Other ENSC Programs	2012** (%)	2013 (%)	2014 (%)
<i>Sample Size*</i>	30	78	68
Definitely	77%	72%	81%
Probably	23%	23%	19%
Probably not	-	3%	-
Definitely not	-	3%	-
*Don't know/refused have been removed from calculations **Source: 2012 C-Sat Commercial Study			

FR4. Next, I'm going to ask you to rate the importance of factors that might have influenced your decision to implement the energy-efficient [MEASURE CATEGORY] measure you implemented through the Business Energy Rebates Program. Using a scale from 0 to 10, where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to implement the energy-efficient [MEASURE CATEGORY] measure you implemented through the Program.

Importance of Factors in Influencing Decision to Implement Energy-Efficient Measures	2012		2013		2014	
	<i>Sample Size*</i>	Mean	<i>Sample Size*</i>	Mean	<i>Sample Size*</i>	Mean
Mean (0 = "not at all important", 10 = "extremely important")						
ENSC rebates	56	8.1	78	7.8	66	8.6
Information received during the initial contact	55	7.5	73	6.9	61	7.8
Organization's corporate policy or guidelines regarding the purchase of equipment	55	6.4	76	6.4	62	6.7
Information provided through BER outreach and marketing activities	55	6.6	78	6.5	63	6.4
Previous experience with BER or similar program	52	4.7	70	5.0	60	6.1
Standard practice in the industry	49	6.4	68	6.3	57	5.9
*Don't know/refused have been removed from calculations						

F1. What is the main activity of your company?

Principal Building Activity	2012	2013	2014
<i>Sample Size</i>	56	80	68
Property management	13%	6%	13%
Retail (other than mall)	2%	6%	13%
Farming/Agriculture	23%	26%	12%
Food service (restaurant)	4%	14%	9%
Recreation/Community Centre	-	-	6%
Manufacturing	4%	8%	4%
Mercantile/Retail (enclosed and strip malls)	2%	4%	4%
Food processing/manufacturing	9%	-	4%
Lodging	4%	6%	3%
Government	4%	1%	3%
Education	4%	1%	3%
Food sales (grocery)	2%	1%	3%
Service	7%	8%	1%
Religious worship	2%	3%	1%
Public assembly	-	3%	1%
Automotive repair	4%	1%	1%
Transportation	4%	1%	1%
Health care – inpatient	2%	1%	1%
Electrical distribution	-	1%	1%
Office	4%	-	-
Others	11%	9%	12%

F2. Approximately how many full-time equivalent workers does your company or organization employ at all locations within Nova Scotia?

Full-Time Employees	2012	2013	2014
<i>Sample Size</i>	56	80	68
Fewer than 5	32%	51%	41%
5 to 9	14%	9%	13%
10 to 19	14%	10%	10%
20 to 49	18%	16%	9%
50 to 99	4%	4%	7%
100 to 249	4%	4%	6%
250 or more	13%	6%	10%
Don't know	2%	-	3%

APPENDIX VII

ON-SITE VISIT SAMPLING AND PROTOCOL

Sampling Methodology

A total of 70 on-site visits were conducted to evaluate BER Mail-In¹⁵.

The sampling plan was developed on the basis of the September 2014 tracking sheet, which included all projects to date. The tracking sheet contained a total of 246 projects (including some projects in progress and expected to be completed by October 2014), and 196 of those were completed. All the 246 projects were used to establish the percentage accounted for by each category in the total tracked savings. The completed projects were implemented by a total of 108 participants and involved all the measure categories. The table below shows the percentage accounted for by each measure category in the total tracked savings and the total number of projects in which each measure category was involved.

Table 29: Total Number of Projects and Tracked Savings Used for On-site Visit Sampling¹⁶

Measure Category	Quantity of Projects	Tracked Savings		Expected Sample Size ¹⁷	Actual Sample Size
		kWh	%	<i>n</i>	<i>n</i>
Commercial Lighting	94	6,074,624	59%	41	25
Commercial Refrigeration	4	70,368	1%	0	3
Motors and VSDs	38	1,142,606	11%	8	11
HVAC	71	2,252,291	22%	15	15
Agricultural Technologies	9	281,280	3%	2	5
Commercial Kitchen	17	230,104	2%	2	5
Compressed Air	9	174,686	2%	1	4
Commercial Water Heating	1	57,109	0%	0	0
Commercial Laundry	2	2,894	0%	0	1
Commercial Solar Heating	1	3,900	0%	0	1
Total	246	10,289,862	100%	69	70

¹⁵ Of the 70 on-site visits conducted, 12 visits were removed from the sample considered by the Evaluator as explained in Section 5.1.

¹⁶ As of September 2014.

¹⁷ Calculated using each measure category's percentage of the tracked savings. Rounding error explains the 1 visit difference between the expected sample size and the actual sample size.

The number of sampled visits to be conducted was first calculated by multiplying the percentage value that each measure category accounted for in the total tracked savings by the total number of site visits required. Such a method for calculating the number of sampled visits was intended to assign appropriate weight to each measure category according to the percentage that it accounted for in the total tracked energy savings. However, this method resulted in 0 visit for 4 of the measure categories, as well as a big number of visits for the lighting projects. Then, to remedy this situation, the Evaluator calculated the square root of the savings and used these percentages to determine the sample size of each measure category. As a result, at least one visit was to be conducted for each category, with the exception of three categories, which respectively accounted for less than 1 percent of the total tracked savings. However, the majority of visits were conducted for projects involving lighting, motor and VSD, and HVAC measures because these measure categories together accounted for 92 percent of the total tracked savings.

On-site Visit Protocol

The 2013 on-site visit protocol was followed when conducting this year's visits, with some minor adjustments made to account for the changes in eligible measures in 2014. The protocol document contains fields for entering measure-specific data, the site occupancy schedule, and the operating hours. The measure-specific data collected was based on the parameters required for the savings calculations, as documented in the 2014 CIRx Screening Tool v1.3. The general format included columns for entering the measure type, the quantity, the wattage or capacity, the manufacturer and the model number, as well as specific characteristics of the new and replaced equipment.

On-Site Visit Data Collection Form

1. General Information

Date of visit:			
Project Name:			
Project Tracking sheet #:			
Company Name:			
Contact Name:			
Address:			
Telephone:			
Type of facility:	Retail: ☐	Manufacturing/ Industrial: ☐	Grocery/ Supermarket: ☐
	College/ University: ☐	Multi-Unit Res.: ☐	Other (Specify): ☐
Name of Contact Met with:			
Operation during Peak Period?	Yes ☐	No ☐	

2. Building Heating/Cooling System Description

Heating Systems:

Please fill the table below for each heating system at the site

	Heating system 1	Heating system 2
Heat source		
% of heat		
Type of system		
Efficiency or COP		

Cooling Systems:

Please fill the table below for each cooling system at the site

	Cooling system 1	Cooling system 2
% of cooling		
Type of system		
SEER or COP		

Notes:

3. Facility Operation Hours and Lighting Usage

Facility occupancy schedule:

Please fill the table below for each occupancy schedule reported by the site contact as occupancy could vary for each section of the facility. Use additional sheets if necessary.

Days/Year with Normal Schedule	Days/Year with No Occupancy (Seasonal Closure or Holiday)	Total (Should be 365 days)	Notes

**Normal week/holidays lighting
 operation schedule (hours per day):**

*Please fill the table below for each lighting schedule reported
 by the site contact as usage could vary for each section of the
 facility. Use additional sheets if necessary.*

Weekday - Hours/Day with Regular Schedule	Weekend - Hours/Day with Regular Schedule	Hours/Day with Holiday Schedule	Hours/Day with No Occupancy	Notes

Notes:

4. Measures information

Lighting : *Collect the information in the table below if lighting measures were installed. Use on-site observation and contact declaration. Use additional sheets if required. Econoler will then compare the information collected with the information in the tracking sheet.*

Date of installation:		
Location	In the Tracking Sheet	
	Validated Onsite	
Is cooling installed in the section with the lighting measure?	☐ Yes	% time with lights <u>AND</u> cooling ON: _____% Cooling system number: _____
	☐ No	
Is heating installed in the section with the measure?	☐ Yes	% time with lights <u>AND</u> heating ON: _____% Heating system number: _____
	☐ No	
The percentage of lighting that remains on when the facility is closed:		
Validate if lamps are still installed and not burnt:		
If some are burnt or missing, indicate how many:		
When was the lamp removed or when did it burn?		
Is the facility manager planning to have them replaced?		
If, not why? Are they OK with the reduced light level?		
Is Lighting Installed Inside or Outside?		
Explain is Quantity Found Onsite Differs from that Indicated in the Tracking Sheet:		
<i>Use the table below to record the information on the lighting measures installed on site. For each type of equipment, indicate the number of equipment with a specific wattage. Use additional sheets if required.</i>		

New equipment installed						Baseline equipment					
Type	Quantity		Wattage		Notes:	Type	Quantity		Wattage		Additional Info
	Tracking Sheet	On-Site validation	Tracking Sheet	On-Site validation			Tracking Sheet	On-Site validation	Tracking Sheet	On-Site validation	
LED Decorative Area Lighting / Walkway Lighting											
LED Canopy / Parking Garage Lighting											
LED Exit Signs						☐ Inc ☐ Fluo ☐ Other					
LED Strip Lighting					If Existing is T12 HO Strip, what length?						
LED Lamps for Fluorescent Fixtures	___ units ___ ft	___ units ___ ft				☐ T12 ☐ T8 ☐ Other					
LED Parking Lot Lights				☐ 30-50W ☐ 51-100W ☐ 101-145W ☐ 146-200W ☐ Other:				☐ ≥100W ☐ ≥150W ☐ ≥400W ☐ Other:			
Reduced Wattage Metal Halide Lamps				☐ 150-250W ☐ 400-750W ☐ 1000W ☐ Other:				☐ ≥400W ☐ ≥1000W ☐ ≥1500W ☐ Other:			
Pin-based CFLs						☐ Inc ☐ Fluo ☐ Other					
T8 Low-Bay Fixtures					Do the fixtures use high performance T8 or reduced wattage T8?	☐ Metal Halide ☐ Other					

New equipment installed						Baseline equipment					
Type	Quantity		Wattage		Notes:	Type	Quantity		Wattage		Additional Info
	Tracking Sheet	On-Site validation	Tracking Sheet	On-Site validation			Tracking Sheet	On-Site validation	Tracking Sheet	On-Site validation	
					How many lamps per fixture?						
T8 Dimmable Stairwell Lighting					Does it dim to <25% full output when no occupants are detected? How many lamps per fixture? Do the fixtures use high performance T8 or reduced wattage T8?						Does it replace non-dimmable stairwell fixture?
Park Light Induction Lamp Fixtures											
Induction Canopy/ Parking Garage Lighting											
Photo-luminescent Exit Signs					Is the product ENERGYSTAR® rated? ☐ Inc ☐ Fluo ☐ Other						

Motors and Drives: *Collect the information in the table below **if motors and drives measures were installed**. Use on-site observation and contact declaration. Use additional sheets if required. The information collected will then be compared with the information in the tracking sheet by Econoler. Additionally, record Manufacturer and Model Number, and all Technical Data (Operating Temp, CFM, Size, Control Info)*

Date of installation: _____

Motors

Total number of motors installed: _____

	Motor 1	Motor 2	Motor 3
Manufacturer:	_____	_____	_____
Model number:	_____	_____	_____
Motor Size [hp]:	_____	_____	_____
NEMA Nominal Efficiency (nameplate):	_____	_____	_____
Load Factor:	_____	_____	_____
Approx. product run time [hr/week]:	_____	_____	_____
Do the new motors operate at least 2,000 hours a year?	_____	_____	_____
Are the new motors listed in the CEE Premium Efficiency Motors List ¹⁸ ?	_____	_____	_____
Are the motors controlled by a VSD?	_____	_____	_____
Specify RPM:	_____	_____	_____
Specify the type of application:	_____	_____	_____

Variable Speed Drives (VSDs)

Total number of VSDs installed: _____

	VSD 1	VSD 2	VSD 3
Validate that the new VSDs do not replace old VSDs?	_____	_____	_____
Validate that the new VSDs are operational?	_____	_____	_____
If not, why and since when?	_____	_____	_____
VSDs are automatically controlled? (Y/N):	_____	_____	_____

¹⁸ Web Site : www.cee1.org/resrc/news_items/CEEMotorsList.php3

If yes, specify the type of control (pressure, flow or T°):

Specify the hp of the motor controlled by the VSDs:

Specify the type of equipment controlled: (Supply fan, return fan, exhaust fan, chilled water pump, boiler feed water, or other (Specify)):

Hours of use (Indicate the corresponding schedule number):

Approx. product run time [hr/week]:

Approx. hours of operation [h/yr]:

Specify Manufacturer and Model Number of VSD:

Load profile: *Use table below to record the information provided by contact declaration*

Load profile (kWh or flow: circle the appropriate one)										
Full load percent	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
% yearly hours at each load										

HVAC: *Collect the information in the table below **if HVAC measures** were installed. Use on-site observation and contact declaration. Use additional sheets if required. The information collected will then be compared with the information in the tracking sheet by Econoler.*

Date of installation:

Total number of AC & Air-Source Heat Pumps (Split & Unitary) installed:

Total number of Ground & Water Source Heat Pumps installed:

Are there any other heating and cooling systems than the ones being replaced/installed? (note % of heating/cooling being provided)

	Existing HVAC 1	Existing HVAC 2	Existing HVAC 3	New HVAC 1	New HVAC 2	New HVAC 3
AC & Air-Source Heat Pumps:						
Location on site:						
Manufacturer:						
Model number:						
Number of units						
Space heating source (electricity, fuel, etc.):						
Specify if condensing unit or evaporator coil:						
HSPF IV						
HSPF V (HSPF IV x 1.15)						
Seasonal Energy Efficiency Ratio (SEER):						
Energy Efficiency Ratio (EER):						
Nominal kBtu/h per unit:						
Hours of use (<i>Indicate the corresponding schedule number</i>):						
Heating set point and setback (if any) temperature [°C] :						
Cooling set point and setback (if any) temperature [°C] :						
Validate if the HVAC systems are properly installed and still operational:						
If no, why, and since when?						
Ground & Water Source Heat Pumps:						
Manufacturer:						
Model number:						
Number of units						
Original heat source (Electricity or other (specify)):						

	Existing HVAC 1	Existing HVAC 2	Existing HVAC 3	New HVAC 1	New HVAC 2	New HVAC 3
Specify if open or closed loop:						
Specify if water-to-air, water-to-water, or air-to-water:						
Energy Efficiency Ratio (EER):						
Coefficient Of Performance (COP):						
Nominal capacity [kBtu/h]:						
Hours of use for equipment (Indicate the corresponding schedule number for each section):						
Heating set point and setback (if any) temperature [°C] :						
Cooling set point and setback (if any) temperature [°C] :						
Validate if the HVAC systems are properly installed and still operational:						
If no, why, and since when?						

HVAC Hotel Occupancy Sensor

Existing control

Is HVAC system <65kBTU/h?

Manufacturer:

Model number:

Quantity:

With building integrated control? [Y/N]:

Number of hotel rooms:

Typical vacancy rate:

Are occupancy sensors operational?

Refrigeration: *Collect the information in the table below **if refrigeration measures were installed**. Use on-site observation and contact declaration. Use additional sheets if required. The information collected will then be compared with the information in the tracking sheet by Econoler. Additionally, record Manufacturer and Model Number.*

Date of installation:

Equipment installed

Strip-curtains – Length installed [ft]:

Is the equipment still used?

If not, why and since when?

Medium or High Temp Cases?

Cooler night covers – Length installed [ft]:

Is the equipment still used?

If not, why and since when?

Medium or High Temp Cases?

Open to closed cooler conversion –
Length installed [ft]:

Is the equipment still used?

If not, why and since when?

Was the original equipment replaced an open multi-deck cooler?

Zero-energy doors and frames (Reach-in type) – Number of doors:

Is the equipment still used?

If not, why and since when?

Hours of use [hr/yr]:

Medium or High Temp?

Door/frame heater controls (Humidity-based) – Number of doors controlled:

Is the equipment still used?

If not, why and since when?

Hours of use [hr/yr]:

Evaporator fan motor controllers –

Number of controllers:

Is the equipment still used?

If not, why and since when?

Hours of use [hr/yr]:

Number of Doors Controlled:

Number of Evaporator Fans:

Does the control system turn off evaporator fans at least 70% of the time when the compressor is not running?

Does the control system reduce the evaporator fan air flow while compressors are in their off-cycle and while no refrigerant is flowing through the evaporator?

Does the control system control a minimum fan load of 1/20 hp when fans operate at full speed.

Intelligent freezer defrost controllers (for walk-in freezer evaporator coils) – Number of controllers:

Is the equipment still used?

If not, why and since when?

Hours of use [hr/yr]:

Type and HP of Compressor:

Do the controllers control the defrost cycle of 3 or more evaporator fans?

Is there fan control?

Outside air economizers for walk-in coolers – Number of economizers:

Is the equipment still used?

If not, why and since when?

Hours of use [hr/yr]:

Is the walk-in cooler 1000 cu. Ft. or large?

Refrigerated vending machine controllers –

Number of controllers:

Is the equipment still used?

If not, why and since when?

Do the controllers use occupancy sensor based controls to de-energize refrigerated vending machines when the surrounding area is not occupied?

Hours of use [hr/yr]:

Agriculture: *Collect the information in the table below if agriculture measures were installed. Use on-site observation and contact declaration. Use additional sheets if required. The information collected will then be compared with the information in the tracking sheet by Econoler. Additionally, record Manufacturer and Model Number, and all Technical Data (Operating Temp, CFM, Size, Control Info)*

Date of installation:

High Efficiency Fans

Ventilation fan – Number installed:

Is the equipment still used?

If not, why and since when?

Size of the fans [inches]:

Airflow:

Ventilating Efficiency Ratio (VER) [cfm/watt]:

Hours of use [hr/yr]:

Circulation fan – Number installed:

Is the equipment still used?

If not, why and since when?

Size of the fans [inches]:

Airflow:

Thrust Efficiency Ratio (TER) [lbs/kW]:

Hours of use [hr/yr]:

High volume speed fan – Number installed:

Is the equipment still used?

If not, why and since when?

Size of the fans [feet]:

Airflow:

Hours of use [hr/yr]:

Livestock Waterers

Livestock waterer – Number installed:

Is the equipment still used?

If not, why and since when?

Old Heater Wattage [W]:

New Heater Wattage [W]:

Does it contain an adjustable thermostat?

Agriculture Heat Pads

Agriculture heat pad – Number installed:

Is the equipment still used?

If not, why and since when?

Single or double?

Wattage [W]:

Does it replace incandescent heat lamps?

Engine Block Heater Equipment

Engine block heater timer – Number installed:

Is the equipment still used?

If not, why and since when?

Engine block heater wattage [W]:

Dairy Farm Equipment

Dairy scroll compressor – Number installed:

Compressor HP:

Does it Replace an Existing Compressor?

Milk pre-cooler/heat recover – Number installed:

Pre-cooler or heat recover?

Number of cows milked:

Hours/Day Equipment Operates:

If HRU - must replace electric water heater
Pre-Cooler - must replace existing unit

Yes

☐

No

☐

VSD on milk vacuum pump – Number installed:

Number of cows milked: Verify >50

Milking setup (parlor or tie stall):

Pump type (rotary vane or blower):

Pump Motor >5 HP:

Validate that it does not replace an existing VSD:

Compressed Air: *Collect the information in the table below **if compressed air measures were installed**. Use on-site observation and contact declaration. Use additional sheets if required. The information collected will then be compared with the information in the tracking sheet by Econoler. Additionally, record Manufacturer and Model Number, and all Technical Data (Operating Temp, CFM, Size, Control Info)*

Date of installation:

Compressed Air Products Installed

Cycling refrigerated air dryer – Number installed: Verify <300 cfm capacity

Is the equipment still used?

If not, why and since when?

Compressor operation [hr/week]:

Does the cycling refrigerated air dryer automatically turn on and off in response to load instead of running continuously?

VSD screw compressor – Number installed:

Is the equipment still used?

If not, why and since when?

Hp rating [hp]: Verify between 10 and 40 hp

Compressor operation [hr/week]:

Air-entraining air nozzle – Number installed:

Is the equipment still used?

If not, why and since when?

Compressor type:

Capacity [cfm]: Verify <14cfm @100psi

Compressor operation [hr/week]:

No-loss drain – Number installed:

Is the equipment still used?

If not, why and since when?

Compressor type:

System pressure [psi]:

Compressor operation [hr/week]: Timer?



Air tank for load / No-load screw compressor – Number installed:

Is the equipment still used?

If not, why and since when?

Compressor type:

Compressor hp rating [hp]:

Air receiver tank size [gallons]:

Compressor operation [hr/week]:

Kitchen: *Collect the information in the table below **if commercial kitchen measures** were installed. Use on-site observation and contact declaration. Use additional sheets if required. The information collected will then be compared with the information in the tracking sheet by Econoler. Additionally, record Manufacturer and Model Number, and all Technical Data (Operating Temp, CFM, Size, Control Info)*

Date of installation:

Commercial Dish Washers Installed (Low T°)

Under-counter commercial dish washer

– Number installed:

Location:

Manufacturer:

Model number:

Is the equipment used for commercial purpose?

Is the equipment still used?

If not, why and since when?

Does it use electricity heated hot water?

Validate the equipment is ENERGY STAR rated:

Operation [days/year]:

Operation [number of racks washed/day]:

Single-tank door type commercial dish washer – Number installed:

Location:

Manufacturer:

Model number:

Is the equipment used for commercial purpose?

Is the equipment still used?

If not, why and since when?

Does it use electricity heated hot water?

Validate the equipment is ENERGY STAR rated:

Operation [days/year]:

Operation [number of racks washed/day]:

Single/Multi-tank conveyor commercial dish washer – Number installed:

Specify if single or multi-tank:

Location:

Manufacturer:

Model number:

Is the equipment used for commercial purpose?

Is the equipment still used?

If not, why and since when?

Does it use electricity heated hot water?

Validate the equipment is ENERGY STAR rated:

Operation [days/year]:

Operation [number of racks washed/day]:

Commercial Dish Washers Installed (High T°)

Under-counter commercial dish washer –
Number installed:

Manufacturer:

Model number:

Is the equipment used for commercial
purpose?

Is the equipment still used?

If not, why and since when?

Does it use electricity heated hot water?

Validate the equipment is ENERGY STAR
rated:

Does it use a built-in booster heater?

If yes, specify booster water heater fuel type:

Operation [days/year]:

Operation [number of racks washed/day]:

**Single-tank door type commercial dish
washer – Number installed:**

Manufacturer:

Model number:

Is the equipment used for commercial
purpose?

Is the equipment still used?

If not, why and since when?

Does it use electricity heated hot water?

Validate the equipment is ENERGY STAR
rated:

Does it use a built-in booster heater?

If yes, specify booster water heater fuel type:

Operation [days/year]:

Operation [number of racks washed/day]:

Single/Multi-tank conveyor commercial dish washer – Number installed:

Specify if single or multi-tank?

Manufacturer:

Model number:

Is the equipment used for commercial purpose?

Is the equipment still used?

If not, why and since when?

Does it use electricity heated hot water?

Validate the equipment is ENERGY STAR rated:

Does it use a built-in booster heater?

If yes, specify booster water heater fuel type:

Operation [days/year]:

Operation [number of racks washed/day]:

Commercial Fryers

Standard capacity commercial fryer – Number installed:

Specify if electric or gas?

Does it replace an electric fryer?

Is it a new installation?

Is the equipment still used?

If not, why and since when?

Validate the equipment is ENERGY STAR rated:

Operation [days/year]:

Operation [hours/day]:

Commercial Hot Food Holding Cabinet

Commercial hot food holding cabinet –
Interior volume [ft³]:

Specify if ½, ¾ or full size?

Is the equipment still used?

If not, why and since when?

Validate the equipment is ENERGY STAR
rated:

Operation [days/year]:

Operation [hours/day]:

Commercial Griddles

Commercial griddle – Length installed [ft]:

Specify if electric or gas?

Does it replace an electric griddle?

Is it a new installation?

Is the equipment still used?

If not, why and since when?

Validate the equipment is ENERGY STAR
rated:

Operation [days/year]:

Operation [hours/day]:

Commercial Refrigeration

Commercial refrigeration – Volume
installed in cubic feet [ft³]:

Specify if solid door or glass door:

Manufacturer:

Model number:

Is it a standalone unit?

Does it replace an existing solid door
refrigerator?

Does it replace an existing glass door
refrigerator?

Is the equipment still used?

If not, why and since when?

Validate the equipment is ENERGY STAR
rated:

Commercial Freezers

Commercial freezer – Volume installed in cubic feet [ft³]:

Specify if solid door or glass door:

Manufacturer:

Model number:

Is it a standalone unit?

Does it replace an existing solid door freezer?

Does it replace an existing glass door freezer?

Is the equipment still used?

If not, why and since when?

Validate the equipment is ENERGY STAR rated:

Commercial Ice Makers

Ice making head – Number installed:

Manufacturer:

Model number:

Harvest [lbs/day]:

Is the equipment still used?

If not, why and since when?

Does it replace non- ENERGY STAR ice maker?

Validate the equipment is ENERGY STAR rated:

Remote condensing unit – Number installed:

Manufacturer:

Model number:

Harvest [lbs/day]:

Is the equipment still used?

If not, why and since when?

Does it replace non- ENERGY STAR ice maker?

Validate the equipment is ENERGY STAR rated:

Self-contained – Number installed:

Manufacturer:

Model number:

Harvest [lbs/day]:

Is the equipment still used?

If not, why and since when?

Does it replace non- ENERGY STAR ice maker?

Validate the equipment is ENERGY STAR rated:

Commercial Convection Ovens

Standard convection commercial oven –
Number installed:

Specify if electric or gas:

Specify if full size or half size:

Oven efficiency:

Idle [kW]:

Pre-heat[kW]:

Is the equipment still used?

If not, why and since when?

Does it replace an electric convection oven?

Is it a new installation?

Validate the equipment is ENERGY STAR rated:

Commercial Kitchen Ventilation Hoods

VSD for kitchen exhaust fans – Number
installed:

Size of the fan controlled by the VSD [hp]:

Is the equipment still used?

If not, why and since when?

Is the equipment controlled by T° and optical sensors located in exhaust hood?

Operation [hours/year]:

Laundry: *Collect the information in the table below **if commercial laundry measures** were installed. Use on-site observation and contact declaration. Use additional sheets if required. The information collected will then be compared with the information in the tracking sheet by Econoler. Additionally, record Manufacturer and Model Number, and all Technical Data (Operating Temp, CFM, Size, Control Info)*

Date of installation:

Water heating source:

Commercial Washing Machines Installed

ENERGY STAR commercial washing machine – Number installed:

Manufacturer:

Model number:

Size [cubic feet]:

Is the equipment used for commercial purpose?

Is the equipment still used?

If not, why and since when?

Validate the equipment is ENERGY STAR rated:

Operation [cycles/week]:

CEE Tier 2 commercial washing machine

– Number installed:

Manufacturer:

Model number:

Size [cubic feet]:

Is the equipment used for commercial purpose?

Is the equipment still used?

If not, why and since when?

Validate the equipment is CEE Tier 2 listed:

Operation [cycles/week]:

CEE Tier 3 commercial washing machine

– Number installed:

Manufacturer:

Model number:

Size [cubic feet]:

Is the equipment used for commercial
purpose?

Is the equipment still used?

If not, why and since when?

Validate the equipment is CEE Tier 3 listed:

Operation [cycles/week]:

APPENDIX VIII

ALGORITHM FOR FREE-RIDERSHIP CALCULATION

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

FR2a. If your company had not participated in BER, what is the likelihood that you would have installed exactly the same energy-efficient equipment that you installed through the program? (Scale 0 to 10)	IF Pre-FR3 = Yes: FR2a = (Answer x 10%) /2 OTHERWISE: FR2a = Answer x 10%
FR2b. If your company had not participated in BER, what is the likelihood that you would have installed standard equipment instead of energy-efficient equipment? (Scale 0 to 10)	IF Pre-FR1 = No: FR2b = (10 – Answer) x 10% /2 OTHERWISE: FR2b = (10 – Answer) x 10%
PA1 Score:	MEAN VALUE OF: (FR2a ; FR2b)
FR1. Did your company decide to implement the energy-efficient measure before participating in BER?	IF 1. Yes: Use FR1a IF 2. No, 98 OR 99 : FR1 = 0%
FR1a. I just want to make sure I understand - Before you decided to participate in BER, you had already made the decision to install the energy- efficient measure?	IF 1. Yes: FR1 = 100% IF 2. No, 98 OR 99 : FR1 = 0%
FR3. If your company had not received the rebate from ENSC, would you have paid for the full cost of the energy-efficient measure, including the portion covered by the rebate? (Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3
FR4. Level of influence (Scale 0 to 10) Factors a, b, c and f = Program factors Factors d and e = Non Program factors	FR4_P = SUM(a; b; c; f) FR4_NP = SUM(d; e)
PA3 Score:	100% - [FR4_P/(FR4_P+FR4_NP)]
FR2c. If your company had not participated in BER, what is the likelihood that you would have installed the energy-efficient equipment through the program but at a later date ? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2d Otherwise: PA4 = EMPTY
FR2d. Approximately how many months later would you have installed this equipment? 1. The last 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later? 7. (Never) 9. (Don't know / Refused)	IF 1. : FR2d = 100% IF 2. : FR2d = 50% IF 3. : FR2d = 25% IF 4. : FR2d = 0% IF 5. : FR2d = 0% IF 6. : FR2d = 0% IF 7. : FR2d = 0% IF 9. : FR2d = 0%
PA4 Score:	IF Pre-FR2 = Yes: FR2d/2 OTHERWISE: FR2d
Final Free-Ridership	MEAN VALUE OF : (PA1 ; PA2 ; PA3 ; PA4)
Inconsistency Test #1	IF ABS(FR2a – FR2b) ≥ 30%: PA1 = MIN OF (FR2a ; FR2b)
Inconsistency Test #2	IF FR3 ≥ 70% AND IF (FR2a OR FR2b < 70%: PA2 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)

APPENDIX IX

CALCULATION EXAMPLE

This Appendix provides an example calculation to describe the adjustment process performed for all savings associated with the measure categories of BER MI. As the HVAC measure category was the largest source of energy savings this year, it was selected as the example. The most common measure implemented was air source heat pumps (ASHPs) with a capacity of less than 65,000 Btu/hr. Therefore, the calculations presented are based on this specific measure. Heating energy and demand savings are only calculated only in cases where there was an existing electric heat source, and cooling energy savings are applicable only to spaces that were cooled prior to the installation of a heat pump.

The algorithms are presented first, followed by the tracked savings and the revised savings results based on the on-site validation and analysis of project documents. The adjustment ratio calculation is also presented.

Energy and Demand Savings Algorithms

The 2014 *CIRx Screening Tool 1.3* HVAC tab contains the energy and demand savings algorithms for all measures. The equations below describe those used for ASHPs with a capacity of less than 65,000 Btu/hr.

$$\Delta kWh_t = \Delta kWh_h + \Delta kWh_c$$

$$\Delta kWh_h = kBTU/hr \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}} \right) \times FLH_w \times Qty$$

$$\Delta kWh_c = kBTU/hr \times \left(\frac{1}{SEER_{base}} - \frac{1}{SEER_{ee}} \right) \times FLH_s \times Qty$$

$$\Delta kW_h = \frac{kBTU}{hr} \times \left(\frac{1}{HSPF_{base}} - \frac{1}{HSPF_{ee}} \right) \times Qty$$

$$\Delta kW_c = \frac{kBTU}{hr} \times \left(\frac{1}{EER_{base}} - \frac{1}{EER_{ee}} \right) \times Qty$$

Where:

- ΔkWh_t = Total annual energy savings of the heat pump in heating and cooling mode
- ΔkWh_h = Annual energy savings of the heat pump in heating mode
- ΔkWh_c = Annual energy savings of the heat pump in cooling mode
- ΔkW_h = Annual demand savings of the heat pump in heating mode
- ΔkW_c = Annual demand savings of the heat pump in cooling mode
- kBtu/hr** = Nominal rated capacity of the heat pump (1 ton = 12 kBtu/hr)

$HSPF_{base}$ = Heating seasonal performance factor of the baseline heating equipment

$HSPF_{ee}$ = Heating seasonal performance factor of the energy-efficient heating equipment

$SEER_{base}$ = Seasonal Energy Efficiency Ratio of the baseline heating equipment

$SEER_{ee}$ = Seasonal Energy Efficiency Ratio of the energy-efficient heating equipment

EER_{base} = Energy Efficiency Ratio of the baseline cooling equipment

EER_{ee} = Seasonal Energy Efficiency Ratio of the energy-efficient cooling equipment

FLH_w = Full load hours per year for heating

FLH_s = Full load hours per year for cooling

Qty = Quantity of heat pumps

Sample Calculation for Tracked Savings

The table below presents a summary of the calculation parameters, and their respective sources, used for a specific ASHP project.

Parameter	Value	Source
Rated heat pump capacity – heating (kBtu/h)	26.4	Air-Conditioning, Heating, and Refrigeration Institute (AHRI) average heating output for product
$HSPF_{base}$	3.412	CIRx Screening Tool 1.3 (electric heat)
$HSPF_{ee}$	8.09	Equipment specification sheet (adjusted for Region V)
FLH_w	2,200	CIRx Screening Tool 1.3
FLH_s	NA	–
Qty	1	Participant worksheet
Tracked ΔkWh	9,843	Calculation
Tracked ΔkW	4.47	Calculation

Sample Calculation for Revised Savings

The table below presents a summary of the revised parameters used in the savings calculations for the aforementioned project. The annual full load heating hours were revised to 2,750, as recommended in the 2013 BER Evaluation. The rated heating capacity was also increased to reflect the value stated in the equipment specification sheet. Cooling energy savings were added to this project, as the on-site verification revealed that a ducted AC system had been used prior to installation of the ASHP. However, cooling demand savings are not applicable, as they cannot be added to the heating demand savings calculated for winter. These changes resulted in an increase in both the energy and demand savings. The parameters used in the revised savings calculations are presented below.

Parameter	Value	Source
Rated heat pump capacity – heating (kBtu/h)	32	Equipment specification sheet
Rated heat pump capacity – cooling (kBtu/h)	30.6	Equipment specification sheet
HSPF _{base}	3.412	CIRx Screening Tool 1.3 (electric heat)
HSPF _{ee}	8.09	Equipment specification sheet (adjusted for Region V)
SEER _{base}	13	CIRx Screening Tool 1.3
SEER _{ee}	17.2	Equipment specification sheet
FLH _w	2,750	2013 BER Evaluation Report (based on AHRI Standard 210/240)
FLH _s	400	CIRx Screening Tool 1.3
Qty	1	Participant worksheet
Revised ΔkWh_t	15,143.61	Calculation
Revised ΔkW	5.42	Calculation

Adjustment Ratios

The modifications to the tracked calculation variables, and the addition of cooling energy savings had a significant impact on revised project savings. As a result, the energy savings adjustment ratio calculated for this project was 1.54, based on the equation below.

$$Adjustment\ Ratio\ on\ Energy\ Savings_{Project} = \frac{Revised\ \Delta kWh}{Tracked\ \Delta kWh} = \frac{15,143.61\ kWh}{9,843.00\ kWh} = 1.54$$

Similarly, the demand savings adjustment ratio was calculated to be 1.21, based on the equation below.

$$Adjustment\ Ratio\ on\ Demand\ Savings_{Project} = \frac{Revised\ \Delta kW}{Tracked\ \Delta kW} = \frac{5.42\ kW}{4.47\ kW} = 1.21$$

These energy and demand adjustment ratios, along with those calculated for all other validated projects, were used to calculate the overall HVAC measure category adjustment ratios for energy and demand savings.



ECONOLER

CUSTOM RETROFIT

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

BAS	Building Automation System
BER	Business Energy Rebates
BNI	Business, Non-Profit and Institutional
CATI	Computer-Assisted Telephone Interviewing
CRA	Corporate Research Associates
DSM	Demand-Side Management
DSMDS	Demand-Side Management Data System
EBC	Existing Building Commissioning
EEM	Embedded Energy Manager
EMIS	Energy Management Information Systems
ENSC	Efficiency Nova Scotia Corporation
EVO	Efficiency Valuation Organization
HVAC	Heating, Ventilating and Air Conditioning
IPMVP	International Performance Measurement and Verification Protocol
M&V	Measurement and Verification
NTGR	Net-to-Gross Ratio
PDA	Project Development Agreement
PM	Program Manager
VFD	Variable Frequency Drive

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VII
1 PROGRAM DESCRIPTION.....	1
2 METHODOLOGY	3
2.1 Presentation of the Team.....	3
2.2 Evaluation Activities	3
2.2.1 Interview with Program Manager.....	4
2.2.2 Survey.....	4
2.2.3 Project File Review, On-site Visits and Interviews	5
2.2.4 Project File Review	5
3 PROCESS EVALUATION	6
3.1 Participation in Custom Retrofit.....	6
3.2 Follow-up on 2012 and 2013 Evaluation Report Recommendations	6
3.3 Program Documentation and Design.....	9
3.4 Tracking System	12
3.4.1 DSMDS Report	12
3.4.2 Online DSMDS.....	13
4 MARKET EVALUATION	16
4.1 Participant Perspectives.....	16
4.1.1 Awareness and Participation.....	16
4.1.2 Custom Retrofit Influence.....	17
4.1.3 Satisfaction with Custom Retrofit.....	18
5 IMPACT EVALUATION FOR CUSTOM RETROFIT.....	20
5.1 Gross Savings	20
5.1.1 Adjustment Methodology for Custom Retrofit.....	20
5.1.2 Adjusted Gross Savings.....	22
5.2 Net-to-Gross Ratio	25
5.2.1 Free-ridership.....	26
5.2.2 Internal Spillover	26
5.2.3 NTGR Calculation	27
5.3 Net Savings.....	27

6	IMPACT EVALUATION FOR EMIS AND EBC	28
6.1	EMIS Review	28
6.2	Existing Building Commissioning Review	29
6.2.1	Validated Gross Savings	31
6.3	Net-to-Gross Ratio	31
6.4	Overall Savings for Custom Retrofit	32
	CONCLUSION	33
	APPENDIX I 2014 RECOMMENDATIONS	34
	APPENDIX II PARTICIPANT SURVEY QUESTIONNAIRE	37
	APPENDIX III PARTICIPANT SURVEY RESULTS	49
	APPENDIX IV ALGORITHM FOR FREE-RIDERSHIP CALCULATION	62
	APPENDIX V INTERNAL SPILLOVER METHODOLOGY	64
	APPENDIX VI CALCULATION EXAMPLE	65
	APPENDIX VII CUSTOM RETROFIT ON-SITE VISIT SAMPLING PLAN AND PROTOCOL	68

LIST OF TABLES

Table 1: Distortion Effects and Net-to-Gross Ratio for Custom Retrofit	viii
Table 2: 2014 Net Savings at the Generator of Custom Retrofit, EMIS and EBC	ix
Table 3: Annual Survey Sample Sizes and Margin of Error for Custom Retrofit	4
Table 4: Implementation Status of Recommendations in 2012 and 2013 Executive Summaries	7
Table 5: Sources of Awareness	16
Table 6: Factors Influencing Participants' Decisions	17
Table 7: Satisfaction with Custom Retrofit.....	18
Table 8: Satisfaction with ENSC	19
Table 9: Adjustment Factors for Gross Energy and Peak Demand Savings Calculations.....	24
Table 10: Evaluation Results – Revised Savings for Custom Retrofit.....	25
Table 11: Net Energy and Peak Demand Savings for Custom Retrofit.....	27
Table 12: Tracked Savings for EMIS and EBC Components.....	31
Table 13: 2014 Net Savings at the Generator of Custom Retrofit, EMIS and EBC	32

LIST OF FIGURES

Figure 1: Methodological Model	3
Figure 2: Projects Implemented through Custom Retrofit	6
Figure 3: Custom Program Delivery Options	11

EXECUTIVE SUMMARY

This report presents the results of the 2014 evaluation of Custom Retrofit, which is based on one in-depth interview with the Program Manager (PM), 22 on-site visits, a telephone survey of 11 participants and a total of 27 project files review.

Program Component Overview

Efficiency Nova Scotia Corporation's (ENSC) Custom Retrofit provides business, non-profit and institutional (BNI) customers with technical assistance, financial incentives and project financing to help reduce their electricity consumption and demand in existing facilities. More precisely, Custom Retrofit provides eligible ENSC customers with technical and financial support to help them conduct scoping and feasibility studies and implement technical changes at their facilities under a customized and flexible approach.

Electrical energy savings and peak demand savings generated by Custom Retrofit are accounted for under the Custom Incentives program. Custom Incentives also includes the following components: Energy Management Information Systems (EMIS), Existing Building Commissioning (EBC) and New Construction. EMIS offers incentives to help medium and large industrial customers reduce their electricity consumption through the implementation of an EMIS, while EBC supports the implementation of no-cost or low-cost energy efficiency measures identified through a recommissioning process for institutional and commercial customers. New Construction is assessed in a separate evaluation report.

Custom Retrofit, EMIS, and EBC combined, aimed to generate net electricity savings of 19.3 GWh and peak demand savings of 3.6 MW for 2014.

Key Findings

In 2014, the Custom Retrofit component had a total of 100 projects implemented, which was lower than the previous years. Custom Retrofit generated net energy savings of 20.292 GWh and net peak demand savings of 1.599 MW in 2014.

The EBC and EMIS components respectively generated 1.690 GWh and 5.006 GWh. No peak demand savings were claimed for those two components.

Custom Retrofit, EMIS and EBC combined achieved net electricity savings of 26.988 GWh and peak demand savings of 1.599 MW for 2014.

Satisfaction

In 2014, nearly all participants claimed to be satisfied with Custom Retrofit overall. Other program aspects generally received good ratings, with the majority of participants offering good ratings for the initial confirmation of eligibility, the project implementation and the incentive amount.

The timeliness in receiving incentives and the paperwork and procedures required for receiving the incentive were the two aspects that received the lowest satisfaction ratings. The lower satisfaction ratings attributed to these factors can be partly explained by the very nature of Custom Retrofit. Specifically, the participation process can be slow at times because of the involvement of many parties in the program and the complexity of certain projects.

That being said, all participants surveyed mentioned that they would recommend Custom Retrofit to other businesses, and that they would participate in other ENSC programs based on their experience with Custom Retrofit.

Energy Savings

To calculate the net savings of Custom Retrofit in 2014, the Evaluator used an approach that involved conducting on-site visits of sample projects and in-depth interviews with sample participants. Then, the Evaluator calculated the gross energy and peak demand savings for all the sampled projects based on the specific characteristics of each project type. These calculation results allowed establishing the adjustment factors to be used to estimate the overall gross savings.

Afterwards, the Evaluator determined the appropriate net-to-gross ratios (NTGRs) to be applied by evaluating the free-ridership and internal spillover effects. With this approach, a free-ridership level of 10 percent was established, which is slightly higher than the free-ridership level established in both 2013 and 2012 (9%). As for spillover, the Evaluator used the same approach as in 2013, which involved interviewing program participants during the on-site visits. This approach has enabled the Evaluator to assess the spillover level of Custom Retrofit more accurately; this distortion effects factor was determined to be nil for 2014, which is not very different from the 2013 results (1%).

The NTGR used to calculate the net energy and peak demand savings of Custom Retrofit for 2014 is shown in the following table. It should be noted that the values in the following table do not include those of the EBC and EMIS components, for which the distortion effects were assumed to be nil.

Table 1: Distortion Effects and Net-to-Gross Ratio for Custom Retrofit

	2014
Free-Ridership Level	10%
Spillover Level	0%
Net-to-Gross Ratio	0.90

The evaluation revealed that Custom Retrofit and its two sub-components generated 26.988 GWh in net energy savings at the generator in 2014. As for electricity demand reduction, the program component achieved 1.599 MW in net peak demand savings at the generator in 2014, while no savings were claimed for EBC and EMIS. The following table presents Custom Retrofit's savings, along with the savings targets set and the savings tracked by ENSC for 2014.

Table 2: 2014 Net Savings at the Generator of Custom Retrofit, EMIS and EBC

	Initial Gross Savings	Adjusted Gross Savings	NTGR*	Net Savings
Energy Savings				
Tracked Savings from ENSC	29.353 GWh	29.353 GWh	0.93	27.314 GWh
Evaluation Results	29.353 GWh	29.244 GWh	0.92	26.988 GWh
Peak Demand Savings				
Tracked Savings from ENSC	2.071 MW	2.071 MW	0.91	1.885 MW
Evaluation Results	2.071 MW	1.777 MW	0.90	1.599 MW
* The NTGR was different for each component. The NTGRs presented in this table match the rounded averages obtained by dividing the net savings by the adjusted gross savings.				

As shown in the previous table, the evaluated net energy savings were lower than those tracked by ENSC by approximately 1.2 percent. This is not due to the adjustments made to the gross savings, because these adjustments reduced the tracked savings by less than 0.5 percent. In fact, the largest portion of the reduction in net energy savings can be explained by the lower NTGR, since free-ridership level increased by one percentage point this year, while the internal spillover level decreased from one percent to nil this year. For their part, gross peak demand savings were adjusted downward by the Evaluator, by about 14 percent. In most cases, this was due to the adjustments made to the diversity factors, though these adjustments were not as significant as last year. The reduction in NTGR also contributed to evaluated net peak demand savings being lower than the tracked value, by 15 percent.

Recommendations

Overall, the Econoler team believes that Custom Retrofit is working well and is achieving good energy savings. In addition to the general recommendations presented for all ENSC program components in the overall 2014 evaluation report's executive summary of the demand-side management (DSM) programs, the team makes specific recommendations throughout this report aimed at optimizing Custom Retrofit. What follows is a summary of the most important recommendations:

2014 Custom-R1. Perform thorough M&V and document it in a complete report for every large project for which thorough M&V work is justified and required. The Evaluator has observed that ENSC is using M&V as a tool increasingly often each year for Custom Retrofit. For some simpler and smaller projects,

performing some hours-of-operation data logging and spot measurement may be adequate to allow establishing savings with a fairly good level of accuracy and reliability. However, this year, the Evaluator encountered some very large projects with multiple energy efficiency measures, for which the M&V activities conducted were limited to a few spot measurements. The Evaluator considers that in order to justify incentives amounting to hundreds of thousands of dollars, a complete M&V report should be written to report on all the major elements defined in standard M&V protocols, such as the IPMVP. For smaller projects, a good practice would be to summarize the measurement methodology (what was measured and when) and the equations used to establish energy savings based on the raw data in a short form.

2014 Custom-R2. Improve the information presented in the DSMDS reports. The Evaluator found that most of the important information for evaluation purposes could be obtained from the DSMDS reports. Some elements could, however, be added to improve clarity and the ease of use. For instance, this report has not presented the line loss factor, the rate code, or the verified savings at the meter. The answers to the free-ridership screening have not been included either. Furthermore, it is only possible to obtain either the projects' total savings (over multiple years), or the claimed savings for the current year. To improve sample selection, it will be important to have both these values, because the adjustment ratios are calculated based on the project's total savings, but the average ratio for all the projects is weighted based on the contribution of each project to the current year's savings. Additionally, some projects were identified as claimed in 2014, while only an adjustment to M&V results was made this year. This resulted in some projects being incorrectly included in the 2013 sample. The Evaluator recommends adding a unique identification code name, or tag to indicate if the project is being claimed in the current year or represents ongoing M&V adjustments being made to a project from a previous year.

2014 Custom-R3. Improve the free-ridership pre-screening procedure. This year again, ENSC discussed the clients' payback period threshold and the importance of the incentive for each of the projects submitted through Custom Retrofit. This way, ENSC can avoid giving incentives to participants who would have implemented the project without it. In turn, the calculated free-ridership has been significantly reduced for all participants who underwent this pre-screening. The Evaluator found that in some cases this year, the answers were weak; for instance, one answer included in the annual survey sample read as "To reduce payback period". It is recommended that the pre-screening questions be standardized, in a way similar to that used for Business Energy Rebates, and that acceptable answers be better defined.

- 2014 Custom-R4. Better define the expected scope of the EBC feasibility studies.** Although the component's name refers to recommissioning, the studies conducted this year were more limited in scope than a full recommissioning process. The Evaluator understands that the reason for this was to focus on low-cost measures and facilitate a first contact with customers who might not be quite ready to participate in the Custom program. However, the Evaluator believes that the scale and scope of the measures to be considered in the study should be better defined. Some studies were limited to rescheduling ventilation to match occupancy schedules, while others considered the operation of the whole HVAC system and its control. A better definition of the expectations will help make sure that the customer gets the full benefits of the study.
- 2014 Custom-R5. Require EMIS service providers to track and present savings using the IPVMP.** The IPVMP, a widely recognized M&V protocol, requires the service providers to develop a detailed M&V plan as part of their implementation plans. This action can help address most of the weaknesses identified in the projects reviewed: for instance, a representative baseline data collection period will be required, and all the adjustments will have to be thoroughly documented. In addition, ENSC should review the proposed M&V plans and verify the tracked savings claimed in the quarterly reporting periods, which will help ensure that all the relevant independent variables have been identified, that the baseline model is adequate, and that the routine and non-routine adjustments are being properly applied.
- 2014 Custom-R6. Plan on conducting a thorough impact evaluation of EMIS and EBC in 2015.** This year, the impact evaluation of the EMIS and EBC was limited in scope, and no on-site visits were conducted. The Evaluator considers that this choice was appropriate, since only 9 projects in total were claimed for these two components. However, the amount of savings (6.696 GWh) they achieved at the generator was significant, with more than 5 GWh achieved by EMIS alone. The Evaluator did not make adjustments to the tracked savings, given the limited amount of information available this year, but it believes that a thorough review should be made next year.

1 PROGRAM DESCRIPTION

Efficiency Nova Scotia Corporation's (ENSC) Custom Retrofit provides business, non-profit and institutional (BNI) customers with technical assistance, financial incentives and project financing to help reduce their electricity consumption and demand in existing facilities. More precisely, Custom Retrofit provides eligible ENSC customers with technical and financial support to help them conduct scoping and feasibility studies and implement technical changes at their facilities under a customized and flexible approach. Moreover, this component's delivery has been structured in such a way that allows customers to participate in any phase of their project prior to implementation, regardless of their current level of energy management expertise.

Custom Retrofit is meant to meet a wide range of customer requirements and support a variety of energy efficiency initiatives in the institutional, charitable, commercial or industrial sectors. Since 2013, two tracks have been offered to the participants:

- › **Track 1:** Eligible projects must save between 5,000 and 20,000 kWh of electricity per year. There are no constraints on the usage of participant accounts.
- › **Track 2:** Eligible projects must save at least 20,000 kWh of electricity per year. Eligible accounts typically have a peak electricity demand of 250 kW as reported by Nova Scotia Power. However, customers may group multiple smaller (< 250 kW) facilities into a single project to make them eligible as long as this approach remains cost-effective and all other requirements are fulfilled.

For eligible projects, no energy-saving technologies are specifically prescribed. ENSC evaluates the eligibility of each measure on a case-by-case basis. Approved energy efficiency measures typically involve compressed air, industrial processes, refrigeration, motors and drives, and heating, ventilating and air conditioning (HVAC) systems.

Efficient lighting was offered under Custom Retrofit in previous years, but was transferred to the prescriptive programs of ENSC in 2014, except for lighting projects requiring a custom design as well as for efficient lighting measures bundled with other customized energy efficiency upgrades or measures.

In addition, measures involving demand-limiting controls or power factor correction systems are ineligible since such measures focus mainly on demand savings and result in minimal or non-existent energy savings. Furthermore, projects with energy and demand savings exceeding the current facility electricity consumption may be eligible for technical and financial support from Custom Retrofit, but will not receive such support from ENSC for any energy savings exceeding their own initial electricity consumption.

Electrical energy savings and peak demand savings generated by Custom Retrofit are accounted for under the Custom Incentives program. Custom Incentives also includes the two sub-components: Energy Management Information Systems (EMIS), Existing Building Commissioning (EBC) and New

Construction. EMIS offers incentives to help medium and large industrial customers reduce their electricity consumption through the implementation of an EMIS, while EBC supports the implementation of no-cost or low-cost energy efficiency measures identified through a recommissioning process for institutional and commercial customers. New Construction is assessed in a separate evaluation report.

Custom Retrofit, EMIS and EBC combined aimed to generate net electricity savings of 19.3 GWh and peak demand savings of 3.6 MW for 2014.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and details regarding the activities carried out for the Custom Retrofit evaluation.

2.1 Presentation of the Team

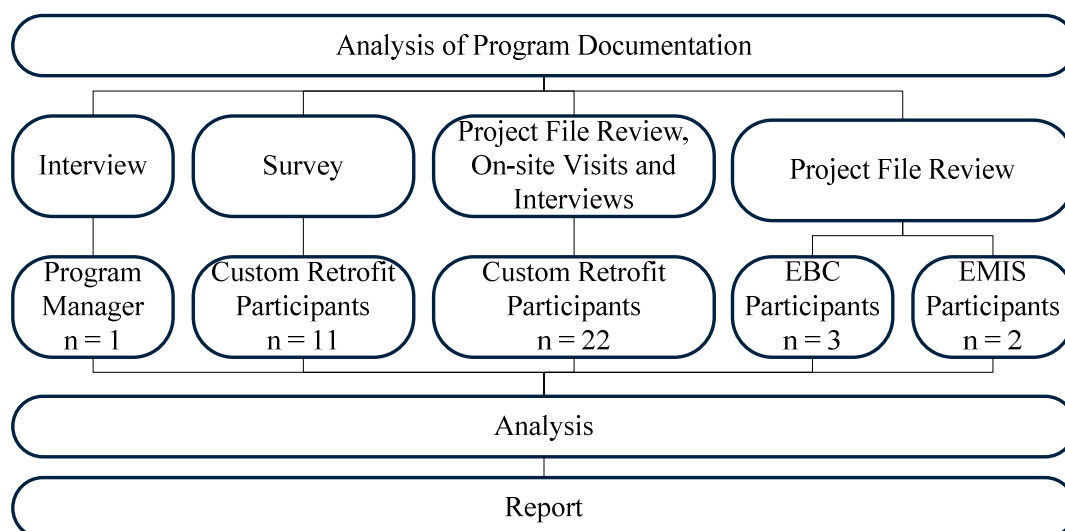
To carry out the 2014 evaluation, Econoler worked with two partner entities: Corporate Research Associates (CRA) and Equilibrium Engineering. Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as for preparing and reviewing all the deliverables.
- › CRA performed the participant survey and also analyzed and reported on the data collected.
- › Equilibrium Engineering conducted the on-site visits, reviewed the tracking sheet and assisted Econoler with certain parts of the impact evaluation. Equilibrium Engineering was also in charge of the analysis and reporting that followed these different activities.

2.2 Evaluation Activities

Figure 1 below illustrates the research strategy and data collection activities used for the 2014 evaluation.

Figure 1: Methodological Model



Each step of this methodological model is further detailed in the following sub-sections.

2.2.1 Interview with Program Manager

The Econoler team conducted one interview with the PM in September 2014. This interview was intended, among other things, to follow up on the 2012 and 2013 evaluation recommendations regarding process issues and to understand the main changes made to program delivery in 2014. Based on the information obtained in this interview, a list of questions and topics to be included in the data collection tools was prepared.

2.2.2 Survey

In the fall of 2014, CRA staff in Halifax conducted a telephone survey with a total of 11 Custom Retrofit participants, using computer-assisted telephone interviewing (CATI) technology. The average length of the survey was 16 minutes.

The participant survey was meant to receive feedback on the following aspects of Custom Retrofit:

- › Free-ridership
- › Previous participation and program awareness
- › Participant motivations and barriers
- › Satisfaction with the program
- › Recommendations for improvements

The questionnaire and complete survey results are presented in Appendix II and Appendix III. The table below shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 telephone surveys. At the time when the survey was being conducted, the population of Custom Retrofit participants for the 2014 survey was 27 (after removing the duplicates). Due to the small population size when the survey was being conducted, an attempted census was conducted rather than a sampling approach. Drawing a random sample of 11 completed projects from a population of 68 would yield a margin of error as noted in the table.

Table 3: Annual Survey Sample Sizes and Margin of Error for Custom Retrofit

Annual Survey	Population	<i>Sample Size (n)</i>	Margin of Error at 90% Confidence Level
2014 Participants	68	11	±23.9%
2013 Participants	134	29	±13.8%
2012 Participants	155	27	±14.4%

The margin of error is used to determine the level of precision¹ of the measurement, and its associated confidence level indicates the probability for a measure to fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or biases, such as data entry errors, respondents providing inaccurate responses or people who could not be contacted.

2.2.3 Project File Review, On-site Visits and Interviews

By the end of 2014, 25 on-site visits and a full technical review of project documentation was carried out for a sample of the 2014 Custom Retrofit participants. However, since some projects recorded in the tracking sheet used for sampling had been entered by mistake, only 22 visit results were used to establish the revised savings. The on-site visits were conducted by Equilibrium Engineering and were meant to validate the technical specifications of the new and old equipment as well as their schedules of operation. In addition, the Evaluator collected information regarding the facilities' characteristics and interviewed participants to assess and quantify possible spillover.

A copy of the Custom Retrofit on-site visit sampling plan and protocol is also included in appendix VII.

2.2.4 Project File Review

In the fall of 2014, the Econoler team evaluated five projects, which were supported by either the EBC or the EMIS components of Custom Retrofit. Conducted on the basis of a technical review of these two sub-components' project documentation, the main objective of this evaluation was to make recommendations on the methodology used to document and calculate savings, as well as on the approach used by ENSC to support and verify such projects.

¹ Precision refers to how close the measured values are to each other. However, it does not take into consideration how close the measured value is to the true value, which refers to accuracy.

3 PROCESS EVALUATION

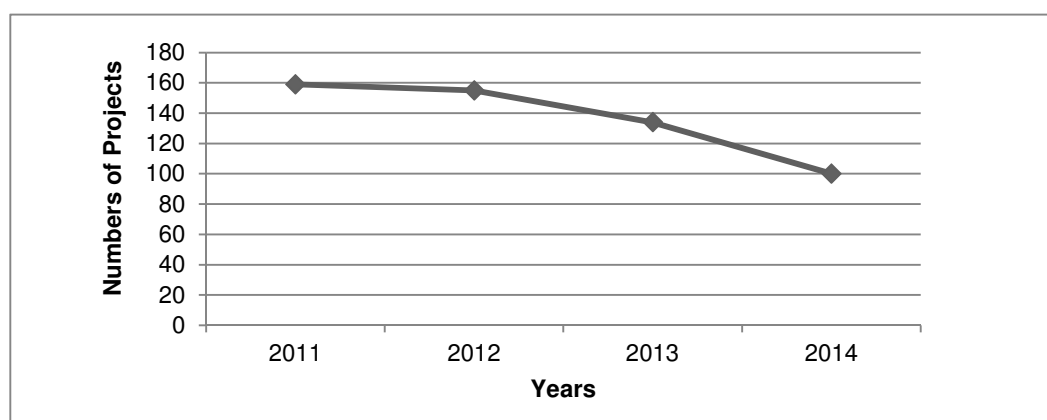
This section presents the findings of the 2014 Custom Retrofit process evaluation, which has been carried out on the basis of the information gathered from the Custom Retrofit documentation and tracking system, as well as an interview with the PM.

3.1 Participation in Custom Retrofit

In 2014, Custom Retrofit saw a total of 100 projects implemented, compared to 134 projects in 2013, 155 projects in 2012 and 159 projects in 2011.

Figure 2 illustrates that the number of projects implemented through Custom Retrofit declined in 2014. This decrease can be explained in part by the fact that many projects that included only lighting measures were offloaded to other programs, such as Business Energy Rebates (BER), for the first time in 2014. Nonetheless, other programs such as BER did not see a major increase in their participation figures in 2014. It is, therefore, possible that the reduced participation in Custom Retrofit was also attributable to the lower targets set by ENSC this year.

Figure 2: Projects Implemented through Custom Retrofit



3.2 Follow-up on 2012 and 2013 Evaluation Report Recommendations

This section reports on the progress made in acting on the recommendations made by the Evaluator in the 2012 and 2013 evaluation reports. The Evaluator reviewed the status of follow-up on the recommendations from both 2012 and 2013 because only a partial process evaluation was conducted in 2013, which did not include a review of the implementation status of the 2012 recommendations.

To monitor the progress in implementing the recommendations, the PM has been using a monitoring tool, namely a table that documents all the recommendations made and the corresponding implementation status. This tool is an excellent initiative to ensure that the program memory is properly kept and updated.

The Evaluator analyzed the content of the monitoring file to determine whether and to what extent ENSC followed up on the recommendations. The following table gives a brief summary of the implementation status of each recommendation presented in the Executive Summary section of the 2012 and 2013 evaluation reports.

Table 4: Implementation Status of Recommendations in 2012 and 2013 Executive Summaries

Recommendation	Status
2012 Recommendation	
2012 Custom-R1 Consider diverting or assigning a proportion of the simple lighting retrofit projects to other prescriptive measure programs.	Implemented
2012 Custom-R2 Improve tracking on implemented measures and savings.	Implemented
2012 Custom-R3 Improve the method for diversity factor calculations and document the assumptions used.	Being implemented
2012 Custom-R4 Promote more active and extensive use of the measurement and verification (M&V) procedures.	Implemented
2012 Custom-R5 Consider performing independent M&V on Custom Retrofit projects that are already carrying out M&V.	Partially Implemented
2013 Recommendation	
2013 Custom-R1 Improve the method for diversity factor calculations and document the assumptions used.	Being implemented
2013 Custom-R2 Create new standardized calculation tools to estimate energy savings from energy-efficient measures that are not lighting retrofits.	Implemented
2013 Custom-R3 Consider performing independent M&V on large Custom Retrofit projects.	Partially implemented
2013 Custom-R4 Develop guidelines for identifying potentially problematic projects.	Being implemented
2013 Custom-R5 Retain the spillover assessment approach used in 2013 under Custom Retrofit evaluation in the future.	Implemented

The following sub-sections detail the actions taken by ENSC to address some of these recommendations.

2012 Executive Summary Recommendations

The Evaluator noticed that one of the 2012 recommendations implemented by ENSC has resulted in major changes for Custom Retrofit. In 2012, projects involving only lighting retrofit accounted for almost 60 percent of the projects claiming savings and achieved more than 52 percent of these savings. Many of these projects were small- or medium-size lighting retrofits that could have been supported by other BNI programs. The Evaluator therefore recommended diverting and assigning other such upcoming simple projects to other appropriate BNI programs so that they could be tracked and managed in a more efficient and cost-effective way (2012 Custom-R1). Since April 2014, Custom Retrofit has discontinued supporting lighting measures, with the exception of projects requiring a

custom design and projects that include other measures which might interact with lighting. Other lighting measures have been transferred to the prescriptive programs of ENSC.

Among the other recommendations made in 2012, it is worth mentioning that the Evaluator proposed promoting a more active and extensive use of the M&V procedures (2012 Custom-R4). This recommendation was made based on the findings of the 2012 project on-site visits and documentation reviews, which revealed that for the majority of projects evaluated, the M&V plans had not been compliant with the International Performance Measurement and Verification Protocol (IPMVP), despite being required by the program documentation. Since then, M&V templates have been developed to address this issue and should be put in place in early 2015.

2013 Executive Summary Recommendations

Some recommendations made in the executive summary section of the 2013 evaluation report were very similar to those proposed in the 2012 evaluation report. It is the case for the recommendation aimed at improving the diversity factor calculations (2013 Custom-R1). Since 2011, the Evaluator team has observed that diversity factors used by ENSC for calculating peak demand savings have been generally obtained by dividing the annual operation hours by the total of hours in one year, which is inappropriate and does not reflect the actual demand savings achieved during the peak period of electricity demand in Nova Scotia. This has been partially addressed by adding a “peak coincidence factor” field (equivalent to “diversity factor”) in the DSMDS, which is used to calculate peak demand savings. Even though very limited information is available on how these diversity factors are established, the addition of this new field will certainly facilitate the evaluation of the Custom Retrofit project impacts. Furthermore, ENSC has planned to offer some internal training to their staff on diversity factor calculation in early 2015.

From 2011 to 2013, the Evaluator noticed that a number of customized spreadsheets and methodologies were used to estimate the potential impacts of the non-lighting projects, such as variable frequency drive (VFD) installation, motor replacement or refrigeration projects. This situation made the work of tracking, verification and independent evaluation of the energy and peak demand savings achieved under Custom Retrofit more complex. Moreover, this practice tends to create errors in energy and peak demand savings calculations. The Evaluator therefore recommended creating new standardized calculation tools to estimate energy savings associated with energy efficient measures other than lighting retrofits (2013 Custom-R2). In 2014, ENSC created a specific calculation tool for VFD installation and motor efficiency enhancement measures on pumps and fans. The Evaluator reviewed this tool and proposed a set of suggestions to improve it. The development of this tool is definitely a step in the right direction, and will be used for new projects in 2015. For other project categories, ENSC still relies on the calculations provided in feasibility studies conducted by the consultants who are supporting the projects.

In the 2012 and 2013 evaluation reports, the Evaluator suggested using independent M&V on selected Custom Retrofit projects to verify their compliance with the IPMVP (2013 Custom-R3). The Evaluator

suggested that independent M&V be conducted on projects that achieve a significant amount of energy savings, or receive a substantial incentive, or whose expected savings depend heavily on equipment operating conditions. Independent M&V was conducted for only a small number of projects, on a case-by-case basis, since conducting a complete M&V activity requires significant additional budget. When the M&V is carried out by the participant or the project design and implementation firm, ENSC does their best to internally validate the M&V procedures, especially on complex or large projects. This aspect will be reassessed in 2015, depending on their internal priorities and available budget.

As part the previous evaluation reports, it was also recommended that guidelines be developed to identify projects that may be claiming too much energy or peak demand savings for the type of energy efficiency measure being implemented (2013 Custom-R4). The projects identified by these guidelines can then be further reviewed, either by ENSC or an independent technical professional. A screening tool developed by ENSC will use a set of variables to establish whether the savings of a particular project are within an expected range and single out those that are outside this range. This tool is planned to be implemented in 2015.

3.3 Program Documentation and Design

Custom Retrofit is by far the most complex component of ENSC's program portfolio. This type of program is usually capital and labour-intensive since it involves supporting and tracking custom projects with characteristics that typically make them ineligible for a prescriptive or more mainstream program.

In 2012, a complete process evaluation was made, including an analysis of all the program documentation to make pertinent recommendations. Over the last two years, most of the Evaluator's recommendations regarding the process have been followed and implemented. Hence, the 2014 process evaluation has focused on Custom Retrofit's major changes that had occurred since the last process evaluation to see if these changes have followed international best practices and to make proper recommendations where necessary.

To effectively make this analysis, it is important to understand the nature of such a program. In the program portfolio of a utility or organization, there are usually projects that do not fit in with any standardized program and such a situation tends to result in so-called "lost opportunities". To seize these lost opportunities, a type of customized program can be created to provide every project with technical, financial, management or any other kind of support. If after a number of years, it is found that some types of projects are often or regularly proposed, the usual course of action would be to either create a standardized program for just such projects or accept them under a new path within the program.

ENSC's Custom Retrofit is just such a program targeting customized measures. Naturally, there are always a number of eligibility criteria to meet to qualify for the program, such as the minimum savings

of 20,000 kWh/year. These threshold conditions ensure that the budget is not used up too quickly and that the types of projects which do not fit in with ENSC corporate values are rejected.

After analyzing the types of projects submitted to the program, the program staff realized that there was a niche for smaller projects that did not fit in the prescriptive programs of ENSC. Hence, a second path was created within Custom Retrofit to receive eligible small-scale projects, which must have estimated savings between 5,000 and 20,000 kWh/year.

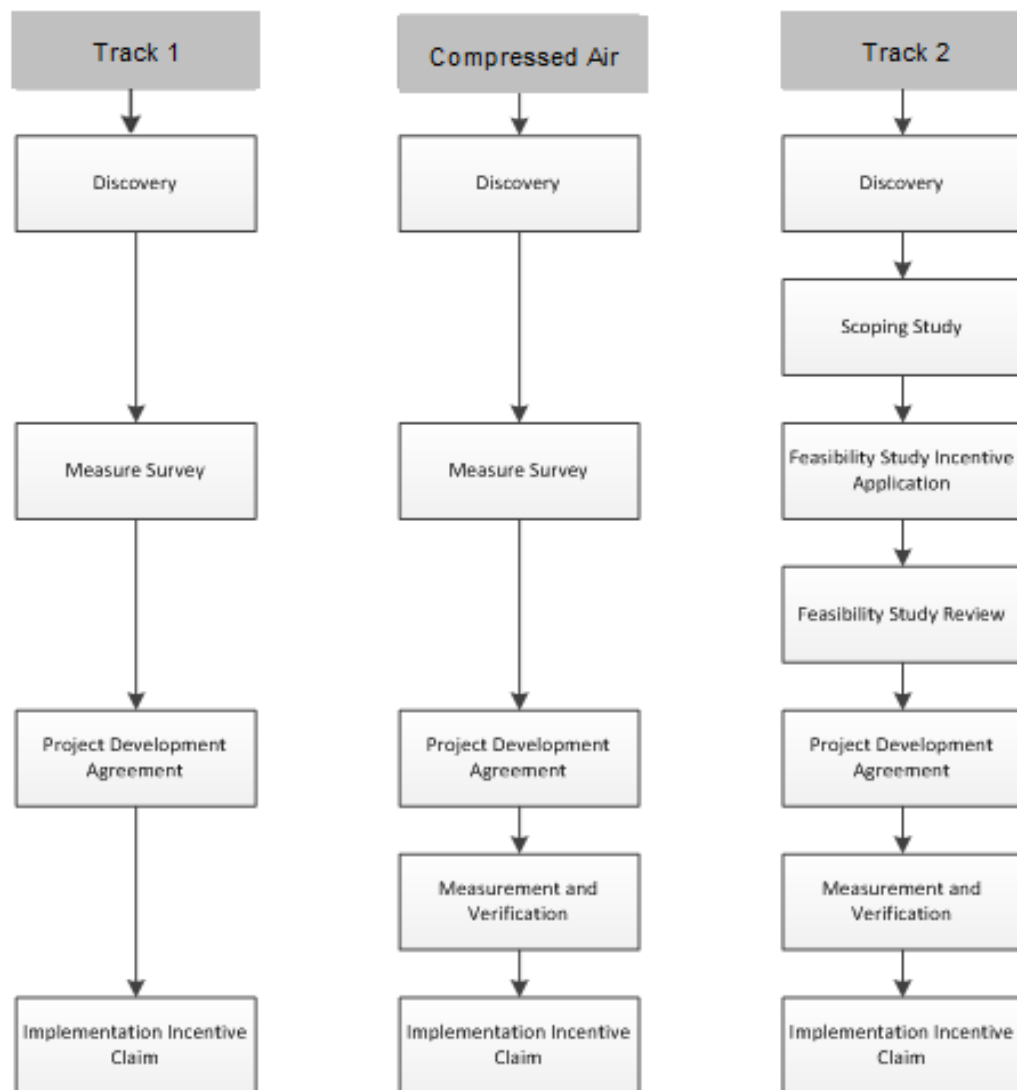
As mentioned previously, Custom Retrofit is a rather labor and capital-intensive type of program. Based on relevant market intelligence, certain modifications were made, including creating a second track to implement smaller projects that otherwise would be ineligible to participate in other ENSC programs, and eliminating the necessity to conduct a feasibility study and develop an M&V plan, so as to make it easier for clients to manage these projects.

An in-between solution was also implemented within Custom Retrofit for compressed air projects. For these projects, ENSC conducts an audit to determine where the leaks are so that they can be fixed. As for the lighting retrofit projects, most of those submitted to Custom Retrofit are now sidetracked to BER². This modification has not changed any of the project delivery paths, but it has enabled the program staff to allocate more time to the tracking and evaluation of the other more complex energy efficiency projects supported by Custom Retrofit.

² As mentioned in Section 1, all lighting retrofit projects which have no design component and are not bundled with other measures into comprehensive energy efficiency projects are now transferred to the prescriptive programs of ENSC.

Figure 3 illustrates the three paths of Custom Retrofit.

Figure 3: Custom Program Delivery Options



The Evaluator thinks that adding these new program paths to Custom Retrofit is a good practice for this type of program and will encourage the program staff to be vigilant in making future modifications to the program so that the participation requirements and procedures for small projects do not become impediments.

The Evaluator also recommends continuing to monitor the types of projects submitted to Custom Retrofit in order to identify whether measures of the same type (becoming less customized) are frequently implemented through the program. If too many projects submitted to Custom Retrofit are similar, ENSC should consider transferring these measures into an existing program with a simpler approach or into a new program.

Finally, another Custom Retrofit improvement noticed by the Evaluator was the creation of a project workflow checklist, which outlines the steps to be followed by the PM. Since every step in processing each new project proposal or application must be properly completed before moving onto the following step, incorporating this workflow into the Demand-side Management Data System (DSMDS) provides an excellent tool for ensuring that the administrative procedures for application processing are followed without having to depend on direct oversight. This tool can also prevent the occurrence of missing information in the database, which can undermine evaluation accuracy.

3.4 Tracking System

In 2014, ENSC tracked Custom Retrofit projects through the DSMDS, and generated tracking reports whenever required for evaluation purposes. Therefore, the DSMDS and the tracking reports replaced the Custom Retrofit tracking sheet used in previous years. Overall, the information provided in the tracking report was complete for evaluation purposes.

3.4.1 DSMDS Report

In 2014, the DSMDS was used to generate the preliminary tracking report for sampling purposes, which contained three tabs: (1) Evaluation Report; (2) Measures by Project; and (3) Measures by Category. However, when generating the final report, the DSMDS encountered a technical problem and did not succeed in generating the same complete report. Because it is assumed that once this problem is solved, the report will be similar to what was provided in the fall of 2014, this version of the report was reviewed by the Evaluator. The following sub-sections provide a detail description of the information contained in each of the three tabs of the report.

Evaluation Report

The Evaluation Report tab contains the most information, and is similar in scope to the 2013 tracking sheet used by ENSC. Information contained in this tab includes: project ID, project status, ENSC project owner, participant contact information, energy/peak demand savings, incentive(s) paid, and project realization rates. The gross energy and peak demand savings claimed by participants and those verified by ENSC are clearly detailed in the report, but the line loss factor and/or Nova Scotia Power rate code of each project is missing, thus preventing the Evaluator from easily calculating the project savings at the meter. Since the information contained in the project feasibility studies, M&V reports and other technical documents are always related to the energy and demand savings to be achieved at the meter, easy access to information regarding the line loss factor and/or Nova Scotia Power rate code in ENSC's tracking reports would be extremely helpful. Incidentally, information on the net energy and peak demand savings tracked by ENSC is not provided in the tracking tool either.

It is worth mentioning that, by following a recommendation made as part of the 2013 program evaluation, facility contact information has been added into this portion of the tracking report. This added information clearly indicates the location where the efficiency measures were implemented, and

has enabled the Evaluator to better coordinate on-site visits. Additionally, the evaluation process has improved, since the facility contacts were normally more involved in implementing the project, and were in a better position to answer questions about schedules and day-to-day operations.

Measures by Project

The contents of the Measures by Project tab of the tracking report includes the project ID, project name, status, measure categories/codes and description, as well as the verified energy and peak demand savings at the generator. To implement the recommendations made by the Evaluator in 2013, a diversity factor for each measure has been added into the report, which shows ENSC's commitment to improving the quality of the information collected.

One peculiarity observed in the review of the information in this tab was a high number of measures that had no reported savings. After a more careful examination, it was found that some of the older projects in the DSMDS had each been originally assigned a potential measure code saved under Custom Retrofit, and that only measures that were implemented had savings values documented. The Evaluator thinks that this situation should be mentioned, and understands that the issue was likely due to ENSC's effort to improve the DSMDS.

Measures by Category

Almost identical to the Measures by Project tab, the information documented in the Measures by Category tab focuses on the types of projects implemented. This structure allowed the Evaluator to gain a better understanding of the types of energy efficiency measures that achieved the savings for each Custom Retrofit project.

3.4.2 Online DSMDS

In addition to the tracking report provided, the Evaluator reviewed the contents and structure of ENSC's DSMDS. Since all current Custom Retrofit projects are now being tracked online through this tool, the Evaluator felt it was necessary to further review its contents to check on accuracy and identify potential areas of improvement. The current version of the DSMDS contains eleven tabs, but this review focused on the three most important ones for evaluation purposes, namely the Project Summary, Measures and Documents tabs.

Project Summary

The Project Summary tab of the DSMDS contains all the relevant information required for a quick overview of any Customer Retrofit project. Information within this tab includes the project information, notes, milestone dates, project budget, savings summaries and the client/facility contact information. To implement the recommendations for Custom Retrofit made in the 2013 evaluation report, ENSC has added a section in the project summary tab to document free-ridership screening information.

Additionally, a section has been added to document details about the facility, including its Nova Scotia Power utility account number, rate code, building type, building sub-group (or occupancy class), and inputs for primary/secondary heating sources, temperature setpoints, facility area, age of building, and number of occupants. Although some of the information in the section was incomplete, it is still a significant improvement in terms of process management and will eventually allow ENSC to mine the data contained in the DSMDS and adjust program offerings.

Measures

The Measures tab in the DSMDS shows a table summarizing individual projects' energy savings and implementation costs. The energy savings section provides necessary information required to assess and verify the tracked savings achieved by implemented measures, and includes additional information about the power factor and the diversity factor. ENSC added these factors to implement the recommendations made by the Evaluator in 2013 as well as in earlier years, indicating that it is committed to improving the overall process.

Under the Measures tab, the implementation costs documented include inputs regarding detailed costs, which enable breaking down the total project costs into labor, materials, engineering, and others. In addition, the section provides space to track non-electrical benefits, expected measure life, and a link to enter further equipment details (e.g., the manufacturer and the model number). Although not all the tabs were complete at the time of evaluation, ENSC's commitment to improving data collection for individual measures was evident.

Milestones

The Milestones tab provides the amount of savings claimed at each step of the project. This tab is particularly useful for projects whose implementation period extends over more than one year. This is also where any subsequent savings adjustments based on M&V are tracked. This tab shows the energy savings at both the meter and the generator. However, only one single value is indicated as peak demand savings, without specifying whether this is for at-the-meter or at-the-generator level; the Evaluator believes that this should be added for clarity.

Documents

The Documents tab contains the most detailed information about the 2014 Custom Retrofit projects; it typically includes scoping studies, feasibility studies, the project development agreement (PDA), M&V documentation and other project-related communication. As was the case with the 2013 evaluation, this tab provided the Econoler team with most of the information needed to carry out on-site visits and savings adjustments.

One recommendation made in 2013 was to standardize file-naming conventions for all documents stored in the DSMDS. A careful inspection of the files stored showed that there seems to be no

defined naming convention adopted. However, each document saved in this section is assigned a document category and a document type, making them relatively easy to locate in the DSMDS.

Overall, the results of the Tracking System review indicate that ENSC is making continued improvements to its process, and that electronic project files are generally well-maintained in a consistent format. It should be noted that the Evaluator noticed a reduction in attached M&V plans, as compared to 2013, and this situation will be further discussed in the section on impact evaluation (Section 5). To sum up, the Evaluator thinks that the 2014 Custom Retrofit tracking system is adequate, and has shown signs of continued improvement over the previous years.

The following recommendations would further improve the tracking system in future years:

- › **Adding the Nova Scotia Power rate code to the DSMDS report:** While the Nova Scotia Power rate code is entered into the DSMDS, it does not appear in the Evaluation Report. As the information contained in the project feasibility studies, M&V reports and other technical documents is always expressed in terms of energy and demand savings at the meter, the Evaluator needs to apply the correct line loss factor to the savings at the generator presented in the DSMDS report to compare the values. An easy access to this Nova Scotia Power rate in the DSMDS report would then be very helpful in establishing the corresponding line loss factor.
- › **Explaining the diversity factor value used in peak demand savings calculations:** In 2014, the report included the addition of a diversity factor for each measure. It is good practice that this factor be explicitly defined on an individual measure basis. To facilitate the task of validating this value for the Evaluator, it would be advisable to add a field where the calculation or assumptions are explained in a few words.
- › **Identify M&V adjustments and milestone claims in the DSMDS report:** At the moment, it is only possible to obtain either the projects total savings (over multiple year), or the claimed savings for the current year. To improve sample selection, it would be important to have both values, as adjustment ratios are calculated based on the project's total savings, but the average ratio for all projects is weighted based on the contribution of each project to the current year savings. Additionally, some projects were identified as claimed in 2014, while only an adjustment to M&V results was made this year. This resulted in some projects being incorrectly included in the 2013 sample. The Evaluator recommends adding a unique identifier, or tag, that would indicate if the project is being claimed in the current year or represents ongoing M&V adjustments being made to a project from a previous year.

4 MARKET EVALUATION

This section presents the findings of the 2014 Custom Retrofit market evaluation based on participants' perspectives.

4.1 Participant Perspectives

A participant survey was conducted as part of the Custom Retrofit evaluation. In addition to the questions designed for impact evaluation purposes, survey participants were asked questions related to program awareness, influence and satisfaction.

4.1.1 Awareness and Participation

The ENSC website or the Internet was the main means by which participants found out about Custom Retrofit. Other sources of awareness were energy managers, ENSC staff, word of mouth, trade magazines, Nova Scotia Power, or through the provincial government.

Table 5: Sources of Awareness

Sources of Awareness*	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	27	29	11
Internet/ENSC website	7%	14%	4
Energy manager	-	-	2
ENSC staff/Someone at ENSC contacted the business	19%	31%	1
Word of mouth: someone in program/business associate/friend	11%	3%	1
Trade magazines	-	-	1
Through Nova Scotia Power	-	-	1
Through the provincial government	-	-	1
Through a third-party contractor	37%	17%	-
ENSC presentation	7%	14%	-
Media advertising	-	14%	-
ENSC literature	7%	-	-
Others	11%	7%	1
Don't know	4%	7%	-
*Multiple responses			

Notably, six of the 11 participants interviewed had previously participated in other ENSC programs, including Business Energy Rebates, Custom New Construction, Smart Lighting Choices, or Commercial Direct Install. Again this year, the primary reason for choosing to participate in Custom Retrofit was to save on energy costs.

4.1.2 Custom Retrofit Influence

In terms of the project design phase, participants relied on different groups to specify measures, including outside design professionals (4 participants), someone within the participant's organization (3 participants), utility account managers (2 participants), or a contractor (one participant).

Participants were asked about the influence of different factors on their decision to implement energy efficiency measures. The one participant who had its scoping/feasibility study funded deemed this study important in its decision to implement energy efficiency measures. Other factors, including previous experience with other ENSC programs, financial incentives or on-bill financing, standard practice in the industry, the existing energy efficiency code, organization's corporate policy and technical assistance offered, received medium ratings.

Table 6: Factors Influencing Participants' Decisions

Importance of Factors in Influencing Decision to Implement Energy Efficiency Measures	2012		2013		2014	
	Sample Size*	Mean	Sample Size*	Mean	Sample Size*	Mean
Mean (0=Not at all important, 10=Extremely important)						
The funded scoping and/or feasibility study	3	8.0	4	9.0	1	9.0
Previous experience with C&IC/Custom Retrofit or a similar program either from ENSC or Nova Scotia Power	25	5.2	23	7.3	10	6.9
Financial incentives and/or on-bill financing	27	8.7	29	8.4	10	6.7
Standard practice in your industry	25	6.4	24	7.0	10	6.7
Existing energy efficiency code	21	5.5	18	7.5	10	6.6
Your company's or organization's corporate policy or guidelines regarding the purchase of equipment	26	6.6	29	6.7	10	6.4
Technical assistance offered by Custom Retrofit during project implementation and the M&V process	26	6.2	28	7.4	11	6.0
Recommendations and technical assistance provided by staff when my company was engaged in discussions with contractors and consultants about equipment choices	27	7.0	29	7.2	10	6.0
*Don't know/Refused/Not applicable responses excluded from calculations						

4.1.3 Satisfaction with Custom Retrofit

Nearly all participants were satisfied with Custom Retrofit overall. Several other program aspects generally received good ratings, with the majority of participants offering good ratings for the initial confirmation of eligibility, project implementation, the incentive amount and the project savings verification. There was a lower level of satisfaction with the delays to receive the rebate or incentive, or the paperwork required to receive the rebate/incentive. On average, participants said it took nearly 11 weeks to receive the rebate or incentive.

Table 7: Satisfaction with Custom Retrofit

Aspect of Custom Retrofit	2012		2013		2014	
	Sample Size	Satisfied** (%)	Sample Size	Satisfied** (%)	Sample Size	Satisfied** (#)
Custom Retrofit overall	27	93%	29	97%	11	9
Initial confirmation of eligibility	26	85%	29	93%	10	7
Project implementation	26	88%	29	83%	11	7
Project implementation incentive amount	27	89%	27	81%	10	7
Project savings verification	22	68%	24	92%	10	6
Delays to receive rebates or incentives	25	60%	23	65%	10	5
Paperwork and procedures required to receive rebate or incentives	27	70%	28	75%	9	4
* Respondents giving a rating of 5 or 4 on a scale of 1 to 5, with 5 indicating "very satisfied" and 1 "not at all satisfied". ** "Don't know/Refused/Not applicable" responses were excluded from calculations.						

Ten out of the 11 participants worked directly with ENSC, and just one worked through a third-party contractor. Various aspects related to ENSC's performance generally received good ratings, although mean scores are slightly lower than in 2013. That said, all participants would participate in other ENSC programs, and all would recommend Custom Retrofit to other businesses.

Table 8: Satisfaction with ENSC

Satisfaction with Overall Performance*	2012***		2013		2014	
	Sample Size*	Satisfied	Sample Size*	Satisfied	Sample Size*	Satisfied
Mean (1=Not at all satisfied, 10=completely satisfied)**						
ENSC's overall performance in working with your company	10	7.8	26	9.2	10	8.1
The value of Custom Retrofit relative to the time and cost involved	10	7.9	26	8.9	10	7.6
The responsiveness of ENSC employees to your requests and inquiries in a timely manner	10	8.4	26	9.1	10	7.5
The technical expertise of ENSC employees related to Custom Retrofit	10	8.3	26	8.8	10	7.5
The ability to provide estimates of the savings or return on investment associated with Custom Retrofit	10	7.9	26	8.7	10	6.9
The speed with which the application was approved	10	7.7	26	8.8	10	6.7
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of "Refused" and "Don't know". ***Source: 2012 C-Sat Commercial Study						

As for the ENSC contact centre, nine of 11 participants had contact with the centre, and high levels of satisfaction were reported regarding various factors, with all participants reporting being satisfied with the level of service, knowledge, and service attitude, and 8 out of 9 participants were satisfied with the contact centre's ability to provide advice.

Meanwhile, the one participant who worked with a third-party contractor was satisfied with the service, and would recommend the contractor to others.

5 IMPACT EVALUATION FOR CUSTOM RETROFIT

The objective of the 2014 impact evaluation for Custom Retrofit was to determine the gross and net energy savings. Both electrical energy and peak demand savings were estimated by analyzing the following parameters:

- › Feasibility studies, engineering calculations and any other pertinent technical reports that estimated the potential energy savings generated by the proposed energy efficiency measures
- › ENSC's reports on M&V activities undertaken before and after implementation of energy efficiency measures
- › Findings and observations collected during the on-site visits and during discussions with participants
- › Free-ridership
- › Internal spillover

The approach to the Custom Retrofit impact evaluation involved: 1) making an in-depth technical review of 22 project files; 2) conducting on-site visits for the projects which files were reviewed; and 3) conducting participant surveys.

5.1 Gross Savings

The gross savings evaluation for Custom Retrofit was based on information in the DSMDS report and the Document folder of the online DSMDS. The Evaluator collected additional supporting information during the on-site visits to gain an accurate understanding of the key project variables. Since the projects carried out under Custom Retrofit can be significantly diverse in nature, the Evaluator conducted a gross-savings analysis for each individual project in the sample. The final analysis for each project was tailored to best suit the type of energy efficiency measures implemented.

5.1.1 Adjustment Methodology for Custom Retrofit

The following sub-sections describe the verification procedure used by the Econoler team when evaluating the gross savings for each Custom Retrofit project. For the 2014 Evaluation, projects were divided into two groups: lighting and others. The split was made to establish individual adjustment factors, and to limit the impact one measure type could have on the total tracked savings.

Lighting Retrofit Projects

In 2014, 36 of the 100 projects included lighting retrofit measures, which accounted for approximately 24 percent of the verified energy savings. In order to paint an accurate picture of Custom 2014, 11 of the 25 sampled projects were lighting retrofits only.

What follows is a brief description of each of the key factors considered and accounted for in verifying the gross savings estimate of each lighting project visited this year. This methodology was developed by Econoler in 2011 and 2012, and is still considered to be accurate.

- › **Unitary wattage:** The unitary wattage values of old and new lamps were the first factor considered by the Evaluator. For most lighting retrofit projects, ENSC had already developed a project impact calculation spreadsheet, which listed and described all the old fixtures to be replaced along with their new high-efficiency equivalents. The Evaluator paid special attention to the inclusion of the ballast factor in the energy consumption calculations.
- › **Installation Rate:** Where possible, the Evaluator visually verified the quantity of each old and new lamp described in the project documentation.
- › **Hours of Operation:** Operating schedules of all lamps described in the simulation reports and feasibility studies were documented in the on-site protocol, and confirmed on site with project representatives.
- › **Diversity Factor:** The annual operating schedules of the new building were confirmed by project representatives during the visits and used to calculate a diversity factor based on the peak demand period (weekday hours of 5:00 p.m. to 7:00 p.m. for December, January and February).
- › **M&V procedures:** M&V plans and activities were reviewed when the documentation was available, and the Evaluator ensured that the results matched the claimed savings.

Other Energy Efficiency Projects

The remaining 2014 Custom projects were grouped into a second category simply named “Other Energy Efficiency Projects”, and it included a variety of measures, such as HVAC upgrades, motor replacements, control installations and renewable energy. This year, the portion of savings attributable to HVAC and refrigeration projects was not big enough to warrant a separate adjustment category. Since the remaining projects were diverse in composition, and included a mix of energy conservation measures, they were categorized as “others”. The weighted adjustment ratio for this category was subsequently calculated and applied to the tracked savings of this group. In order to evaluate the tracked savings of these projects, a detailed review of the PDA provided in the project documentation was performed. Key technical variables used in the calculation of original savings were identified. Also, a review of all pre- and post-M&V results was made and documented for verification during the on-site visits.

During the on-site assessments, the Evaluator verified whether all the proposed energy-efficient equipment had been properly installed. Technical specifications (i.e., capacity, efficiency, manufacturer, etc.) for all major systems were confirmed by comparing equipment nameplates to DSMDS documentation. Where documentation did not exist in the DSMDS project packages, the Evaluator verified the key variables by using manufacturers’ websites to collect missing technical documents.

Facility and equipment operation schedules and setpoints were confirmed with participants during the on-site visit in order to validate the systems' operating parameters and calculate the diversity factors to be used for peak demand savings calculations. In all cases, the Evaluator discussed each of the key operating variables and calculation assumptions documented in the PDA with the customer, or technical representative during the on-site interview. Additional information was requested from the client and/or ENSC, if required.

Using all of the information provided by ENSC and gathered during the on-site visits, the Evaluator reviewed the tracked savings values and made adjustments where inconsistencies in key equation factors were discovered. The calculated adjustments were made in accordance with engineering best practices based on the actual information collected.

5.1.2 Adjusted Gross Savings

The final tracked gross energy and peak demand savings results for Custom 2014 were reviewed and adjusted by the Evaluator. All adjustments were made following a comparison of the claimed project savings with the Evaluator's sample calculations, which were based on an initial sample size of 25 projects.

As explained previously, three projects were excluded from the 2014 sampling plan. The following adjustments have been based on only the remaining 22 sample projects, and have been applied to all the tracked savings reported for 2014.

Adjustments to Lighting Retrofit Projects

The adjustment factors for lighting retrofits were determined through the analysis of the information obtained during the 10 on-site visits for lighting retrofit measures.

The overall energy and peak demand savings adjustment factors were calculated using a weighted average of the adjustments applied to those 10 projects. Most adjustments made to the energy savings of the sampled projects were prompted to account for three types of errors:

- › Discrepancy between the claimed hours of operation and the verified hours of operation (either from M&V, or verified on site)
- › Difference in quantity and/or type of fixtures declared by the participant and confirmed during the on-site count
- › Adjustments made to heating/cooling equipment that affected the interactive effects.

Accounting for these errors on an individual project basis, the Evaluator established the weighted energy savings adjustment factor for lighting retrofit measures at 1.009. Similarly, the peak demand ratio resulted in an upward adjustment ratio of 1.142.

Small adjustments to the overall accuracy in hours of operation and interactive effects were required, but in general, most of the lighting projects were well-documented. One recommendation regarding

ongoing lighting projects would be to standardize M&V plans for individual measures, and document M&V requirements by the size of the proposed project (e.g., projects with savings greater than 200,000 kWh require a representative measurement plan). Focusing the M&V effort on larger projects and providing clear summary reports will help further improve the verification process.

Adjustments to Other Custom Retrofit Projects

The remaining Custom projects in the sample are classified as “other” Custom Retrofit projects for this report. The tracked savings for each project were adjusted using a similar methodology as described for lighting retrofit projects. Energy and peak demand savings adjustment factors were calculated individually for each of the 12 sampled projects, and then used to calculate a weighted adjustment factor for the “other” category.

The majority of the projects in this category required only minor energy savings adjustments, which were mainly due to small discrepancies, such as the count or hours of operation for energy-efficient equipment installed. Some savings adjustments were also made when mistakes were found in the feasibility study calculations or when M&V adjustments were not documented in the DSMDS. The adjustments made to peak demand savings were much bigger, mostly because the diversity factor was reduced.

For some of the projects with the highest level of complexity, the Evaluator verified on site whether the energy-efficient equipment was properly installed and in operation, but could not validate all the parameters used in the savings calculations. Validating those parameters would have required a metering activity over a certain period of time, which was not included as part of the evaluation methodology. For such projects, the Evaluator expected that a complete M&V activity should have been conducted by the participant (under ENSC supervision) and documented in a clear and concise way. When no M&V had been conducted or M&V was not properly documented, the parameters were reviewed based on the available information and no adjustment were applied to the track savings unless the parameters were deemed unrealistic based on the Evaluator’s knowledge and experience.

Within the “other” Custom Retrofit projects category, two projects required significant adjustments to their tracked savings. Neither of the two projects were complex in nature, but the adjustments were large in comparison to the tracked value. One of the project adjustments was made to the peak demand savings of a project, which had been mistakenly documented as kW instead of the measured kVA, and was simply modified to account for the measured power factor value. The second major adjustment involved revising the tracked savings to reflect the results of post-M&V work carried out. Overall, the two large adjustments had little impact on the weighted adjustment, because their portion of savings in the sample was relatively small in comparison to the total.

In the end, an overall adjustment factor of 0.991 was applied to the tracked energy savings for this category, which is an improvement to the 2013 value of 0.934. For the peak demand savings adjustments the Evaluator noticed an improvement to the calculated peak coincidence factors. Rather than applying the simplified hours of operation ratio used in 2013, ENSC used the reported operating

schedules to estimate peak coincidence factors. However, the Econoler team's estimates were often lower than those of ENSC, and it proved difficult to explain those differences, since the calculations used for the diversity factor were not documented. This resulted in an adjustment factor of 0.686 being applied to the peak demand savings. This downward adjustment is nevertheless compensated in part by the upward adjustment made to lighting project peak demand savings.

Calculation of Adjusted Gross Savings

Table 9 details the adjustment factors used by the Evaluator for the overall gross energy and peak demand savings calculations.

Table 9: Adjustment Factors for Gross Energy and Peak Demand Savings Calculations

Project Type	Adjustment Ratios	
	Gross Energy Savings	Gross Peak Demand Savings
Lighting retrofit only	1.009	1.142
Other Custom Retrofit projects	0.991	0.686

It is worth noting that for the entire gross impact assessment described in this report, interactive effects related to space heating and cooling systems and the diversity factor were already taken into account in the savings calculation of each individual project and were revised as part of the adjustment presented previously. Therefore, there is no need for making additional calculations to incorporate these two aspects of program impact calculations.

Continued success in the delivery of non-lighting Custom projects will require continued improvement to the application of M&V practices. In a number of cases, M&V activities were not summarized or documented in the DSMDS. More specifically, the Evaluator found that, out of the 22 sampled projects, only 13 included some measurements (such as hours of operation logging or electrical power measurements). In one case, various measurements were made, but could not be associated with the energy savings. For the remaining 9 projects, savings were based mostly on engineering calculations. Standardizing M&V plans and assigning group or category requirements will help minimize the cost of the activities while improving the accuracy of larger and more complex projects.

The specifics of the final gross energy and peak demand savings calculated for 2014 Custom Retrofit are presented in the following table, with detailed figures for savings at both the meter and the generator. Since ENSC tracks savings at the generator, savings at the meter level have been calculated using the weighted average line loss factor established based on the sampled projects, because rate codes were not available from the DSMDS report.

The 2014 overall gross energy savings for Custom Retrofit are estimated at 21.279 GWh at the meter and 22.547 GWh at the generator. The total gross peak demand savings are estimated at 1.619 MW at the meter and 1.716 MW at the generator.

Table 10: Evaluation Results – Revised Savings for Custom Retrofit

Program Path	Lighting Retrofit Projects	Other Energy Efficiency Projects	Total for all Custom Retrofit Projects
Number of Projects	36	64	100
Program Tracking Sheets			
Total Tracked Energy Savings – at the Meter (GWh)	5.203	16.180	21.383
Total Tracked Peak Demand Savings – at the Meter (MW)	0.738	1.216	1.954
Total Tracked Energy Savings – at the Generator (GWh)	5.521	17.136	22.657
Total Tracked Peak Demand Savings – at the Generator (MW)	0.783	1.288	2.071
Evaluated Energy Savings			
Adjustment Ratio for Energy Savings	1.009	0.991	0.995
Total Gross Energy Savings – at the Meter (GWh)	5.251	16.029	21.279
Average Line Loss Factor	1.061	1.059	1.060
Total Gross Energy Savings – at the Generator (GWh)	5.571	16.976	22.547
Evaluated Peak Demand Savings			
Adjustment Ratio for Demand Savings	1.142	0.686	0.858
Total Gross Peak Demand Savings – at the Meter (MW)	0.842	0.834	1.676
Average Line Loss Factor	1.061	1.059	1.060
Total Gross Peak Demand Savings – at the Generator (MW)	0.894	0.883	1.777

5.2 Net-to-Gross Ratio

The NTGR evaluation was made on the basis of the results from a self-report survey using a set of questions designed to measure the influence of Custom Retrofit on participants' decision on whether to implement eligible energy efficiency upgrades and measures. The survey was conducted to assess two distortion effects, namely free-ridership and internal spillover.

This section presents the methodology used to transform responses to survey questions into an NTGR.

5.2.1 Free-ridership

In the case of Custom Retrofit, free-ridership can occur when participants would have still implemented the energy efficiency upgrades and measures in the absence of the program. The free-ridership level was measured through a set of questions asked during the participant survey. Then, the feedback collected from the surveyed participants was converted into an overall free-ridership level using the same algorithm as that for the previous evaluations.³ It should also be noted that for all participants for whom the pre-screening questions were completed, an adjustment was made to the free-ridership calculation. The algorithm behind the free-ridership calculation is presented in Appendix IV.

The 2014 survey results revealed an overall free-ridership level of 10 percent for Custom Retrofit. This free-ridership level is slightly higher than that established by last three years' evaluations, i.e., 9 percent in both 2013 and 2012, and 7 percent in 2011.

5.2.2 Internal Spillover

For Custom Retrofit, internal spillover occurs when participants implement eligible energy efficiency measures under the influence of their previous participation in the program, yet without having any kind of additional support from the program. In 2011 and 2012, the Custom Retrofit evaluations revealed no internal spillover based on the results of a participant survey. In 2013, the Evaluator chose to change the spillover assessment approach and use the on-site visits to directly question the participants about any potential spillover effects. Using this new method in 2013, the Evaluator established the internal spillover effect factor at 1 percent.

As part of the 2014 evaluation, the Evaluator followed the same methodology as in 2013 to evaluate the level of internal spillover among Custom Retrofit participants. This methodology is presented in Appendix V. By assessing the results of the 2014 on-site visits, it was established that no significant internal spillover had occurred for Custom. Indeed, this year, out of the 22 projects considered, no participant declared having installed additional energy efficiency measures without receiving any additional funding from ENSC. This is similar to the result of last year, when only one participant out of the 25 surveyed declared having done so.

The Evaluator did investigate the case of one Embedded Energy Manager (EEM) who has submitted many Custom projects. EEMs are energy specialists affiliated to ENSC, who lends them to institutions or companies to manage energy efficiency projects. This EEM provided a list of initiatives that had been undertaken under his leadership, but which had not received additional funding from ENSC.

³ As part of the 2013 Custom Retrofit impact evaluation, a new approach to assessing free-ridership was also tested: a web-based survey with free-ridership questions was sent to all the program participants immediately after their project was completed. However, this new survey did not collect enough answers to allow properly assessing the free-ridership level of Custom Retrofit based on a representative sample.

However, for all the big projects, work had been completed prior to 2014, or all the savings generated were non-electrical. Consequently, no spillover was attributed to the work of this EEM.

In addition, it will be very helpful to future evaluations if ENSC can define a set of documentation requirements for each initiative proposed by the EEM. The documentation will then provide the Evaluator with a means to assess the savings achieved over a specific year, by either reviewing technical specifications or verifying the measure's characteristics via a phone interview.

5.2.3 NTGR Calculation

The NTGR was calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership} + \% \text{ internal spillover}).$$

Using the free-ridership and spillover levels established for Custom Retrofit, the NTGR value was estimated at 0.90.

5.3 Net Savings

The net savings for the program were estimated using the NTGR calculated, as described above. The following equation was used to calculate both the net peak demand savings and the net energy savings.

$$\text{Net savings} = \text{gross evaluation savings} \times NTGR$$

The results obtained are presented in Table 11.

Table 11: Net Energy and Peak Demand Savings for Custom Retrofit

	Custom Retrofit
Energy Savings	
Total Gross Energy Savings – at Meter (GWh)	21.279
NTGR	0.90
Total Net Energy Savings – at Meter (GWh)	19.151
Line Loss Factor	1.060
Total Net Energy Savings – at Generator (GWh)	20.292
Peak Demand Savings	
Total Gross Peak Demand Savings – at Meter (MW)	1.673
NTGR	0.90
Total Net Peak Demand Savings – at Meter (MW)	1.509
Line Loss Factor	1.060
Total Net Peak Demand Savings – at Generator (MW)	1.599

6 IMPACT EVALUATION FOR EMIS AND EBC

EMIS and EBC were two Custom Retrofit components newly introduced in 2014. This limited-scope impact evaluation was conducted on the basis of a technical review of these two sub-components' project documentation. The main objective was to make recommendations on the methodology used to document and calculate savings, as well as on the approach used by ENSC to support and verify such projects.

6.1 EMIS Review

A newly introduced Custom Retrofit sub-component, EMIS was first undertaken in 2013 as a pilot. The main goal of EMIS is to assist industrial clients in making real-time decisions about their process using energy consumption data of metered systems. Its primary focus is to provide industrial clients with the funding required to audit their systems, develop an EMIS implementation plan and offset the cost of installing metering and monitoring equipment.

The Evaluator consulted the program manual provided by ENSC and conducted an interview with the program manager to better understand the program. Then, the documentation of the 2014 EMIS projects was reviewed. As part of the 2014 impact evaluation, ENSC provided a preliminary tracking report extracted from the DSMDS with four projects, which were at various stages of the EMIS implementation process. Additional technical documents related to these projects were also available for download from the DSMDS.

Of the four projects reported, only two are currently generating savings for 2014, while the remaining two are still in the implementation process. A review of the current EMIS Program Manual indicated that ENSC had invested a significant amount of time to develop and document the process flow. All of the key steps are well defined, and the expectations for participants/consultants are clearly laid out. Additional procedural controls are provided in the form of the EMIS Audit Manual and EMIS Implementation Plan guides, which further outline the process for completing each of the two preliminary steps required prior to implementation. Overall, the EMIS documentation is well defined and adequate to guide both participants and consultants through the assessment and implementation phases.

The Evaluator carried out an analysis of the project documents hosted on the DSMDS to determine if there was enough information to allow verifying the tracked savings claimed, and assessing the level of compliance with the EMIS guides. The Evaluator has determined that the available documentation, namely the implementation plans and quarterly savings reports, does not provide enough information to allow verifying the tracked savings for the two active 2014 projects.

The implementation plan was intended to describe the design of the EMIS, and, therefore, did not serve the purpose of estimating and justifying the potential for achieving savings; this is achieved through the quarterly savings report. The Evaluator has found that the quarterly reports provided

rather general information and were insufficient to allow assessing the claimed EMIS savings. The savings reports specified targets and energy consumption trends, but contained little information on how the raw data was treated to obtain those values. Savings were calculated in both reports using baseline models that were not described in detail, and appeared to have been developed using relatively short monitoring periods (one month and two months).

Since the verified savings must be derived from consistently monitored improvements within the facility, an M&V plan must be properly developed and then followed. Although the EMIS documentation did make references to the “Superior Energy Performance - Measurement and Verification Protocol for Industry” (November 2012), the documents reviewed did not contain the necessary elements that would have been expected by an M&V protocol. To accurately capture the savings, consistent M&V work must be done for each project by following an established protocol, which entails developing and carrying out a detailed M&V plan.

Overall, the available information was sufficient to provide a breakdown of the EMIS process and overview of the tracked savings, but was not detailed enough to be used for savings validation purposes. The Evaluator is of the opinion that EMIS has much potential for generating significant savings in the years to come, and that a thorough M&V procedure would allow estimating and determining those savings in an accurate and reliable manner.

Suggestions for Improvement

To improve the EMIS process and the accuracy of the tracked savings, ENSC should adopt the current version of the IPMVP released by the Efficiency Valuation Organization (EVO). Many of ENSC’s staff members are certified IPMVP professionals and therefore, can assist in implementing this protocol. This protocol will require the service providers to develop a detailed M&V plan as part of their implementation plan. This action would address most of the weaknesses identified in the reviewed projects, such as the lack of a representative baseline data collection period and not all adjustments being fully documented. In addition, ENSC should review the proposed M&V plan and verify the tracked savings claimed in the quarterly reporting periods; doing so will help ensure that all the relevant independent variables have been identified, that the baseline model is adequate, and that the routine and non-routine adjustments are being properly applied.

6.2 Existing Building Commissioning Review

As mentioned previously, EBC was one of the Custom Retrofit components newly introduced in 2014. The goal of this component is to achieve energy and peak demand savings through the appropriate and efficient functioning of all participating buildings’ systems. The primary focus of EBC is low-cost and no-cost measures, such as operating schedule changes and modification of operating parameters of key mechanical systems within a building.

In the fall of 2014, ENSC provided a program report extracted from the DSMDS with information documented on four completed projects. The Evaluator reviewed the tracking sheet, the contents of

the project files from the DSMDS and the program information shown on the ENSC website. Although the number of project was relatively small, the savings generated were substantial, amounting to approximately 850 MWh. Based on the ratio of the incentive amounts to the tracked savings, the Evaluator has found that EBC seems to be a very cost-effective method for generating energy savings.

In some cases, the program may not be applicable to all buildings or occupancy types, because scheduling requires a building automation system (BAS), or digital machine level controls. As many older buildings do not have centralized electronic control for all the major mechanical systems, the pool of potential participants for this program is limited to rather new buildings or those which underwent major retrofits in the last few years unless the program provides additional incentives to implement BAS.

The Evaluator reviewed the project documentation to assess whether it was complete and the energy savings were properly substantiated. It was found that the quality of implementation reports varied widely from one project to another. Two reports presented logged schedules and measured current readings, which allowed ensuring a sufficient level of accuracy to substantiate the savings. Another report based expected savings on percentages from a literature review or from previous experience, while the fourth report provided no substantiation of savings at all. Some projects presented very clear explanations of the buildings systems and controls as well as of implemented measures and potential capital projects. In contrast, one project included no information about additional capital projects at all. Since this impact evaluation did not include on-site visits, the Evaluator did not have sufficient evidence to adjust the tracked savings.

Suggestions for Improvement

What follows is a list of recommendations that the Evaluator has made to help ENSC improve EBC.

- › **Better define the expected scope of the feasibility studies:** Although the component's name refers to recommissioning, the studies conducted this year were more limited in scope than a full recommissioning process. The Evaluator understands that the reason for this choice was to focus on low-cost measures and facilitate a first contact with customers who might not be ready to participate in the Custom program. However, the Evaluator believes that the scale and scope of the measures to be considered in the study should be better defined. Some studies were limited to rescheduling ventilation to match occupancy schedules, while others considered the operation of the whole HVAC system and its control. A better definition of the expectations would help make sure that the customer gets the full benefits of the study.
- › **Require that contractors collect and document the main equipment specifications for all the major mechanical systems reviewed in the scoping studies:** This information should be presented in the implementation report, and would help ENSC ensure that all major energy-saving opportunities related to capital projects were considered.

- › **Supply service providers with a standardized summary document for them to report the actual measures implemented:** This document will help ensure that savings and associated costs are indicated for each measure, along with a short description on the substantiation approach (schedule log, engineering calculation, etc.). Furthermore, the document will indicate the savings in kWh and dollars, therefore avoiding combining non-electrical and electrical savings into a single value.

6.2.1 Validated Gross Savings

As explained in previous sections, the Evaluator did not make adjustments to the gross savings value reported by ENSC. The tracked gross energy savings values reported by ENSC are summarized in the table below. No demand savings were claimed for either of the two components.

Table 12: Tracked Savings for EMIS and EBC Components

Custom Retrofit Sub-component	EMIS	Retrocommissioning	Total
Number of Projects	2	7	9
Tracked Savings			
Total Tracked Energy Savings – at the Meter (GWh)	4.795	1.591	6.386
Average Line Loss Factor	1.044	1.063	1.049
Total Tracked Energy Savings – at the Generator (GWh)	5.006	1.690	6.696

6.3 Net-to-Gross Ratio

For all the projects implemented through EMIS and EBC, an NTGR of 1.00 was applied, since no evaluation of the distortion effects was planned for those new components. Therefore, net savings are assumed to be equal to the gross savings presented above.

6.4 Overall Savings for Custom Retrofit

The following table presents the total tracked and evaluated savings for Custom Retrofit as well as its two sub-components, EBC and EMIS.

Table 13: 2014 Net Savings at the Generator of Custom Retrofit, EMIS and EBC

	Initial Gross Savings	Adjusted Gross Savings	NTGR	Net Savings
Energy Savings				
Tracked Savings from ENSC	29.353 GWh	29.353 GWh	0.93	27.314 GWh
Evaluation Results	29.353 GWh	29.244 GWh	0.92	26.988 GWh
Peak Demand Savings				
Tracked Savings from ENSC	2.071 MW	2.071 MW	0.91	1.885 MW
Evaluation Results	2.071 MW	1.777 MW	0.90	1.599 MW

The Evaluator made few adjustments to tracked energy savings this year, indicating that ENSC's validation process was properly carried out. Indeed, the evaluated net energy savings were lower than those tracked by only about 1.2 percent, and this was due mostly to the reduction of the NTGR ratio for the Custom Retrofit component, which was decreased from 0.92 to 0.90. For their part, gross peak demand savings were adjusted downward by the Evaluator, by about 14 percent. In most cases, this was due to the adjustments made to the diversity factors, though these adjustments were not as big as last year. The reduction in NTGR also contributed to the evaluated net peak demand savings being lower than the corresponding tracked value, by 15 percent.

CONCLUSION

The 2014 evaluation of Custom Retrofit demonstrated that most of the recommendations made in previous evaluations have been implemented. The Evaluator commends ENSC on its efforts in improving and optimizing Custom Retrofit. Among the improvements, the Evaluator noticed the efforts made to improve the general project documentation. Moreover, the Evaluator noticed that one of the 2012 recommendations implemented by ENSC has resulted in major changes for Custom Retrofit, namely: simple lighting projects have been transferred to the prescriptive programs of ENSC. This change may explain the participation decline observed for Custom Retrofit in 2014. The evaluation nevertheless demonstrated that the 100 projects completed through Custom Retrofit in 2014 generated a good level of electrical savings.

To calculate the savings of Custom Retrofit in 2014, the Evaluator used an approach that involved conducting on-site visits of sample projects and an in-depth review of each sample project's technical documentation (e.g., feasibility study, metered data, energy billing, M&V reports, etc.). Then, the Evaluator calculated the gross energy and peak demand savings for all the sampled projects, based on the specific characteristics of each project type. The adjustment ratios that resulted from this calculation were used to estimate the overall gross savings. It was found this year that the adjustment ratios for energy savings were very close to unity, which indicates that ENSC's verification process was thoroughly and properly conducted. One element that explains why adjustments to peak demand savings were more significant is that the Evaluator changed some of the diversity factors estimated by ENSC.

Moreover, when calculating the net energy and peak demand savings achieved by Custom Retrofit in 2014, the Econoler team applied the free-ridership level measured using a telephone survey with participants, and the spillover level established through the on-site visits,. The free-ridership level was found to have increased slightly compared with last year (from 9% to 10%). No internal spillover was detected.

In 2014, Custom Retrofit generated net energy savings of 20.292 GWh and net peak demand savings of 1.599 MW at the generator. Additionally, EBC and EMIS respectively generated 1.690 GWh and 5.001 GWh, amounting to a total of 26.988 GWh energy savings when combined with Custom Retrofit's energy savings. No demand savings were claimed for those two components.

Like the last few years, a survey conducted with participants revealed that most of them were satisfied with Custom Retrofit overall. All participants surveyed mentioned that they would recommend Custom Retrofit to other businesses, and that they would participate in other ENSC programs, based on their experience with Custom Retrofit.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix presents all recommendations made by the Evaluator throughout the report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Perform thorough M&V and document it in a complete report for every large project for which thorough M&V work is justified and required. The Evaluator has observed that ENSC is using M&V as a tool increasingly often each year for Custom Retrofit. For some simpler and smaller projects, performing some hours-of-operation data logging and spot measurement may be adequate to allow establishing savings with a fairly good level of accuracy and reliability. However, this year, the Evaluator encountered some very large projects with multiple energy efficiency measures, for which the M&V activities conducted were limited to a few spot measurements. The Evaluator considers that in order to justify incentives amounting to hundreds of thousands of dollars, a complete M&V report should be written to report on all the major elements defined in standard M&V protocols, such as the IPMVP. For smaller projects, a good practice would be to summarize the measurement methodology (what was measured and when) and the equations used to establish energy savings based on the raw data in a short form.
	2 Improve the information presented in the DSMDS reports. The Evaluator found that most of the important information for evaluation purposes could be obtained from the DSMDS reports. Some elements could, however, be added to improve clarity and the ease of use. For instance, this report has not presented the line loss factor, the rate code, or the verified savings at the meter. The answers to the free-ridership screening have not been included either. Furthermore, it is only possible to obtain either the projects' total savings (over multiple years), or the claimed savings for the current year. To improve sample selection, it will be important to have both these values, because the adjustment ratios are calculated based on the project's total savings, but the average ratio for all the projects is weighted based on the contribution of each project to the current year's savings. Additionally, some projects were identified as claimed in 2014, while only an adjustment to M&V results was made this year. This resulted in some projects being incorrectly included in the 2013 sample. The Evaluator recommends adding a unique identification code name, or tag to indicate if the project is being claimed in the current year or represents ongoing M&V adjustments being made to a project from a previous year.

Sections	Recommendations
	3 Improve the free-ridership pre-screening procedure. This year again, ENSC discussed the clients' payback period threshold and the importance of the incentive for each of the projects submitted through Custom Retrofit. This way, ENSC can avoid giving incentives to participants who would have implemented the project without it. In turn, the calculated free-ridership has been significantly reduced for all participants who underwent this pre-screening. The Evaluator found that in some cases this year, the answers were weak; for instance, one answer included in the annual survey sample read as "To reduce payback period". It is recommended that the pre-screening questions be standardized, in a way similar to that used for Business Energy Rebates, and that acceptable answers be better defined.
	4 Better define the expected scope of the EBC feasibility studies. Although the component's name refers to recommissioning, the studies conducted this year were more limited in scope than a full recommissioning process. The Evaluator understands that the reason for this was to focus on low-cost measures and facilitate a first contact with customers who might not be quite ready to participate in the Custom program. However, the Evaluator believes that the scale and scope of the measures to be considered in the study should be better defined. Some studies were limited to rescheduling ventilation to match occupancy schedules, while others considered the operation of the whole HVAC system and its control. A better definition of the expectations will help make sure that the customer gets the full benefits of the study.
	5 Require EMIS service providers to track and present savings using the IPVMP. The IPVMP, a widely recognized M&V protocol, requires the service providers to develop a detailed M&V plan as part of their implementation plans. This action can help address most of the weaknesses identified in the projects reviewed: for instance, a representative baseline data collection period will be required, and all the adjustments will have to be thoroughly documented. In addition, ENSC should review the proposed M&V plans and verify the tracked savings claimed in the quarterly reporting periods, which will help ensure that all the relevant independent variables have been identified, that the baseline model is adequate, and that the routine and non-routine adjustments are being properly applied.
	6 Plan on conducting a thorough impact evaluation of EMIS and EBC in 2015. This year, the impact evaluation of the EMIS and EBC was limited in scope, and no on-site visits were conducted. The Evaluator considers that this choice was appropriate, since only 9 projects in total were claimed for these two components. However, the amount of savings (6.696 GWh) they achieved at the generator was significant, with more than 5 GWh achieved by EMIS alone. The Evaluator did not make adjustments to the tracked savings, given the limited amount of information available this year, but it believes that a thorough review should be made next year.

Sections	Recommendations
Program Documentation and Design	7 The Evaluator also recommends continuing to monitor the types of projects submitted to Custom Retrofit in order to identify whether measures of the same type (becoming less customized) are frequently implemented through the program. If too many projects submitted to Custom Retrofit are similar, ENSC should consider transferring these measures into an existing program with a simpler approach or into a new program.
Impact Evaluation EMIS and EBC	8 Require that contractors collect and document the main equipment specifications for all the major mechanical systems reviewed in the scoping studies: This information should be presented in the implementation report, and would help ENSC ensure that all major energy-saving opportunities related to capital projects were considered.
	9 Supply service providers with a standardized summary document for them to report the actual measures implemented: This document will help ensure that savings and associated costs are indicated for each measure, along with a short description on the substantiation approach (schedule log, engineering calculation, etc.). Furthermore, the document will indicate the savings in kWh and dollars, therefore avoiding combining non-electrical and electrical savings into a single value.

APPENDIX II PARTICIPANT SURVEY QUESTIONNAIRE

Could I speak with [INSERT NAME]?

1. Yes [GO TO INTRODUCTION]
2. No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

Hello, my name is _____ and I am with CRA (Corporate Research Associates), a Halifax-based survey research company. We are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your firm recently participated in Efficiency Nova Scotia Corporation's Custom Retrofit Program. We would appreciate your collaboration in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. The survey will take about fifteen minutes. Is this a good time for you?

Verification and Recall [V Series]

V1. The Custom program helps businesses implement electrical energy-saving projects. The Custom program offers technical assistance, financial incentives and financing to offset the cost of engineering studies, energy efficiency equipment and installation.

Our records indicate that your company or organization participated in Efficiency Nova Scotia's Custom Program in 2014. Is this correct?

1. Yes (GO TO V3)
2. No

V2. Is there someone else at your company or organization who would know about your company or organization's participation in Efficiency Nova Scotia's Custom Program?

1. Yes (Ask to speak with correct person, if unavailable, ask for name: _____ and telephone #: _____) (THANK AND TERMINATE; SCHEDULE INTERVIEW WITH BEST CONTACT)
2. No (THANK AND TERMINATE)

V3. Are you the person in your company or organization who is most knowledgeable about your experience with the Efficiency Nova Scotia's Custom Program?

1. Yes (IF YES GO TO P1)
2. No

V4. We would like to talk to the person who is the most knowledgeable about your experience with the Efficiency Nova Scotia's Custom Program. Could you give me the name and telephone number of this person? [Probe this individual may be an engineer, equipment contractor, or utility account manager].

Name: _____

Telephone #: _____

[NOTE: THANK AND TERMINATE CALL. SCHEDULE INTERVIEW WITH BEST CONTACT REGARDING EXPERIENCE WITH THE PROGRAM]

Reasons for Participating [P Series]

P1. Did your company or organization participate in any other Nova Scotia Power or Efficiency Nova Scotia energy efficiency programs before participation in the Custom Program? CODE ONE ONLY

1. Yes
2. No (GO TO P4)
98. (Don't know) (GO TO P4)
99. (Refused) (GO TO P4)

P2. (IF P1 = YES) Which programs did your company or organization participate in prior to the Custom Program? [IF RESPONDENT CANNOT RECALL THE PROGRAM NAMES RECORD A SHORT DESCRIPTION VERBATIM] [DO NOT READ RESPONSES – CODE AS MANY AS APPLY]

1. (I Business Energy Solutions (BES))
2. (Business Energy Rebates (BER))
96. (Other, please specify: _____)
98. (Don't know)
99. (Refused)

- P4. What was the SINGLE most important reason your company or organization chose to participate in the Custom Program? [DO NOT READ – ACCEPT ONE RESPONSE]
1. (to take advantage of program incentives)
 2. (this was part of an already planned project)
 3. (to save on energy/to save on energy costs)
 4. (for quality improvement (in terms of lighting conditions, comfort or equipment performance))
 5. (to help protect the environment)
 6. (to replace non-working equipment/equipment in poor condition)
 7. (past participation in another utility program)
 8. (to take advantage of the technical support offered under the program)
 96. (Other: Please Specify: _____)
 98. (Don't know) (GO TO P6)
 99. (Refused) (GO TO P6)
- P5. What was the SECOND most important reason your company or organization chose to participate in the Custom program? [DO NOT READ – ACCEPT ONE RESPONSE – SAME LIST AS P4]
97. (No other reasons)
 98. (Don't know)
 99. (Refused)
- P6. Some companies work with a design professional, project architect, engineer, equipment contractor, or a utility account manager as part of the project design phase. Who do you feel was more responsible for specifying the measures to install through the Custom Program? Was it ...: [RANDOMIZE, READ, ACCEPT ONE RESPONSE]
1. An outside design professional (architect, engineer, etc.)
 2. A contractor
 3. A manufacturer representative
 4. A utility account manager
 5. Someone within your company or organization
 96. (Other, please specify: _____)
 98. (Don't know/Don't recall)
 99. (Refused)

Free-Ridership [FR Series]

According to our information, through its participation in the Custom Program, your business or organization received incentives to implement electrical energy-saving projects in one or several facilities or buildings. When answering the next survey questions, please take into account only those measures implemented as part of your [INSERT NAME OF PROJECT] project in the Custom Program.

FR1. **Before participating** in the Custom Program, did your company or organization have plans to implement the specific energy efficiency measures that were implemented through the Custom Program?

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

FR1a. IF FR1=YES, THEN ASK: I just want to make sure I understand - Before you decided to participate in the Custom Program, you had already made the decision to implement the energy efficiency measures you implemented through the program?

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Custom Program.

If your company or organization had not participated in the Custom Program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely **Would Not** Have Taken the Action," and a 10 indicating that you "Definitely **Would Have** Taken the Action." [AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: "AND NEXT, in the absence of the Program, would you have . . . : DO NOT ACCEPT A RANGE – POSE FR2 SEQUENCE IN ORDER/DO NOT RANDOMIZE]

FR2a. ... implemented exactly the same energy efficiency measures that you implemented through the program?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2b. ... installed standard equipment instead of energy-efficient equipment?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2c. ... implemented the energy efficiency measures that you implemented through the program, *but at a later date*?

___ Response ___ 98 Don't Know ___ 99 Refused

IF FR2C > 5, THEN ASK:

FR2d. DO NOT POSE FR2d IF DON'T KNOW OR REFUSED IN Q.FR2c You indicated in your response to the previous question that if the Custom Program had not been available there was [a/an] X in 10 likelihood that you would have implemented the same energy efficiency measures but at a later date. Approximately how many months later would you have implemented these measures? [DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

1. ___ months later

2. (Never)

3. (At the same time)

98. (Don't Know)

99. (Refused)

[IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2d ANSWER IN MONTHS, READ]:

FR2dd. Would it have been within ...:

1. Less than 6 months?

2. Within 6 months to less than 1 year later?

3. 1 to less than 2 years later?

4. 2 to less than 3 years later?

5. 3 to less than 4 years later?

6. 4 or more years later?

7. (Never)

98. (Don't Know)

99. (Refused)

FR3. As part of its Custom Program, Efficiency Nova Scotia offers financial incentives and on-bill financing to help the implementation of energy-saving projects. If your company or organization had not received the financial incentives and/or on-bill financing from Efficiency Nova Scotia, would you have paid and/or financed the full cost of the project you

implemented? Please answer on a scale of 0 to 10, with a 0 indicating that you “Definitely **Would Not** Have Paid and/or Financed” and a 10 indicating that you “Definitely **Would** Have Paid and/or Financed.” [PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

___ Response ___ Don't Know ___ Refused

FR4. Next, I'm going to ask you to rate the importance of factors that might have influenced your decision to implement the energy efficiency measures you implemented through the program. Using a scale from 0 to 10, where 0 means “Not at all important” and 10 means “Extremely important”, please rate the importance of each of the following in your decision to implement the energy efficiency measures you implemented through the Program. [RANDOMIZE – READ - DO NOT ACCEPT A RANGE]

[RECORD RESPONSE 0-10; 97=NOT APPLICABLE; 98=DON'T KNOW; 99=REFUSED]

- a. The program financial incentives and/or on-bill financing
[STATE IF ASKED WHAT 'ON-BILL FINANCING' IS: Efficiency Nova Scotia's Custom Program offers the opportunity for qualified participant to repay their financing through additional payments on their monthly electricity bills, if they so desire.]
- b. The recommendations and technical assistance provided by the program when your company was engaged in discussions with contractors and consultants about equipment choices
- c. The technical assistance offered by the program during the project implementation and the Measurement & Verification process
- d. [ASK IF, IN DATABASE, SCOPING STUDY OR FEASIBILITY STUDY=YES] The funded Scoping Study and/or the Feasibility Study
- e. Your company or organization's corporate policy or guidelines regarding the purchase of equipment
- f. The standard practice in your industry
- g. The existing energy efficiency code
- h. Previous experience with the Custom Program or a similar program either from Efficiency Nova Scotia or Nova Scotia Power

Satisfaction [S Series]

CS1. How did your company first learn of the programs offered by Efficiency Nova Scotia?

DO NOT PROVIDE RESPONSE CATEGORIES - CODE AS MANY AS APPLICABLE

1. Media advertising
2. Someone at Efficiency Nova Scotia contacted the business
3. Through a third-party contractor
4. The business contacted Efficiency Nova Scotia about the program
5. Word-of-mouth
6. Efficiency Nova Scotia website
7. Facebook or other social media
9. Other **[SPECIFY: _____]**
8. Cannot recall

S1. On a scale of 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how was your company or organization's experience with each of the following aspect of the Custom Program? If your company or organization did not have experience with one of the aspects please tell me. [DO NOT RANDOMIZE, DO NOT ACCEPT A RANGE]

[97 = Not Applicable, 98 = Don't know/Don't recall, 99 = Refused]

- d. Initial confirmation of eligibility
- f. [READ IF, IN DATABASE, SCOPING STUDY=YES] Scoping Study
- g. [READ IF, IN DATABASE, SCOPING STUDY=YES] Scoping Study rebate amount
- h. [READ IF, IN DATABASE, FEASIBILITY STUDY=YES] Feasibility Study
- i. [READ IF, IN DATABASE, FEASIBILITY STUDY=YES] Feasibility Study incentive amount
- j. Project implementation
- k. Project implementation incentive amount
- l. [READ IF, IN DATABASE, FINANCING=YES] Program on-bill financing
- m. Project savings verification
- n. Paperwork and procedures required to receive rebate or incentives
- o. Delays to receive rebates or incentives
- p. The program overall

CS2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent?
CODE ONE ONLY

1. Directly with Efficiency Nova Scotia
2. Third-party contractor or agent
3. Both

SKIP TO CS6

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with **READ AND ROTATE**

CODE ONE RESPONSE FOR EACH FACTOR

- a. The technical expertise of ENSC employees related to the program
- b. The responsiveness of ENSC employees to your requests and enquiries in a timely manner
- c. The speed with which the application was approved
- d. The value of the program relative to the time and cost involved
- j. The ability to provide estimates of the savings or return on investment associated with the program

CS5. Now, using the same 10-point scale, how satisfied are you with Efficiency Nova Scotia’s overall performance in working with your company?

CODE ONE RESPONSE

- 01 Not at all satisfied
- 02
- 03
- 04
- 05
- 06
- 07
- 08
- 09
- 10 Completely satisfied
- 98 Don’t know/No answer

CS6. Did you speak directly to any of Efficiency Nova Scotia’s contact centre representatives? [**DO NOT READ RESPONSES – CODE ONE ONLY**]

- 1. Yes
- 2. No
- 98. (Don’t know)
- 99. (Refused)

IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO CS28.

CS7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

1. Completely satisfied
2. Mostly satisfied
3. Mostly dissatisfied
4. Completely dissatisfied
97. (Neither satisfied nor dissatisfied)
98. (Don't know)
99. (Refused)

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's... **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**

- a. Service attitude
- b. Knowledge of programs available
- c. Ability to provide advice
1. Completely satisfied
2. Mostly satisfied
3. Mostly dissatisfied
4. Completely dissatisfied
97. (Neither satisfied nor dissatisfied)
98. (Don't know)
99. (Refused)

CS28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia?

CODE ONE ONLY

- 1 Definitely
- 2 Probably
- 3 Probably not
- 4 Definitely not
- 7 [VOLUNTEERED] Not eligible for any other programs
- 8 [VOLUNTEERED] Don't know
- 9 Refused

CS29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others? **CODE ONE ONLY**

- 1 Definitely
- 2 Probably
- 3 Probably not
- 4 Definitely not
- 8. [VOLUNTEERED] Don't know
- 9. Refused

[IF CS2 = 2 OR 3, then ask:]

CS30. How satisfied were you overall with the service provided by your third-party contractor on managing the process of securing a payment from Efficiency Nova Scotia? Were you:
READ RESPONSES IN ORDER – CODE ONE ONLY

- 1 Completely satisfied
- 2 Mostly satisfied
- 3 Mostly dissatisfied
- 4 Completely dissatisfied
- 5 [VOLUNTEERED] Neither satisfied nor dissatisfied
- 8. [VOLUNTEERED] Don't know
- 9. VOLUNTEERED Refused

[IF CS2 = 2 OR 3, then ask:]

CS32. Based on your personal experience would you definitely, probably, probably not, or definitely not recommend this third-party contractor to others?

CODE ONE ONLY

- 1 Definitely
- 2 Probably
- 3 Probably not
- 4 Definitely not
- 8. [VOLUNTEERED] Don't know
- 9. **[VOLUNTEERED}** Refused

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in weeks, was it before you received your rebate or incentive? [RECORD NUMBER OF WEEKS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

Barriers to Actions and Recommendations [B Series]

- B1. Did you face any challenges or barriers when implementing energy efficiency measures through the Custom Program?
1. Yes
 2. No (SKIP TO B7)
 98. (Don't know) (SKIP TO B7)
 99. (Refused) (SKIP TO B7)
- B2. a. What was the most important challenge or barrier? [DO NOT READ - ACCEPT ONE RESPONSE]
1. (approval takes too long)
 2. (measurement and verification requirements)
 3. (payback time frame)
 96. (Other – SPECIFY: _____)
 98. (Don't know)
 99. (Refused)
- B7. Do you have any suggestions on how to improve the Custom Program? Consider all aspects of the program: Participation process or program components (Scoping Study, Feasibility Study, project implementation, and project savings verification), marketing, interactions with staff, interactions with contractors, and program forms. PROBE: Anything else? RECORD VERBATIM [998 = No answer]

Firmographics [F Series]

- F1. What is the main activity of your company or organization? [DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]
1. Education
 2. Food Sales (grocery)
 3. Food Service (restaurant)
 4. Health Care - Inpatient
 5. Health Care - Outpatient
 6. Lodging
 7. Mercantile— Retail (Enclosed and Strip Malls)

8. Mercantile – Retail (Other than Mall)
9. Office
10. Public Assembly
11. Public Order and Safety
12. Religious Worship
13. Service
14. Warehouse / storage
15. Manufacturing
16. Vacant building
17. Other (SPECIFY: _____)
98. (Don't know)
99. (Refused)

B6. Approximately what percent of your annual operating budget do energy costs account for?

[998 = Don't know, 999 = Refused] [DO NOT ACCEPT A RANGE] ____ %

F3. Approximately how many full-time equivalent workers does your company or organization employ at all locations within Nova Scotia?

1. Fewer than 5
2. 5 to 9
3. 10 to 19
4. 20 to 49
5. 50 to 99
6. 100 to 249
7. 250 or more
98. (Don't know)
99. (Refused)

F5. Is your company independent, or part of a larger company?

1. Independent
2. Part of a larger company
3. Other (_____)
98. (Don't know)
99. (Refused)

F6. How many business locations does your organization have in Nova Scotia?

[RECORD A NUMBER 1-99; 998 = Don't know, 999 = Refused]

END: Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

APPENDIX III

PARTICIPANT SURVEY RESULTS

P1. Did your company or organization participate in any other Nova Scotia Power or Efficiency Nova Scotia energy efficiency programs before participation in the Custom Program?

Previous Participation	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	27	29	11
Yes	44%	41%	6
No	52%	48%	5
Don't know	4%	10%	-

P2. (IF P1 = YES) Which programs did your company or organization participate in prior to the Custom Program?

Programs Previously Participated	2014 (#)
<i>Sample Size</i>	6
Business Energy Rebates	2
Custom New Construction	1
Smart Lighting Choices	1
Commercial Direct Install	1
Others	2
Don't know	1

- P4. What was the SINGLE most important reason your company or organization chose to participate in the Custom Program?
- P5. What was the SECOND most important reason your company or organization chose to participate in the Custom program?

Motivations for Participating	2012		2013		2014	
	Most Important Motivation (%)	Second Most Important Motivation (%)	Most Important Motivation (%)	Second Most Important Motivation (%)	Most Important Motivation (#)	Second Most Important Motivation (#)
<i>Sample Size</i>	27	27	29	29	11	11
Save on energy/energy costs	56%	33%	69%	21%	9	2
Incentives	33%	19%	21%	21%	1	1
Protect environment	4%	15%	-	24%	-	2
For quality improvement-lighting conditions, comfort, equipment performance	-	22%	-	17%	-	2
To take advantage of technical support offered by Custom Retrofit	-	-	3%	7%	-	1
Support Efficiency Nova Scotia					-	1
It was part of an already planned project	-	7%	-	-	-	-
Past participation in other utility programs	-	-	-	-	-	-
Energy efficiency	-	-	-	-	-	-
Replace non-operational equipment	-	-	-	-	-	-
Others	7%	-	7%	3%	1	1
None/No other reasons	-	-	-	3%	-	-
Refused/Don't know	-	4%	-	3%	-	1

- P6. Some companies work with a design professional, project architect, engineer, equipment contractor, or a utility account manager as part of the project design phase. Who do you feel was more responsible for specifying the measures to install through the Custom Program?
Was it ...:

Parties Responsible for Specifying Measures	2012 (%)	2013 (%)	2014 (#)
Sample Size	27	29	11
Outside design professional	15%	31%	4
Someone within the organization	30%	21%	3
Utility account manager	4%	3%	2
Contractor	33%	17%	1
Manufacturer representative	15%	14%	-
Energy advisor from ENSC	-	7%	-
Others	4%	3%	1
Don't know	-	3%	-

- FR4. Next, I'm going to ask you to rate the importance of factors that might have influenced your decision to implement the energy efficiency measures you implemented through the program. Using a scale from 0 to 10, where 0 means "Not at all important" and 10 means "Extremely important", please rate the importance of each of the following in your decision to implement the energy efficiency measures you implemented through the Program.

Importance of Factors in Influencing Decision to Implement Energy Efficiency Measures	2012		2013		2014	
	Sample Size*	Mean	Sample Size*	Mean	Sample Size*	Mean
Mean (0=Not at all important, 10=Extremely important)						
The funded scoping and/or feasibility study	3	8.0	4	9.0	1	9.0
Previous experience with C&IC/Custom Retrofit or a similar program either from ENSC or NSPI	25	5.2	23	7.3	10	6.9
Financial incentives and/or on-bill financing	27	8.7	29	8.4	10	6.7
Standard practice in your industry	25	6.4	24	7.0	10	6.7
Existing energy efficiency code	21	5.5	18	7.5	10	6.6
Your company's or organization's corporate policy or guidelines regarding the purchase of equipment	26	6.6	29	6.7	10	6.4
Technical assistance offered by Custom Retrofit during project implementation and the M&V process	26	6.2	28	7.4	11	6.0
Recommendations and technical assistance provided by staff when my company was engaged in discussions with contractors and consultants about equipment choices	27	7.0	29	7.2	10	6.0
*Don't know/Refused/Not applicable responses excluded from calculations						

CS1. How did your company first learn of the programs offered by Efficiency Nova Scotia?

Sources of Awareness*	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	27	29	11
Internet/ENSC website	7%	14%	4
Energy Manager	-	-	2
ENSC staff/Someone at ENSC contacted the business	19%	31%	1
Word of mouth: someone in program/business associate/friend	11%	3%	1
Trade magazines	-	-	1
Through NSPI	-	-	1
Through the provincial government	-	-	1
Through a third-party contractor	37%	17%	-
ENSC presentation	7%	14%	-
Media advertising	-	14%	-
ENSC literature	7%	-	-
Others	11%	7%	1
Don't know	4%	7%	-
*Multiple responses			

S1. On a scale of 1 to 5, where 1='not at all satisfied' and 5='very satisfied', how was your company or organization's experience with each of the following aspect of the Custom Program?

Aspects of Custom Retrofit	2012		2013		2014	
	Sample Size	Satisfied** (%)	Sample Size	Satisfied** (%)	Sample Size	Satisfied** (#)
Custom Retrofit overall	27	93%	29	97%	11	9
Initial confirmation of eligibility	26	85%	29	93%	10	7
Project implementation	26	88%	29	83%	11	7
Project implementation incentive amount	27	89%	27	81%	10	7
Project savings verification	22	68%	24	92%	10	6
Delays to receive rebates or incentives	25	60%	23	65%	10	5
Paperwork and procedures required to receive rebate or incentives	27	70%	28	75%	9	4
Feasibility study/assessment***	2	2	4	4	1	1
Feasibility study/assessment incentive amount***	2	2	4	4	1	1
On-bill financing***	3	3	3	3	1	1
*Respondents giving a rating of 5 or 4 on a scale with rating 5 indicating 'very satisfied' and 1 'not at all satisfied'. **Don't know/Refused/Not applicable responses excluded from calculations. ***Base: participants who were identified in the sample as scoping, feasibility, or financing.						

CS2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent?

Contact with ENSC	2012* (#)	2013 (%)	2014 (#)
Sample Size	10	29	11
Directly with ENSC	5	79%	10
Third-party contractor or agent	-	10%	1
Both	5	10%	-
*Source: 2012 C-Sat Commercial Study			

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with...

CS5. Now, using the same 10-point scale, how satisfied are you with Efficiency Nova Scotia’s overall performance in working with your company?

Satisfaction with Overall Performance*	2012***		2013		2014	
	Sample Size*	Satisfied	Sample Size*	Satisfied	Sample Size*	Satisfied
Mean (1=Not at all satisfied, 10=completely satisfied)**						
ENSC’s overall performance in working with your company	10	7.8	26	9.2	10	8.1
The value of Custom Retrofit relative to the time and cost involved	10	7.9	26	8.9	10	7.6
The responsiveness of ENSC employees to your requests and enquiries in a timely manner	10	8.4	26	9.1	10	7.5
The technical expertise of ENSC employees related to Custom Retrofit	10	8.3	26	8.8	10	7.5
The ability to provide estimates of the savings or return on investment associated with Custom Retrofit	10	7.9	26	8.7	10	6.9
The speed with which the application was approved	10	7.7	26	8.8	10	6.7
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of ‘Refused’ and ‘Don’t know’ ***Source: 2012 C-Sat Commercial Study						

CS6. Did you speak directly to any of Efficiency Nova Scotia’s contact centre representatives?

Contact with ENSC Contact Centre Staff	2014 (#)
Sample Size	11
Yes	9
No	2
Don’t know	-

CS7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's...?

Satisfaction with Overall Performance	2014	
	Sample Size*	Satisfied** (#)
Overall level of service provided by ENSC contact centre staff	9	9
Knowledge of programs available	9	9
Service attitude	9	9
Ability to provide advice	9	8
*Base: Number of respondents who had contact with ENSC staff **Percentage of respondents who gave a rating of completely or mostly satisfied'; Don't know removed from calculations		

CS28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia?

Would Participate in Other ENSC Programs	2012** (#)	2013 (%)	2014 (#)
Sample Size*	10	29	10
Definitely	7	86%	6
Probably	2	14%	4
Probably not	1	-	-
Definitely not		-	-
*Don't know/refused have been removed from calculation **Source: 2012 C-Sat Commercial Study			

CS29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others?

Would Recommend Custom Retrofit to Other Businesses/Companies	2012** (#)	2013 (%)	2014 (#)
<i>Sample Size*</i>	9	29	11
Definitely	6	97%	7
Probably	3	3%	4
Probably not	-	-	-
Definitely not	-	-	-
*Don't know/refused have been removed from calculation **Source: 2012 C-Sat Commercial Study			

CS30. How satisfied were you overall with the service provided by your third-party contractor on managing the process of securing a payment from Efficiency Nova Scotia? Were you:

Satisfaction with Overall Performance*	2012****		2013		2014	
	<i>Sample Size**</i>	Satisfied*** (#)	<i>Sample Size**</i>	Satisfied*** (#)	<i>Sample Size**</i>	Satisfied*** (#)
Overall service provided by third-party contractor on managing the process of securing payment from ENSC	6	6	6	6	1	1
*Percentage very satisfied/satisfied **Base: Respondents who worked with third-party contractor ***Don't know/no answer removed from calculation ****Source: 2012 C-Sat Commercial Study						

CS32. Based on your personal experience would you definitely, probably, probably not, or definitely not recommend this third-party contractor to others?

Recommend Third-Party Contractor**	2012*** (#)	2013 (#)	2014 (#)
<i>Sample Size*</i>	8	6	1
Definitely	6	5	-
Probably	2	1	1
Probably not	-	-	-
Definitely not	-	-	-
*Don't know/refused have been removed from calculation **Base: Respondents who worked with third-party contractor ***Source: 2012 C-Sat Commercial Study			

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in weeks, was it before you received your rebate or incentive?

Length of Time to Receive Rebate or Incentive	2014 (#)
<i>Sample Size*</i>	7
2-3 weeks	1
4-5 weeks	2
6-11 weeks	3
12+ weeks	1
Average	10.7 weeks
*Don't know/refused have been removed	

B1. Did you face any challenges or barriers when implementing energy efficiency measures through the Custom Program?

B2. What was the most important challenge or barrier?

Barriers	2012		2013		2014*
	Most Important Barrier (%)	Second Most Important Barrier (%)	Most Important Barrier (%)	Second Most Important Barrier (%)	Most Important Barrier (#)
Sample Size	27	27	29	29	11
No barriers	89%	89%	83%	83%	10
Procurement	-	-	-	-	1
Providing/sending in forms/reports	-	-	7%	-	-
Financial	-	-	1%	-	-
Contractor	-	-	1%	-	-
Retrofitting lighting (technical challenge)	-	-	1%	-	-
M&V requirements	11%	-	-	-	-
Don't know	-	11%	-	17%	-
*Questionnaire in 2014 only asked about most important barrier					

- B7. Do you have any suggestions on how to improve the Custom Program? Consider all aspects of the program: Participation process or program components (Scoping Study, Feasibility Study, project implementation, and project savings verification), marketing, interactions with staff, interactions with contractors, and program forms.

Recommendations for Improvements	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	27	29	11
Broadening the scope of energy savings, including oil and fuel, other utilities, not just electricity/Offer more products/energy savings options	7%	10%	2
Increase staff technical knowledge/more knowledgeable staff	7%	7%	1
Increase/better advertising/marketing	15%	3%	1
Faster approval/takes too long	4%	3%	1
Everything was fine/satisfied with the Custom Retrofit/it's a good program	11%	14%	-
More staff, more on-site visits to get things moving, quicker process	-	3%	-
Simplified process	-	3%	-
Feasibility study	-	3%	-
Online application process	-	3%	-
More information available	7%	-	-
Others	7%	7%	1
Don't know/no suggestion	44%	45%	5

F1. What is the main activity of your company or organization?

Business Type	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	<i>27</i>	<i>29</i>	<i>11</i>
Health Care (inpatient or outpatient)	7%	21%	2
Enclosed and strip malls	-	7%	2
Office	7%	-	2
Government	4%	10%	1
Food manufacturing	7%	3%	1
Agriculture	-	-	1
Public order and safety	-	-	1
Food service (restaurant)	-	-	1
Manufacturing	4%	17%	-
Retail (other than mall)	22%	10%	-
Recreation centre/community hall	15%	3%	-
Education	7%	3%	-
Lodging	7%	3%	-
Transportation	4%	3%	-
Real estate/Property Management	-	3%	-
Service	-	3%	-
Warehouse and storage	-	3%	-
Others	15%	3%	-

B6. Approximately what percent of your annual operating budget do energy costs account for?

Percent of Budget	2012 (#)	2013 (#)	2014 (#)
<i>Sample Size*</i>	15	19	5
Less than 10%	5	4	2
10-19%	2	6	2
20-29%	3	3	1
30-39%	2	2	-
40-49%	1	3	-
50-59%	2	1	-
60-69%	-	-	-
70-79%	-	-	-
80-89%	-	-	-
90-99%	-	-	-
Average Percent	22%	21%	9%
*Note: Don't know responses were removed from data.			

F3. Approximately how many full-time equivalent workers does your company or organization employ at all locations within Nova Scotia?

Full-time Equivalent Workers	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	27	29	11
Fewer than 5	15%	3%	2
5 to 9	4%	7%	-
10 to 19	4%	7%	-
20 to 49	15%	3%	1
50 to 99	11%	14%	1
100 to 249	15%	17%	2
250 or more	30%	41%	4
Don't know	7%	7%	1

F5. Is your company independent, or part of a larger company?

Type of Company	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	27	29	11
Independent	52%	59%	7
Part of a larger company	37%	28%	4
Franchise	-	-	-
Others	11%	3%	-

F6. How many business locations does your organization have in Nova Scotia?

Number of Locations	2012 (%)	2013 (%)	2014 (#)
<i>Sample Size</i>	27	29	11
1-5	63%	59%	3
6-10	11%	24%	4
11-20	15%	3%	-
21-50	7%	7%	2
51-100	-	-	1
Don't know/Don't recall	4%	7%	1

APPENDIX IV

ALGORITHM FOR FREE-RIDERSHIP CALCULATION

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

The three free-ridership questions asked to participants in the approval form are used by the Evaluator in the free-ridership calculation to validate the consistency with the answers collected from the participants surveyed after the participation process.

FR2a. If your company had not participated in Custom, what is the likelihood that you would have implemented exactly the same energy efficiency measures that you implemented through the program? (Scale 0 to 10)	FR2a = Answer x 10%
FR2b. If your company had not participated in Custom, what is the likelihood that you would have installed standard equipment instead of energy-efficient equipment? (Scale 0 to 10)	FR2b = (10 – Answer) x 10%
PA1 Score:	MEAN VALUE OF: (FR2a ; FR2b) IF PRE-SCREENING: 0%
FR1. Before participating in Custom, did your company have plans to implement the specific energy efficiency measures that were implemented through the program?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%
FR1a. I just want to make sure - Before you decided to participate in Custom, you had already made the decision to implement the energy efficiency measures you implemented through the program?	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%
FR3. If your company had not received the financial incentives and/or on-bill financing from ENSC, would you have paid and/or financed the full cost of the project you implemented? (Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3 IF PRE-SCREENING: 0%
FR4. Level of influence (Scale 0 to 10) Factors a, b, c, d, e and h = Program factors Factors f and g = Non Program factors	FR4_P = SUM(a; b; c; d; e; h) FR4_NP = SUM(f; g)
PA3 Score:	100% - [FR4_P/(FR4_P+FR4_NP)]
FR2c. If your company had not participated in Custom, what is the likelihood that you would have implemented the energy efficiency measures but at a later date? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2dd Otherwise: PA4 = EMPTY
FR2dd. Approximately how many months later would you have implemented the measures? 1. Less than 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later? 7. (Never) 9. (Don't know / Refused)	IF 1. : FR2dd = 100% IF 2. : FR2dd = 50% IF 3. : FR2dd = 25% IF 4. : FR2dd = 0% IF 5. : FR2dd = 0% IF 6. : FR2dd = 0% IF 7. : FR2dd = 0% IF 9. : FR2dd = 0%
PA4 Score:	FR2dd
Final Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)
Inconsistency Test #1	IF ABS(FR2a – FR2b) ≥ 30%: PA1 = MIN OF (FR2a ; FR2b)
Inconsistency Test #2	IF FR3 ≥ 70% AND IF (FR2a OR FR2b < 70%: PA2 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)

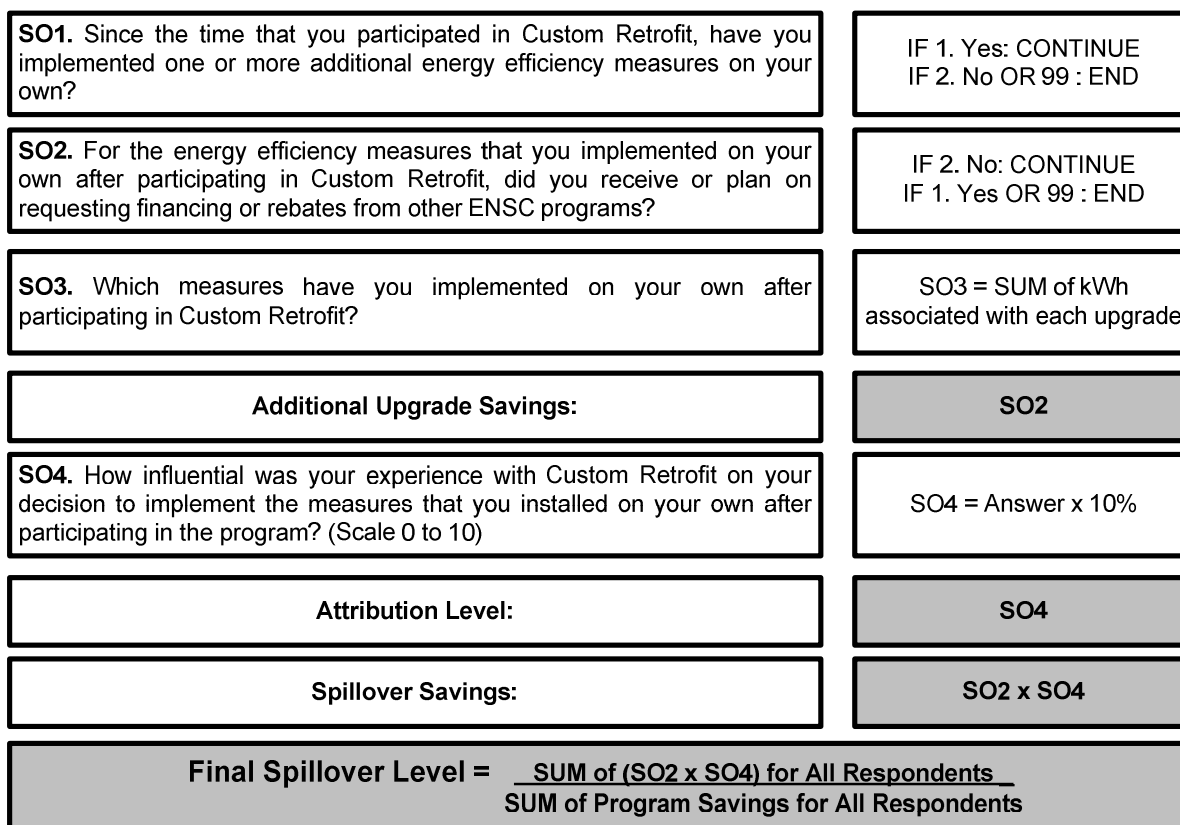
APPENDIX V

INTERNAL SPILLOVER METHODOLOGY

Internal spillover was measured using on-site visits. Participants were asked whether following their participation in the program, they implemented any additional energy efficiency measures, without benefitting from any rebates offered by ENSC programs. If a participant did admit to having implemented additional measures, they were asked a set of questions designed to identify the additional energy efficiency measures implemented and to quantify their associated savings (type of measure, quantity, efficiency level, etc.). Subsequently, another question was asked to quantify the level of influence the program had on the participant's decision to whether implement these additional measures. The value established regarding this level of influence was used to determine the portion of the additional savings attributable to the program.

Then, the level of internal spillover was established by dividing the total quantity of the additional savings attributable to the program by the total quantity of savings achieved by the program for all the survey respondents.

The figure below illustrates the methodology used to calculate the internal spillover level.



APPENDIX VI

CALCULATION EXAMPLE

This appendix describes the step-by-step calculations that have produced the results for one of the projects in the 2014 Custom Retrofit impact evaluation. The algorithm described concerns the adjustments made to a lighting project, and includes both energy and demand savings adjustments.

The equations used for the savings calculations are presented first, followed by the tracked savings claimed by ENSC. Revised savings are then calculated using information collected during the on-site visit and a subsequent analysis of the DSMDS file. A project-specific adjustment ratio was established as a result of the evaluation.

Savings Equations

Documentation of the energy and demand savings calculations consisted of ENSC's standardized lighting retrofit workbook. All of the key project variables were listed in the workbook, and the savings calculations were based on a comparison of the energy use performance of the equipment before and after the implementation. In the calculation sheet, the following calculations are used to determine the final annual savings value at the meter.

Net Electrical Savings

$$\begin{aligned}
 &= [(Fixture Qty \times Fixture Wattage \times Annual HOURS)_{Existing} \\
 &- (Fixture Qty \times Fixture Wattage \times Annual HOURS)_{New}] \pm Interactive Effects
 \end{aligned}$$

$$\text{Interactive Effects} = \text{Cooling Bonus} - \text{Heating Penalty}$$

Cooling Bonus

$$\begin{aligned}
 &= [(Electrical Consumption_{Existing} \times Space Fraction_{Existing}) \\
 &- (Electrical Consumption_{New} \times Space Function_{New})] \\
 &\times (Percent of Year / COP_{Cooling})
 \end{aligned}$$

Heating Penalty

$$\begin{aligned}
 &= \text{Heat Gain Factor} \\
 &\times [(Fixture Qty \times Fixture Wattage \times Annual HOURS)_{Existing} \\
 &- (Fixture Qty \times Fixture Wattage \times Annual HOURS)_{New}]
 \end{aligned}$$

Net Demand Savings

$$\begin{aligned}
 &= (Fixture Qty \times Fixture Wattage \div 1000 \frac{W}{kW})_{Existing} \\
 &- (Fixture Qty \times Fixture Wattage \div 1000 \frac{W}{kW})_{New}
 \end{aligned}$$

Tracked Savings Calculation

This project involved replacing high bay metal halide fixtures with more efficient high bay T8 fixtures. ENSC calculated the tracked savings for this project by applying the lamp wattage of the existing fixtures, and the fixture wattage from the supplier of the new lights. The annual hours of operation used in the tracked savings calculation were based on 51 fixtures running for 3,120 hours/year and 4 fixtures running for 8,760 hours/year. As the heating for the facility was provided using natural gas, no heating penalty was applied. Similarly, since no active cooling was installed in the facility, there was no cooling bonus calculated for the project. The results of consumption measurements are presented in the following table.

Table 14: Tracked Savings Values

Baseline Energy Consumption (kWh)	72,408
Post-retrofit Energy Consumption (kWh)	37,279
Tracked Gross Energy Savings (kWh)	35,129
Baseline Demand (kW)	21.400
Post-retrofit Demand (kW)	10.560
Tracked Gross Demand Savings (kW)	10.840
Tracked Diversity Factor	0.4
Tracked Gross Peak Demand Savings (kW)	4.336

Revised Savings Calculation

Adjustments to the energy savings were made based on a minor correction of the count of lights a modification of the hours of operation (HOUs) (based on the facility manager's declaration), and a correction to the base equipment wattages to account for a ballast factor.

The HOUs in the PDA were based on 60 hours/week for line items 1 & 2 and 168 hours/week for line item 3. Based on the declaration by the facility manager, the HOUs for lines 1 & 2 were updated to reflect the 88 hours/week of normal operation (4,576 hours per year). Dividing the 88 hours/week by 7 days per week, the average daily operation of 12.57 hours/day was established. This value was multiplied by 10 (which is the number of official holiday dates when the building is totally closed) to obtain the value of 125.7 hours/year, which was then subtracted from the total annual value listed above (i.e., 4576 hours - 125.7 hours = 4,450.3 hours/year). This new value was divided by 52 weeks and input back into the lighting spreadsheet (85.6 hrs/week).

The fixture wattages for the baseline equipment was set at 400W and 250W, which only represent the rated wattages of the lamp and not the fixture. The baseline values were adjusted to 458 W (400W) and 288W (250W), as per Table 17 in Efficiency Maine - Commercial TRM v2014.1. No adjustment of wattage was made to the 6LT8 fixtures' value of 192 W/fixture, because it fell within the TRM range of 154-224W/fixture.

Revised demand savings were calculated using the adjustments above, and then multiplied by a diversity factor of 0.40. The diversity factor represents the fraction of time that the lights are expected to be running during the peak demand period of 5:00-7:00 pm in the months of December through February. Based on the calculations made above, the revised savings are increased by 28,963 kWh/year and 3.28 kW before the diversity factor is applied. Detailed results are presented in the table below.

Table 15: Revised Gross Savings Values

Baseline Energy Consumption (kWh)	113,578
Post-retrofit Energy Consumption (kWh)	49,486
Revised Gross Energy Savings (kWh)	64,092
Baseline Demand (kW)	24.680
Post-retrofit Demand (kW)	10.560
Revised Gross Demand Savings before Diversity Factor (kW)	14.120
Diversity Factor Applied	0.40
Revised Gross Peak Savings (kW)	5.648

Final Adjustment Ratios

The changes made to the fixture wattages and annual hours of operation had a significant impact on the energy savings for this project, resulting in an adjustment ratio of 1.824. The calculated demand savings increase also resulted in an upward adjustment ratio of 1.282. The individual ratios were then used to calculate the weighted adjustment ratios for the lighting project sample, and subsequently applied to the total tracked savings for the lighting project category.

APPENDIX VII

CUSTOM RETROFIT ON-SITE VISIT SAMPLING PLAN AND PROTOCOL

Sampling Methodology

The sampling selection was made based on the tracking sheet provided by ENSC in October 2014. This tracking sheet contained a tab showing all the projects expected to be claimed and evaluated in 2014. ENSC made the selection using the project implementation⁴ status to determine whether it would allow for on-site validation by the Evaluator. As of October 2014, 44 projects in the tracking sheet met the implementation criterion and reached an advanced-enough stage of completion to be claimed within 2014. As of October 2014, the projected gross savings at the generator for the 44 projects were listed in the tracking sheet as 9.705 GWh/year in energy savings, and 0.997 MW in demand savings.

In order to determine the 25 sites to be selected for the sample, the following three selection criteria have been developed and shall be applied in order of importance:

- › Verified project energy savings at the generator in 2014
- › Project type or category (i.e., HVAC, lighting, refrigeration, etc.)
- › Program track (i.e., Track 1, Compressed Air Track, or Track 2)

The criteria were ranked in order of importance, with “project energy savings” being the most important and the other two criteria given relatively equal weight. Each of the three sampling criteria are described in further detail below.

Project size. The 2014 energy savings at the generator for each project were considered the most important criterion for selecting a representative sample. As the adjustment factors of larger projects have a greater impact on the overall claimed savings, the sample has been weighted to include a higher percentage of large projects. Additional consideration has been given to the range of individual projects’ savings, as the results listed in the Custom Retrofit tracking sheet ranged from 2.8 MWh/year to 1,737 MWh/year.

To account for the impact of project size on the sampled set, four energy savings bands (strata) were created. The strata were selected using 35 equal intervals of 50 MWh with the intent of obtaining 6 visits per band. The Evaluator set the stratum boundary points using the Dalenius and Hodge (1959) method⁵, also known as the approximate rectangular method. This method involves setting arbitrary intervals of the same size⁶ and then calculating the square root of frequency of projects per interval.

⁴ The 2014 projects available for sampling had one of five progress tags: approved, closed, completed, installed or paid.

⁵ COCHRAN, William G., *Sampling Techniques (Third Edition)*, John Wiley and Sons, Inc., New York, 1977.

⁶ 50 MWh/year in the present case, giving a project frequency per interval 0 to 14 projects.

Subsequently, the sum of square roots for the number of projects in each interval was divided by the pre-established number of strata (four) to determine the resultant division of strata. Once the sum was calculated and the divisions finalized, the inclusion probability for each stratum was calculated and six projects were randomly selected in each stratum. Since a total of 25 projects had to be sampled while only 24 projects had been selected using this methodology, the remaining sample project was randomly selected within the stratum that had the lowest inclusion probability, i.e., the first stratum (0 to 100 MWh of savings, as shown in the table below).

The table below provides a tabular summary of the results.

Table 16: Sampling Strata by Project Size

Stratum	Range of Annual Savings	Number of Projects	Total Energy Savings (MWh/yr)	Percentage of Total Energy Savings	Sample	Inclusion Probability
1	Savings ≤ 100 MWh	21	327	9%	7	33%
2	100 MWh < Savings ≤ 200 MWh	12	748	16%	6	67%
3	200 MWh < Savings ≤ 450 MWh	7	1,640	22%	6	86%
4	Savings > 450 MWh	2	2,008	53%	6	250%
Total		44	9,705	100%		

Project type. Since the types of energy efficiency measures implemented in Custom Retrofit projects can vary widely, the Evaluator decided that the project-type distribution in the sample should accurately represent the proportion of each measure category. For the 2014 evaluation, Econoler has defined six types of energy efficiency categories for sampling purposes, which include:

1. Lighting retrofits
2. HVAC upgrades
3. Compressed air upgrades
4. Process improvement
5. Multiple EEMs implemented
6. Other EEMs

The “multiple EEMs” category was developed to isolate five large projects implemented in 2014, and to reduce the amount the sample was skewed by the lighting category project savings. The “other” category included small projects involving building envelope upgrades, renewable energy system installations, and some larger projects involving fuel-switching, refrigeration, and control system integration.

The categorization of the 44 projects has resulted in four relatively medium-sized groups, and two larger groups that each represents nearly twice the annual savings of the four smaller categories. The

two largest groups are lighting retrofits and HVAC upgrades, and the remaining four categories make up the smaller groups. The result allowed the Evaluator to ensure that every type of project in the sample is represented and reasonably balanced. The table below provides a breakdown of the savings by category, and as a percentage of the total tracked savings.

Table 17: Sampled Projects by Category

Category Name	Count by Category	Sum of Energy Savings (kWh/year)	Percentage of Total Savings (%)
Compressed air	3	969,946	10%
HVAC	4	1,420,665	15%
Lighting	18	2,523,336	26%
Multiple	5	2,793,051	29%
Other	10	696,357	7%
Process	4	1,302,091	13%
Grand Total	44	9,705,447	100%

Program track. As part of a process evolution, ENSC has created three distinct program tracks within Custom Retrofit. The three tracks provide alternate project pathways depending on the anticipated size of the savings, with Track 2 holding large complicated projects, and Track 1 holding smaller, less technical projects. A third track was added for compressed air projects, which provides technical assistance from ENSC and is aimed at optimizing compressed air system performance in the manufacturing sector. The program track criterion was added in response to changing program offerings, and as a means of balancing the assessment process.

Applying these four sampling criteria, the Evaluator has established a list of 25 projects to be visited. The following table shows a comparison of the sample and the total population of Custom Retrofit projects and their respective program savings.

Table 18: Comparison of Custom Retrofit Program Population and On-site Visit Sample⁷

Description	Number of Projects	Expected Gross Energy Savings at the Generator (GWh/year)	Expected Gross Demand Savings at the Generator (MW)
Population	44	9.705	0.997
Sample	25	8.348	0.748
Percentage of Tracked	56.8%	86.0%	75.0%

⁷ As of October 2014.

On-site Visit Protocol

To collect and assess the information and data regarding relevant operating variables, M&V activities and adjusted gross savings, the Evaluator used an on-site visit form, developed to concisely document the important information gathered from both ENSC's project documentation database (DSMDS) and the observations made on site. This form captures general project information, creates a typical operating schedule, collects data on key operating variables, documents affected equipment, and summarizes M&V activities.

Prior to carrying out any Custom Retrofit on-site visits, the Evaluator gathers useful information from documents stored in the DSMDS, which typically include:

1. Scoping and/or feasibility studies
2. EEM savings calculations
3. Project development agreements
4. M&V reports
5. Email correspondence

These documents are used to validate technical information, such as the quantity and types of equipment installed (e.g., lighting fixtures), and the relevant operating specifications (e.g., wattage, phase, speed, efficiency etc.). The Evaluator reviewed all the project-specific documents and completed the "Pre-Visit Assessment" portion of the on-site form before arriving on site. This process allowed the Evaluator to define a reasonable set of project boundaries and key parameters.

As part of the verification of project impacts, the on-site visits were used by the Evaluator to collect information about the spillover level among participating projects. Since the evaluation of this distortion effect is crucial to understanding program impact, this on-site interview provided a method of qualifying spillover levels throughout the program.

1. General Information

Site Visit Date: _____ Contact Name: _____
Project ID: _____ Contact Title: _____
Project Type: _____ Contact Phone: _____
Company Name: _____ Email: _____
Address: _____

List of people met during the visit: _____

Type of building:

Commercial/institutional		Industrial/manufacturing	
Municipal		Other (specify)	

 Specify: _____

2. Key Project Variables

Variable Descriptions: *List key project variables and listed KPIs from M&V Plan*

NOTE: PC Users "Alt+Enter" for new line in cell. MAC Users "CMD+Option+Enter".

3. Facility Operation Schedules

Facility Description: *Outline a quick description of the facility and its primary operation/purpose.*

NOTE: PC Users "Alt+Enter" for new line in cell. MAC Users "CMD+Option+Enter".

Facility Annual Schedule: *Fill the table below for each occupancy schedule reported by the site contact as occupancy could vary for each section of the facility. Use additional sheets if necessary.*

Description	1 - Normal Schedule		2 - Specify:		3 - Specify:	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
Number of day with regular schedule per year						
Number of day with regular holidays schedule per year						
Number of days with no occupancy per year (For example: seasonal closure)						
Total number of day per year	0	0	0	0	0	0

Total=261 Total=104

Facility Daily Schedule:

Fill the table below for each occupancy schedule reported by the site contact as occupancy could vary for each section of the facility. Use additional sheets if necessary.

Schedules		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Holidays
Schedule 1: Normal	<i>Time of use (e.g. 8:00 am to 5:00 pm)</i>								
	<i>Hours per day</i>								
Schedule 2 (specified above)	<i>Time of use</i>								
	<i>Hours per day</i>								
Schedule 3 (specified above)	<i>Time of use</i>								
	<i>Hours per day</i>								

4. Interactive Effects

Interactive Effects?

YES

NO

If YES the fill in the table below for each heating system at the site

Briefly describe interactive effects for the project.

5. Building Heating/Cooling System Description
Heating Systems

Fill the table below for each heating system at the site.

Description	Heating System 1	Heating System 2	Heating System 3	Heating System 4
Energy Source				
Heating System Type				
Nominal Capacity				
Efficiency or COP				
If any, changes in building set points (occ./ unocc. temp., % hum)				

Cooling Systems

Fill the table below for each cooling system at the site.

Description	Cooling System 1	Cooling System 2	Cooling System 3	Cooling System 4
Energy Source				
Cooling System Type				
Nominal Capacity				
SEER or COP				
If any, changes in building set points (occ./ unocc. temp., % hum)				

6. Pre-Visit Assessment of the Project

Indicate the key observations from the feasibility study and M&V report analysis. These notes will serve on site to guide the visit and identify the main information to collect and/or verify.

7. On-Site Observations and Findings

Report the on-site visit and indicate the key observations and findings made on site.

8. Spillover Assessment

Spillover Questionnaire Completed?

 (Y/N)

9. M&V Post Implementation Results

Report the on-site visit and indicate the key observations and findings made on site.

Seasonal Load Profile?

(Y/N)

Summer Load Variations?

(Y/N)

Predicted Results (MWh)	M&V Results	Percent of Expected (%)	M&V Start Date	M&V Finish Date	Days in Period	Notes

Notes: Insert Comments from M&V Reports

10. Energy and Demand Savings Adjustments

Energy Savings from Tracking Sheet:	#REF! ##### kWh/yr
Demand Savings from Tracking Sheet:	0,0 kW
Diversity Factor Used by ENSC:	-

Adjustment from the Evaluator

Adjustment - M&V Energy Savings:	#REF!
Adjustment - M&V Demand Savings:	0%
Diversity Factor Used by Econoler:	-

Project Estimated Finish Month:	#REF!
Notes on Project Status:	#REF!

Final Project Impacts at the Meter

Evaluated Energy Savings:	kWh/yr
Evaluated Demand Savings:	- kW

11. Additional Notes



ECONOLER

CUSTOM NEW CONSTRUCTION

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ECONOLER

ABBREVIATIONS

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BNI	Business, Non-Profit and Institutional
CV	Coefficient of Variation
DSM	Demand-side Management
DSMDS	Demand-side Management Data System
EM	Energy Modelling
ENSC	Efficiency Nova Scotia Corporation
HDD	Heating Degree-Days
HVAC	Heating, Ventilation and Air Conditioning
IPMVP	International Performance Measurement and Verification Protocol
M&V	Measurement and Verification
MNECB	Model National Energy Code for Buildings
NC	New Construction
NCEM	New Construction Energy Modelling
NECB	National Energy Code for Buildings
NTGR	Net-to-Gross Ratio
PDA	Project Development Agreement
PM	Program Manager
RMSE	Root Mean Squared Error

DEFINITIONS

Billing calibration	An activity that consists in adjusting the expected energy savings based on the relative difference between the results of the building energy simulations and the actual energy consumption of the building.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.
Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	VI
1 PROGRAM DESCRIPTION.....	1
2 METHODOLOGY	2
2.1 Presentation of the Team.....	2
2.2 Evaluation Activities	2
2.2.1 Project File, On-site Visits and Interviews	2
2.2.2 Billing Calibration	3
3 PROCESS EVALUATION	4
3.1 Participation in Custom NC.....	4
3.2 Tracking System	4
3.2.1 Tracking Report	4
3.2.2 Demand-side Management Data System.....	6
4 IMPACT EVALUATION	8
4.1 Gross Savings	8
4.1.1 Adjustment Methodology.....	8
4.1.2 Billing Calibration with Past Participants.....	9
4.1.3 Adjusted Gross Savings.....	12
4.2 Net-to-Gross Ratio	14
4.3 Net Savings.....	15
CONCLUSION.....	17
APPENDIX I 2014 RECOMMENDATIONS.....	18
APPENDIX II ALGORITHM FOR IMPACT CALCULATION.....	19
APPENDIX III ON-SITE VISIT SAMPLING AND PROTOCOL	21

LIST OF TABLES

Table 1: Comparison of Tracked and Evaluated Savings at the Generator	vii
Table 2: Comparison of Regression Analysis Statistics.....	11
Table 3: Evaluation Results – Gross Energy and Peak Demand Savings	14
Table 4: Comparison of Tracked and Evaluated Savings at the Generator	15
Table 5: Final Sample for Custom NC.....	21

LIST OF FIGURES

Figure 1: Methodological Model	2
Figure 2: Projects Implemented through Custom NC	4

EXECUTIVE SUMMARY

This report presents the results of the 2014 evaluation of Custom New Construction (NC), which is a component of the Custom Incentives program. The 2014 evaluation was based on nine on-site visits and full project technical documentation reviews, as well as a billing calibration.

Program component Overview

Efficiency Nova Scotia Corporation's (ENSC) Custom NC provides business, non-profit and institutional (BNI) customers with incentives to help them achieve significant and predictable electrical savings in new commercial or industrial buildings, as well as in additions and major renovations. Custom NC delivery has been constructed in such a way as to get the customers involved from the preliminary design stage to effectively implement the energy efficiency measures and achieve maximum energy savings.

Custom NC aimed to achieve net electrical energy savings of 4.6 GWh and peak demand savings of 1.1 MW for 2014.

Key Findings

As the evaluation of Custom NC showed, the program component saw a total of 13 projects implemented in 2014, compared to 15 projects in 2013 and eight projects in 2012.

To calculate the savings of Custom NC in 2014, the Econoler team first conducted on-site visits and full project technical documentation reviews for nine projects. Based on the information collected on site, the Econoler team calculated the gross energy and peak demand savings for all the 2014 projects according to the specific characteristics of each project type.

In 2014, ENSC changed its approach to take into account the original design intention of the participants when establishing the baseline, rather than assuming that the baseline is the current practice (i.e., MNECB 1997.) This has significantly reduced the gross savings for many projects—for four of the nine projects reviewed, the baseline was more energy efficient than the MNECB by a margin of 23 percent to 50 percent. In accordance with this new approach of calculating savings using a specific baseline for each participant, no free-ridership was applied in 2014.

The impact evaluation revealed that Custom NC generated net energy savings of 6.656 GWh at the generator in 2014. As for electrical demand reduction, Custom NC achieved 2.517 MW in net peak demand savings at the generator in 2014. The following table presents the Custom NC final savings, along with the savings tracked by ENSC for 2014.

Table 1: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Adjusted Gross Savings	Net-to-Gross Ratio (NTGR)	Net Savings
Energy Savings				
Tracked Savings from ENSC	7.122 GWh	7.122 GWh	1.00	7.122 GWh
Evaluation Results	7.122 GWh	6.656 GWh	1.00	6.656 GWh
Peak Demand Savings				
Tracked Savings from ENSC	2.619 MW	2.619 MW	1.00	2.619 MW
Evaluation Results	2.619 MW	2.517 MW	1.00	2.517 MW

As shown in Table 1 above, the gross energy and peak demand savings at the generator evaluated by the Econoler team are respectively 6.5 percent and 3.9 percent lower than those tracked by ENSC. This difference is mainly due to the adjustments made to the tracked gross savings of one LEED registered project, for which the ratio of cost savings required by LEED energy performance pre-requisite had not been applied. For other projects, adjustment ratios were smaller or, in three out of nine projects visited, nil. This year, ENSC included a diversity factor in their tracked peak demand calculations. As a result, the Evaluator did not have to make sizeable adjustments to calculate peak demand savings, as was the case in 2013.

Recommendations

Overall, the Econoler team assessed that Custom NC works well and at a satisfactory level. In addition to the general recommendations presented for all ENSC program components in the overall executive summary of the 2014 demand-side management (DSM) programs, the team outlines specific recommendations throughout the report to optimize Custom NC. Based on the evaluation results, here are the most relevant recommendations:

2014 Custom NC-R1. Gather more data to conduct a conclusive calibration billing analysis in 2015. Despite the fact that 23 projects were completed in 2012 and 2013, it was only possible to obtain sufficient energy billing data for seven projects to perform a calibration analysis in 2014. This calibration analysis proved to be inconclusive due to numerous factors. The Evaluator consequently suggests that this evaluation activity be continued in future evaluation. Other measures could be taken to ensure the quality of the result, such as requiring a final energy simulation submission (based on the as-built conditions), making enhanced building commissioning a mandatory element of Custom NC and/or including a full energy simulation review to ensure the accuracy of the model inputs.

2014 Custom NC-R2. Adopt the National Energy Code for Buildings (NECB) 2011 as a baseline for all new projects in 2015. The literature review conducted as part of 2013 evaluation revealed that more stringent baseline construction designs are currently being used in similar new construction programs in other Canadian jurisdictions. Moreover, the NECB is now enforced in large buildings as of January 2015 in Nova Scotia. Therefore, the Evaluator reiterates their 2013 recommendation of updating the baseline used for calculating savings. Noteworthy is that the eligibility criteria Custom NC should also be modified in accordance with this change to baseline construction design.

2014 Custom NC-R3. Explain the diversity factor value used in peak demand savings calculations. In 2014, the report included the addition of a diversity factor for each measure. It is good practice that this factor be explicitly defined on an individual measure basis. To facilitate the task of validating this value for the Evaluator, it would be advisable to add a field where the calculation or assumptions are explained in a few words.

1 PROGRAM DESCRIPTION

Efficiency Nova Scotia Corporation's (ENSC) Custom New Construction (NC) provides technical assistance and financial incentives to help business, non-profit and institutional (BNI) customers build more energy-efficient facilities and reduce their electricity consumption and demand. The rationale behind granting Custom NC's participants with this support is that most new construction projects today are still managed and measured on a separate capital budget for construction with almost no financial motivation to include the ongoing operating budget or total cost of ownership when selecting construction materials and equipment technology. As capital budgets come under pressure, the high efficiency measures that tend to have a higher initial cost are compromised.

Custom NC provides eligible customers with incentives to help them achieve significant and predictable electricity savings in new BNI buildings, as well as in additions and major renovations. Custom NC delivery was constructed in such a way as to get the customer involved from the preliminary design stage to effectively implement the energy efficiency measures and achieve maximum energy savings.

There are two paths to participate in Custom NC: (a) New Construction Energy Modelling (NCEM); and (b) prescriptive rebates (refer to the Business Energy Rebates – BER – report for further information on prescriptive rebates granted to Custom NC projects). The NCEM path uses energy modelling (EM) to examine and quantify potential energy savings measures within building systems as a whole.

Custom NC aimed to achieve net electricity savings of 4.6 GWh and peak demand savings of 1.1 MW for 2014. Electrical energy savings generated by NC are accounted for under the Custom Incentives program.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and the activities carried out for the Custom NC evaluation.

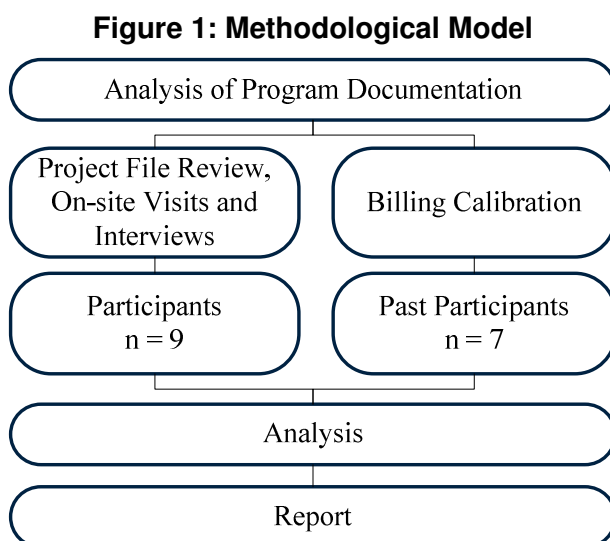
2.1 Presentation of the Team

To carry out the 2014 evaluation, Econoler worked together with Equilibrium Engineering:

- › Econoler acted as the team leader and was responsible for coordinating all evaluation activities, as well as preparing and reviewing all deliverables.
- › Equilibrium Engineering conducted the on-site visits, reviewed the tracking sheet and assisted Econoler with certain parts of the impact evaluation. Equilibrium Engineering was also in charge of the analysis and the reporting that followed those different activities.

2.2 Evaluation Activities

The figure below illustrates the research strategy and data collection activities used for the 2014 evaluation.



2.2.1 Project File, On-site Visits and Interviews

In October and November 2014, nine on-site visits and full project technical documentation reviews were conducted by Equilibrium at facilities that had participated in Custom NC. These site visits helped validate the technical specifications of the new energy-efficient equipment and the operation schedule as well as collect information on the facility characteristics and operations. In-depth interviews were also conducted with participants during on-site visits to collect information on free-ridership. A copy of the on-site visit sampling and protocol is included in Appendix III.

2.2.2 Billing Calibration

For 2014, ENSC collected actual energy consumption and demand data of buildings from the 2012 and 2013 evaluations to compare them with the proposed case energy consumption and demand figures simulated before project implementation. Such a comparison can be used to verify whether the building simulation reflected the actual energy consumption and demand profile of the new building. It also helps identify potential recommendations on how to improve the accuracy of the energy and peak demand savings tracking procedures under Custom NC. This verification process is based on best practices for energy performance measurement and verification (M&V) in new constructions, such as those defined in the International Performance Measurement and Verification Protocol (IPMVP).

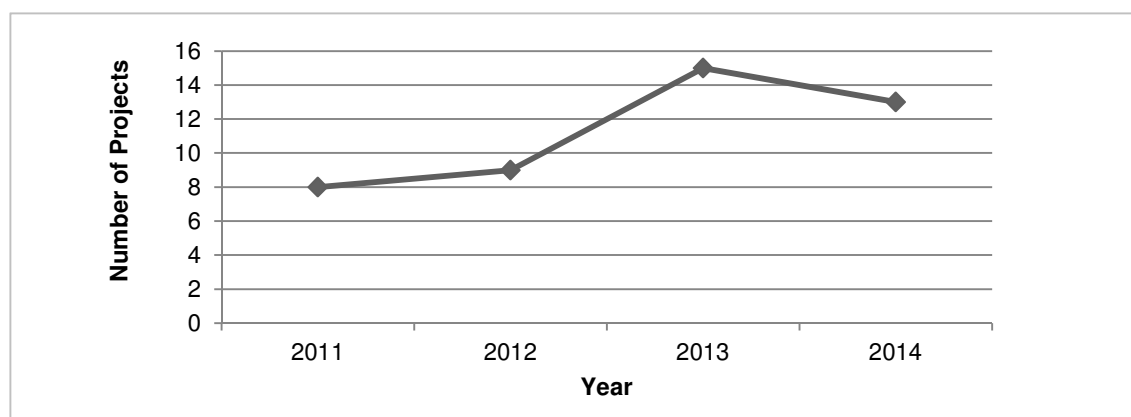
3 PROCESS EVALUATION

This section presents the findings of the 2014 Custom NC partial process evaluation, which are based on the tracking system review.

3.1 Participation in Custom NC

As shown in Figure 2, Custom NC totalled 13 projects for the year 2014, compared to 15 projects in 2013, 8 projects in 2012 and 9 projects in 2011.

Figure 2: Projects Implemented through Custom NC



3.2 Tracking System

In 2014, ENSC tracked Custom NC projects through the demand-side management data system (DSMDS) and generated tracking reports in the form of an Excel workbook for evaluation purposes. The following two sections present the Evaluator's review of both the tracking reports and the DSMDS in general.

3.2.1 Tracking Report

The 2014 tracking report contained three tabs: (1) Evaluation Report, (2) Measures by Project, and (3) Measures by Category. The following sections detail the information contained in each of the individual tabs.

Evaluation Report

The evaluation report tab contains general project information including project ID, project status, ENSC project owner, participant/facility contact information, verified energy/peak demand savings, incentive(s) paid, verified unit cost (\$/kWh) and project realization rates. The gross energy and peak demand savings claimed by participants and those verified by ENSC are clearly detailed in the report, but the line loss factor and/or rate code of Nova Scotia Power for each project is missing, thus

preventing the Evaluator from easily calculating the project savings at the meter. As the information contained in the project feasibility studies, M&V reports and other technical documents always relate to the energy and demand savings to be achieved at the meter, an easy access to the line loss factor and/or Nova Scotia Power rate code in ENSC's tracking reports would be extremely helpful. Incidentally, information on the net energy and peak demand savings tracked by ENSC is not provided in the tracking tool either.

In 2014, ENSC improved the tracking report by adding the contact information and address of the facility as part of recommendations made in the 2013 program evaluation. The added information enables the Evaluator to better coordinate on-site visits with the project contact. The evaluation process is moreover improved as the facility and/or modelling contacts are normally more involved with the construction process, which enhances their ability to answer questions about implemented measures.

Measures by Project

The Measures by Project tab in the tracking report includes the project ID, project name, status, categories of measure/codes and description, as well as the verified energy and peak demand savings at the generator. This new tab clearly helped meet one of the 2013 recommendations requesting more information on the energy efficiency measures implemented in each project. Even if some categories of energy efficiency measure were not standardized (as of November 2014, approximately 40 percent of the categories were defined as "Custom NC", "Custom" or "NC – Custom"), the enhancement of the Custom NC tracking system is very useful to the Evaluator as it enables to quickly understand the scope of each project and evaluate how each energy efficiency measure contributes to the total Custom NC impacts.

In response to another recommendation made by the Evaluator in 2013, the report also came with the addition of a diversity factor and savings values for each of the implemented measures within the projects. This additional information is extremely useful to the Evaluator as it breaks the total verified project savings into distinct measures and allows for better on-site verification. The improvements made to the 2014 tracking report shows ENSC's commitment to improving the usefulness of the information collected.

Measures by Category

The information contained in the Measures by Category tab was identical to the Measures by Project tab, but was presented in a manner that focused on the types of projects implemented. The benefit to the Evaluator was an improved understanding of what types of energy efficiency measures were generating the savings of each Custom NC project.

3.2.2 Demand-side Management Data System

Beyond the review of the tracking report provided, the Evaluator reviewed the contents, and structure of ENSC's Demand-Side Management Data System. Since all current Custom NC projects are now being tracked online through the DSMDS, the Evaluator felt it was necessary to further review its contents for accuracy.

The current version of the DSMDS contains eleven tabs that include; Project Summary, Tech Studies, Subcontractors, Measures, M&V, Milestones, Payment, Documents, Notes, Workflow, and Reports. All of the eleven the tabs were reviewed for content and assessed for potential improvement. Of the eleven tabs, three were found to contain the information required to carry out on-site evaluations and verify tracked savings. A summary of the three key tabs is provided below.

Project Summary

The Project Summary tab of the DSMDS contains all of the relevant information required for a quick overview of any Customer NC project. Information within this tab includes the project information, notes, milestone dates, project budget, savings summaries and the client/facility contact information.

In response to the recommendations made in the 2013 evaluation report for Custom NC, ENSC added a section to the project summary tab to capture the free-ridership screening information. Additionally, a section was added to capture details about the facility, which includes Nova Scotia Power's utility account number, rate code, building type, building sub-group (or occupancy class) and inputs for primary/secondary heating sources, temperature set points, facility area, age of building, and number of occupants. Although some of the information in the section was incomplete, it shows a significant improvement in process and will eventually allow ENSC to mine the data contained in the DSMDS and adjust program offerings.

Measures

The Measures tab in the DSMDS provides a summary table of the energy savings and implementation costs of an individual project. The energy savings section provides necessary information required to assess and verify the tracked savings by implemented measures, and includes additional information about the power factor and diversity factor. The addition of these factors was part of recommendations made by the Evaluator in 2013, and indicates that ENSC is focused on improving the overall process.

Within the implementation costs portion of the Measures tab are inputs for detailed costs that enable the project to be broken into different sections: labour, materials, engineering and others. The section also provides space to track non-electrical benefits, expected life of measures and a link to enter further equipment details (e.g., manufacturer, model number). Although not all tabs were complete, the commitment to improving data collection for individual measures is evident.

Documents

The Documents tab contains the most detailed information about the 2014 Custom Retrofit projects, and typically includes the modelling summary report, the ENSC NC-EM2 Excel document, relevant calculation workbooks and other project-related communications. As was the case in the 2013 evaluation, this tab provided the Evaluator with most of the information used to carry out on-site visits and make savings adjustments.

One recommendation made in 2013 was to standardize file-naming conventions for all documents that are stored in the DSMDS. Upon further inspection of the files stored here, there still seems to be no defined naming convention adopted. However, each document saved to this section is assigned a document type and a document name, making them relatively easy to navigate in the DSMDS.

Missing from the Documents tab are detailed project files, such as the energy model, equipment specifications and architectural/mechanical drawings. The Evaluator had a conversation with ENSC about the missing files and confirmed that these documents are stored on an internal server. Since the submitted project files can be numerous and excessively large, it was decided not to upload them to the DSMDS and rather make them available upon request by the Evaluator.

Overall, the results of the Tracking System review indicate that ENSC is making consistent improvements to their process, and that electronic project files are generally well maintained in a consistent format. In summary, the Evaluator concludes that the 2014 Custom NC tracking system is adequate and showing indications of continuous improvement from year to year.

The following recommendations would further improve the tracking system in future years:

- › **Adding the Nova Scotia Power's rate code to the DSMDS report:** While the Nova Scotia Power's rate code is entered into the DSMDS, it does not appear in the Evaluation Report. As the information contained in the project feasibility studies, M&V reports and other technical documents is always expressed in terms of energy and demand savings at the meter, the Evaluator needs to apply the correct line loss factor to the savings at the generator presented in the DSMDS report to compare the values. An easy access to Nova Scotia Power's rate in the DSMDS report would then be very helpful in establishing the corresponding line loss factor.
- › **Explaining the diversity factor value used in peak demand savings calculations:** In 2014, the report included the addition of a diversity factor for each measure. It is good practice that this factor be explicitly defined on an individual measure basis. To facilitate the task of validating this value for the Evaluator, it would be advisable to add a field where the calculation or assumptions are explained in a few words.

4 IMPACT EVALUATION

The objective of the 2014 Custom NC impact evaluation was to determine the gross and net savings. Both electrical energy and peak demand savings were estimated by analyzing the following:

- › Feasibility studies, building energy model simulation reports and any other relevant technical reports provided that calculated the potential energy savings generated by the proposed energy efficiency measures incorporated into the building design;
- › ENSC's reports on M&V activities undertaken after building construction;
- › Results of the in-depth interviews conducted with participants during on-site visits;
- › Findings and observations from the billing calibration with past participants of Custom NC;
- › Free-ridership.

The approach for the Custom NC impact evaluation consisted of an in-depth technical review of nine project files followed by on-site visits and participant interviews.

4.1 Gross Savings

Under the 2014 impact evaluation, the Evaluator calculated the gross energy and peak demand savings for all the nine sampled projects in accordance with the specifics of each project. These results were then compared to the gross savings presented in the tracking sheet, and appropriate adjustment factors were determined for the energy and peak demand savings of each project. A weighted average was used to calculate the overall energy and peak demand savings adjustment factors for all the Custom NC projects. These two overall adjustment factors determined the adjusted gross energy and peak demand savings for all the 2014 Custom NC projects.

The next three subsections describe in greater detail the approach followed by the Evaluator to assess the gross savings achieved under Custom NC in 2014.

4.1.1 Adjustment Methodology

Nine on-site visits were conducted with the intent of confirming that the tracked savings recorded in the DSMDS were appropriate and accurate using a similar approach than the one used in 2013. The on-site visits allowed the Evaluator to visually verify the technical specifications of energy-efficient equipment and the building envelope as recorded in the project documentation. Operational factors, including hours of use, equipment/building schedules, expected occupancy categories and set-point changes, were recorded based on contact interviews and used to determine adjustment and diversity factors for each project.

The gross savings calculations for the NCEM projects were completed using information provided by ENSC, and information collected during the on-site visits. Since each of the NCEM projects was unique, the Evaluator followed a customized approach to validate the tracked gross savings for each

site. The analysis approach was adjusted to accommodate the complexity of individual projects, the type of technical evaluation performed by the program participant (feasibility study, energy modelling, etc.), the types of energy efficiency measures implemented and the results of documented M&V activities.

In reviewing the projects, the following elements were considered:

- › **Baseline used:** The Evaluator reviewed the baseline assumptions for each project, as documented in ENSC's NC-EM2 forms. Validation of the project baselines was performed through the participant interview portion of the on-site visits.
- › **Equipment specification:** As part of the on-site visits the Evaluator verified that the documented equipment installed in the new building corresponded to the specifications used in calculations. In most cases the consultant's modelling summary report provided this information. In several instances, however, the shop drawings and specification sheets for the energy efficient upgrades were loaded in the DSMDS.
- › **Installation Rate:** Where possible, the Evaluator visually verified the quantity of each energy efficiency measures installed in the newly constructed building, including mechanical equipment, appliances, lighting, and envelope specifications.
- › **Hours of Operation:** Operating schedules of all energy-efficient equipment described in the simulation reports and feasibility studies were noted in the on-site protocol, and confirmed on-site with project representatives, and/or site contacts
- › **Diversity Factor:** The annual operating schedules of the new building were confirmed by site contacts during the visits and used to calculate a diversity factor based on the peak demand period (weekday hours of 5:00 p.m. to 7:00 p.m. for the months of December, January and February).
- › **M&V procedures:** M&V plans and activities were reviewed for all nine of the projects included in the 2014 sample. Focus was placed on assessing the normal practices of ENSC, identifying adjustments made post-implementation and documenting areas of potential improvement

4.1.2 Billing Calibration with Past Participants

As part of this year's impact evaluation, seven past participants of Custom NC were selected to validate the accuracy of the building energy simulations against actual billing data. The building energy simulations are a requirement of NC and are used by the Program Manager in the incentive calculations.

The building energy simulations provide an analysis of a reference building versus the proposed building. Typically the type and efficiency of the heating, ventilation and air conditioning (HVAC) equipment, the lighting density, and the service water usage of the reference building are based on the Model National Energy Code for Buildings (MNECB 1997). The energy modeller then models the proposed building as per the design intent and/or the construction drawings.

One of the energy simulation outputs is the monthly energy consumption value per fuel type for both the reference building and the proposed building. When available, these monthly electrical consumption values were used to compare the results of the energy simulation to the actual electrical billing data for a 12-month period. The files of only two participants contained both the monthly energy simulation results and 12 months of actual electrical consumption. The other five participants were either missing some of the actual billing data or the monthly simulation results. In these cases, the annual energy consumption from the simulation was used for the calibration.

To perform the calibration, the Evaluator used a regression analysis to determine the relationship between the heating degree-days (HDD) and the actual energy consumption. The Coefficient of Variation of the Root Mean Squared Error (CV [RMSE]) was calculated and compared to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Guideline 14-2002, "Measurement of Energy and Demand Savings". The guideline states that comparing monthly data is not as accurate as comparing hourly data; it does however consider a CV(RSME) value between 5 and 15 percent to be acceptable when using monthly data. It was also compared to the IPMVP recommendation of less than 5 percent.

The Evaluator performed the following steps to complete the analysis:

- › Compiled the actual billing data and energy simulation results in an Excel spreadsheet;
- › Collected historical monthly climate data, specifically heating-degree-days, for each location using RETScreen Plus®;
- › Collected actual monthly heating-degree-days for the billing period and location using a government website;
- › Performed a regression analysis on each participant's actual monthly consumption to generate the linear regression equation;
- › Entered the historical monthly climate data (independent x-variable) into the linear regression analysis to predict the new consumption (y-variable);
- › Calculated the CV(RSME) using the standard error of the prediction divided by the average energy use;
- › Based on an acceptable t-statistic range, the HDD was deemed to be statistically significant or not; and
- › Calculated the percent difference between the simulated energy consumption and the predicted consumption.

The table below presents the results of these calculations.

Table 2: Comparison of Regression Analysis Statistics

Participant (#)	R-squared ¹	CV(RSME) ²	t-statistic ³	Significance	Reg Diff. ⁴	Real Diff.	Bldg Function
1	0.84	0.07	9.84	Highly	*60%	52%	Office Bldg
2	0.19	0.08	-0.84	Not	3%	*-13%	Lab, offices, pool
3	0.47	0.20	2.32	Slightly	*4%	N/A	Recreation Centre
4	0.70	0.44	4.07	Highly	*-42%	-43%	Office/Class-room Bldg
5	0.01	0.46	-0.26	Not	17%	*29%	Office Bldg
6	0.02	0.34	-0.66	Not	-5%	*2%	MURB
7	0.20	0.16	2.50	Slightly	-26%	*-31%	Office Bldg

The results indicate that

- 1 none of the seven participants meet all the generally accepted IPMVP standards for a satisfactory regression analysis;
- 2 only two participants have an R² value indicative of energy consumption correlated to the number of HDD;
- 3 four of the projects had an excessive over- or underestimation of the building consumption (industry standard typically varies +/-15 percent between the predicted and modeled results);
- 4 the office building type had the greatest variance between the simulation results and the actual billing data.

There could be several reasons for the participants to experience a significantly different actual consumption than the simulation results. These reasons could include, but are not limited to:

- › insufficient data points for the actual consumption;
- › occupancy levels during the billing periods;
- › amount and quality of building commissioning that has occurred;
- › whether the energy simulation was based on the as-built conditions or on the preliminary design; and
- › influence of the occupants on the building systems.

¹ IPMVP Recommends >0.75

² IPMVP Recommends <0.05

³ IPMVP Recommends <-2 or >2

⁴ Percent difference is calculated based on the regression energy predictions and the building energy model results.

As the Evaluator has not performed on-site visits with all of these participants, only specific comments can be made for some of the results and are as follows:

- › Participant no. 1 was a targeted LEED building.
- › No information was known about Participant no. 2 except that it was a targeted LEED building.
- › Participant no. 3 planned to hire a commissioning agent for a year post-occupancy.
- › No information was known about Participant no. 4.
- › Participant no. 5 had very low tenancy at the time of the on-site visit (November 2013), which may explain its low consumption value.
- › Participant no. 6 was a LEED Gold-certified building and the tenants are able to view their own energy consumption.
- › Participant no. 7 was a LEED building but indicated that there were unresolved heating and cooling conflicts at the time of the on-site visit (December 2012).

To improve the accuracy of the energy simulations, the Evaluation makes the following recommendations:

- › A final energy simulation submission could be required and would be based on the as-built conditions.
- › Enhanced building commissioning could be a requirement of the NC initiative.
- › Projects from 2011 should be included as to increase the availability of energy consumption data.
- › The impact evaluation could include a full energy simulation review to ensure the accuracy of the model inputs.

In summary, the Evaluator is unable to make a conclusive declaration about the accuracy of the NC energy simulations due to the sample size and availability of both the billing data and the monthly simulation results.

4.1.3 Adjusted Gross Savings

The 2014 gross energy savings presented in the ENSC tracking sheet for each project visited were individually revised according to the adjustments identified by the Evaluator. Adjustment calculations were performed for each of the nine projects, in order to improve the accuracy of the overall adjustments applied to Custom NC. Because the sample of projects visited for Custom NC in 2014 only included nine of the final thirteen completed projects, a weighted adjustment factor was calculated based on the reviewed projects and then applied to all thirteen projects

For most projects, the on-site visits did not reveal any significant discrepancies between the installed measures and those included in the simulations. For one project, a significant adjustment factor was applied as the building was a LEED® NC certified building, and the baseline adjustment methodology,

as described in the Custom NC Program Manual, was not followed. Consequently, a ratio of cost savings was used to modify the baseline so it would meet the minimum energy performance required by LEED NC (23% more efficient than NMECB 1997). The only other significant adjustment was made for a project where all lighting was listed as CFL, and on-site visits showed that only incandescent lighting was installed. For other projects, some smaller adjustments were made to lighting counts, appliance ratings and operating schedules.

Evaluating the peak demand savings for NC projects proved more difficult because many of the documented building simulation reports and feasibility studies provided limited information about the model assumptions. In most cases, the ideal information required for demand calculations from energy models studies is the month-by-month consumption profiles common to most modelling software suites. The Evaluator did not adjust peak demand savings for projects lacking adequate information.

Similar to the energy savings adjustments, most of the nine projects in the sample did not require any significant adjustment. Two of the projects had adjustments made due to apparent clerical errors, which were overridden so as not to skew the overall adjustment factor. Of the nine projects, significant adjustments were made to the peak demand savings of three projects, with one of the three being the LEED® EAp2 adjustment described above. The remaining two adjustments were based on changes to the initial scope of measures installed and updates to appliance ratings.

Calculation of Adjusted Gross Savings

To calculate the adjustment ratio, the Evaluator used eight of the nine projects reviewed. The LEED project savings that had not been adjusted to take into account the LEED energy performance requirements was considered to be an outlier, as this error could not have happened for other projects (this project was the only one aiming for a LEED certification this year). Consequently, the adjustments for this project were made separately from the adjustment ratio.

Based on the remaining eight projects, an adjustment ratio of 0.982 was calculated for gross energy savings, and of 0.976 for gross peak demand savings.

It is worth noting that all the gross impact assessments described by the Econoler team in this report have already taken into account, on an individual project basis, the interactive effects on space heating and cooling systems, as well as the diversity factor. There is no need for additional calculations regarding these aspects of project impact calculations.

The details of the energy and peak demand savings calculated for Custom NC are presented in the following table, which indicates the savings at the meter as well as at the generator. Savings at the generator level were calculated using the line loss factor of each participant based on the transmission and distribution losses on the grid, according to the rate codes each project is assigned by Nova Scotia Power. For reference purposes, the weighted average line loss factors of NC as a whole is also presented in Table 3.

The 2014 overall gross energy savings for Custom NC are estimated at 6.257 GWh at the meter and 6.656 GWh at the generator. The total gross peak demand savings are respectively estimated at 2.367 MW at the meter and 2.517 MW at the generator. It should be noted that the adjustment ratios presented in this table do not correspond to those presented in Table 3, as they include both the adjustment ratio calculated in and the isolated adjustment that was made on the LEED project.

Table 3: Evaluation Results – Gross Energy and Peak Demand Savings

Program Path	Total for all NC Projects
Number of Projects	13
Program Tracking Sheets	
Total Tracked Energy Savings – at meter (GWh)	6.696
Total Tracked Demand Savings – at meter (MW)	2.462
Total Tracked Energy Savings – at generator (GWh)	7.122
Total Tracked Peak Demand Savings – at generator (MW)	2.180
Evaluated Energy Savings	
Adjustment Ratio on Energy Savings	0.934
Total Gross Energy Savings – at meter (GWh)	6.257
Average Line Loss Factor	1.064
Total Gross Energy Savings – at generator (GWh)	6.656
Evaluated Peak Demand Savings	
Adjustment Ratio on Demand Savings	0.961
Total Gross Peak Demand Savings – at meter (MW)***	2.367
Average Line Loss Factor	1.064
Total Gross Peak Demand Savings – at generator (MW)	2.517

4.2 Net-to-Gross Ratio

To correctly estimate net savings, the Evaluator needs to calculate the difference between the energy consumption of the hypothetical building that would have been built in the absence of the program, and the more efficient building that was constructed because of the said program. In 2013, the difference between the current practice and the buildings that would have been built in the absence of the program was calculated through a self-report approach, where the participant was asked which proportion of the energy efficient measures he would have implemented without the incentive and technical support of ENSC. Using the free-ridership level obtained from this approach, a net-to-gross ratio (NTGR) value was then calculated.

As mentioned previously, in 2014, ENSC changed its approach and now takes into account the original design intention of the participants when establishing the baseline, rather than assuming that the baseline is the current practice (i.e. MNECB 1997.) This has significantly reduced the gross savings for many projects. Indeed, for four of the nine projects reviewed, the baseline was more energy efficient than the MNECB by a margin of 23 percent to 50 percent.

Since the Evaluator was not made aware of this new approach before conducting the on-site visits and participant interviews, the same questionnaire as in 2013 was used for the assessment of free-ridership. This questionnaire refers to the energy efficiency measures implemented in general, and not to the additional measures with respect to the adjusted baseline. However, applying a free-ridership ratio is not applicable in 2014, since it would go against ENSC new approach of defining a specific baseline for each participant. Indeed, calculating savings using a specific baseline for each participant can be another acceptable approach to directly obtain net savings. The Evaluator thus elected to calculate the New Construction net savings using the evaluated adjusted savings, without applying any free-ridership.

It should be noted that if ENSC conserved this approach for future year, the evaluation methodology will need to be changed. A focus will have to be put on validating the baseline adjustments defined by ENSC for each participants during the site visits and calculating a net savings adjustment ratio if any discrepancies are observed.

4.3 Net Savings

As explained in the previous section, in 2014, savings were obtained in a way that directly yielded net savings. Consequently, the net-to-gross ratio has a value of 1.00. The following table compares the net energy savings values calculated in the previous table and the program tracked net savings for 2014.

Table 4: Comparison of Tracked and Evaluated Savings at the Generator

	Initial Gross Savings	Adjusted Gross Savings	NTGR	Net Savings
Energy Savings				
Tracked Savings from ENSC	7.122 GWh	7.122 GWh	1.00	7.122 GWh
Evaluation Results	7.122 GWh	6.656 GWh	1.00	6.656 GWh
Peak Demand Savings				
Tracked Savings from ENSC	2.619 MW	2.619 MW	1.00	2.619 MW
Evaluation Results	2.619 MW	2.517MW	1.00	2.517 MW

As shown in the table above, adjustments made to both gross energy and peak demand savings this year were relatively small. Only two projects out of the nine projects included in the sample were subjected to significant adjustment ratios, in one case to apply the LEED energy performance

requirement to the baseline, and in the other, to account for incandescent lighting in place of the CFLs modelled in the energy simulation. For other projects, adjustment ratios were smaller or, in three cases out of nine projects visited, nil. This year, ENSC included a diversity factor in their tracked peak demand calculation. As a result, the Evaluator did not have to make sizable adjustments to calculate peak demand savings, as was the case in 2013.

CONCLUSION

Custom NC saw a total of 13 projects implemented in 2014, which represents a small decrease over the 15 projects implemented in 2013. However, the 2014 project count is higher than the number of projects carried out in 2012 (8) and 2011 (9), which indicates that Custom NC is maintaining its level of participation.

The 2014 evaluation of Custom NC demonstrated that the program component generated net energy savings of 6.656 GWh, and peak demand savings of 2.517 MW at the generator. In comparison, Custom NC had net energy savings of 7.477 GWh and peak demand savings of 2.122 MW in 2013, and respectively 4.644 GWh and 0.525 MW in 2012. The small drop in annual savings can be attributed to the small reduction in participants over 2013.

A total of nine site visits were carried out in 2014. The results of the site visits were used in combination with the project information provided by ENSC to validate and adjust the tracked savings. To calculate the savings of Custom NC in 2014, the Econoler team revised the gross energy and peak demand savings for all of the sampled projects in accordance with the specifics of each project. The team calculated adjustment factors to be applied to all 2014 Custom NC projects, resulting in adjusted gross energy and peak demand savings. Overall, Custom NC showed solid results that exceeded ENSC's annual target. The adjustments made to the 2014 sample were relatively small, which indicates that the majority of projects are being carried out as submitted.

Due to ENSC's new approach of defining a specific baseline for each participant, no free-ridership was applied as part of the 2014 evaluation. The net savings were therefore equivalent to the adjusted gross energy and peak demand savings.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix presents all recommendations made by the Evaluator throughout the report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Gather more data to conduct a conclusive calibration billing analysis in 2015. Despite the fact that 23 projects were completed in 2012 and 2013, it was only possible to obtain sufficient energy billing data for seven projects to perform a calibration analysis in 2014. This calibration analysis proved to be inconclusive due to numerous factors. The Evaluator consequently suggests that this evaluation activity be continued in future evaluation. Other measures could be taken to ensure the quality of the result, such as requiring a final energy simulation submission (based on the as-built conditions), making enhanced building commissioning a mandatory element of Custom NC and/or including a full energy simulation review to ensure the accuracy of the model inputs.
	2 Adopt the National Energy Code for Buildings (NECB) 2011 as a baseline for all new projects in 2015. The literature review conducted as part of 2013 evaluation revealed that more stringent baseline construction designs are currently being used in similar new construction programs in other Canadian jurisdictions. Moreover, the NECB is now enforced in large buildings as of January 2015 in Nova Scotia. Therefore, the Evaluator reiterates their 2013 recommendation of updating the baseline used for calculating savings. Noteworthy is that the eligibility criteria Custom NC should also be modified in accordance with this change to baseline construction design.
	3 Explain the diversity factor value used in peak demand savings calculations. In 2014, the report included the addition of a diversity factor for each measure. It is good practice that this factor be explicitly defined on an individual measure basis. To facilitate the task of validating this value for the Evaluator, it would be advisable to add a field where the calculation or assumptions are explained in a few words.
Tracking System	4 Adding the Nova Scotia Power's rate code to the DSMDS report: While the Nova Scotia Power's rate code is entered into the DSMDS, it does not appear in the Evaluation Report. As the information contained in the project feasibility studies, M&V reports and other technical documents is always expressed in terms of energy and demand savings at the meter, the Evaluator needs to apply the correct line loss factor to the savings at the generator presented in the DSMDS report to compare the values. An easy access to Nova Scotia Power's rate in the DSMDS report would then be very helpful in establishing the corresponding line loss factor.
Impact Evaluation	5 To improve the accuracy of the energy simulations, the Evaluation makes the following recommendations: › A final energy simulation submission could be required and would be based on the as-built conditions. › Enhanced building commissioning could be a requirement of the NC initiative. › Projects from 2011 should be included in the calibration study as to increase the availability of energy consumption data. › The impact evaluation could include a full energy simulation review to ensure the accuracy of the model inputs.

APPENDIX II

ALGORITHM FOR IMPACT CALCULATION

This appendix provides a sample of the step-by-step calculations used to adjust the tracked savings results for one of the sample projects reviewed in the impact evaluation of New Construction. The algorithm presented is based on an adjustment made to the tracked appliance energy savings values, for which savings were calculated separately from the building energy simulation file. A similar adjustment was made to four of the nine projects in the Custom NC sample.

In the next subsections, the following will be presented and discussed:

- › savings calculation used by the participant to determine the tracked savings;
- › calculation used to adjust tracked savings estimated by ENSC; and
- › revised savings results presented in this evaluation, based on on-site visit results and documentation analysis.

Savings Equations

Tracked Appliance Energy Savings

$$= (2004 \text{ EnerGuide Average Annual Appliance Consumption} \\ - \text{Proposed EnerGuide Appliance Consumption}) \times \text{Number of Appliances}$$

Revised Appliance Savings

$$= (2004 \text{ EnerGuide Average Appliance Consumption} \\ - \text{Actual EnerGuide Appliance Consumption}) \times \text{Number of Appliances}$$

Adjustment to Tracked Energy Savings

$$= \text{Revised Appliance Energy Savings} - \text{Tracked Appliance Energy Savings}$$

Where:

- › 2004 EnerGuide average annual consumption for fridges = 465 kWh/year
- › Proposed EnerGuide appliance consumption for fridges = 383 kWh/year
- › Actual EnerGuide appliance consumption for fridges = 455 kWh/year
- › 2004 EnerGuide average annual consumption for stoves = 622 kWh/year
- › Proposed EnerGuide appliance consumption for stoves = 485 kWh/year
- › Actual EnerGuide appliance consumption for stoves = 563 kWh/year
- › Number of appliances equalling the number of apartments = 54

APPENDIX III ON-SITE VISIT SAMPLING AND PROTOCOL

The 2014 Custom NC impact evaluation was mandated to conduct on-site visits, including an assessment of the free-ridership levels. The sampling methodology is presented in the following section, along with an explanation of the on-site visit protocol used to conduct the visits.

Sampling Methodology

The Evaluator received the first Custom NC tracking sheet in October 2014. At that point in time the tracking sheet contained only six projects, and therefore comprised the entire available sample. In November a second tracking sheet was provided by ENSC, which contained a total of nine Custom NC projects. The initial mandate required a sample size of ten projects; the additional three projects were immediately added to the sampling plan. Since there were less than the mandated ten projects completed under Custom NC for 2014 at the time of the selection, no decision criteria were required to determine the best sample. Instead, all projects in ENSC's November tracking sheet were used as the sample population.

Table 5: Final Sample for Custom NC⁵

Description	Number of Projects	Expected Gross Energy Savings at the Meter (GWh/yr)	Expected Gross Demand Savings at the Meter (MW)
Sample	9	3.977	1.343
Final Tracked Projects	13	6.696	2.462

On-site Visit Protocol

The Evaluator reviewed the protocol used in 2013 and deemed it appropriate for the 2014 impact evaluation, with the exception of minor adjustments. These adjustments included a space allocated for a list of the project's key variables, and a checkbox for the free-ridership questionnaire completion.

⁵ As of January 9, 2015.

As in previous years, three primary tools were used for preparing and conducting the visits: the on-site protocol, ENSC's electronic project files stored in the DSMDS and the free-ridership questionnaire. The on-site protocol was designed as a standardized form used for the collection of the following information:

- › project name and contact details;
- › building space heating and cooling systems used for the evaluation of interactive effects;
- › facility's normal hours of operation and annual operating days;
- › collection of the actual electricity consumption and demand from utility bills (if possible) to compare with the building simulation model outputs;
- › pre-visit summary section for the Evaluator to identify key items requiring validation while on-site;
- › on-site observations and findings to be used by the Evaluator for the final evaluation of project savings.

The pre-visit assessment portion of the protocol allowed the Evaluator to review and summarize ENSC's project documents taken from the DSMDS. The process gave the Evaluator the opportunity to prepare questions and outline key elements of the project prior to arriving on site. These files typically included items such as the initial energy model results, M&V reports, the Project Development Agreement (PDA), email correspondence and equipment drawings/specifications.

The Evaluator used the provided information to create a list of key project variables and recorded this in the protocol sheet. Upon arrival at the site, the Evaluation team confirmed the key items through face-to-face participant interviews visual confirmation of the nameplate information on equipment, installed quantities, and where available, building automation schedules. The collection of on-site information was carried out in accordance with engineering best practices and based on ASHRAE's commercial energy audit guidelines.

The free-ridership questionnaire was designed to evaluate the level of free-ridership by Custom NC participants. The questionnaire included questions about the client's design intent, the impact that Custom NC funding played in making the building more efficient and an assessment of how the project would have proceeded without assistance from ENSC. The results from the questionnaires were subsequently compiled and used to calculate the overall level of free-ridership in Custom NC for 2014.

1. General Information

Site Visit Date: _____	Contact Name: _____								
Project ID: _____	Contact Title: _____								
Project Type: _____	Contact Phone: _____								
Project Status: _____	Email: _____								
Project Name: _____	_____								
Address: _____	_____								
List of people met during the visit: _____									

Type of building:	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Commercial/institutional</td> <td style="width: 20px;"></td> <td style="padding: 2px;">Industrial/manufacturing</td> <td style="width: 20px;"></td> </tr> <tr> <td style="padding: 2px;">Municipal</td> <td></td> <td style="padding: 2px;">Other (specify)</td> <td></td> </tr> </table>	Commercial/institutional		Industrial/manufacturing		Municipal		Other (specify)	
Commercial/institutional		Industrial/manufacturing							
Municipal		Other (specify)							
	Specify: _____								

2. Key Project Variables

Variable Descriptions: *List key project variables.*

NOTE: PC Users "Alt+Enter" for new line in cell. MAC Users "CMD+Option+Enter".

3. Facility Operation Schedules

Facility Description: *Outline a quick description of the facility and its primary operation/purpose.*

NOTE: PC Users "Alt+Enter" for new line in cell. MAC Users "CMD+Option+Enter".

Facility Annual Schedule:

Fill the table below for each occupancy schedule reported by the site contact as occupancy could vary for each section of the facility. Use additional sheets if necessary.

Description	1 - Normal Schedule		2 - Specify:		3 - Specify:	
	Weekdays	Weekends	Weekdays	Weekends	Weekdays	Weekends
Number of day with regular schedule per year						
Number of day with regular holidays schedule per year						
Number of days with no occupancy per year (For example: seasonal closure)						
Total number of day per year	0	0	0	0	0	0

Total=261 Total=104

Facility Daily Schedule:

Fill the table below for each occupancy schedule reported by the site contact as occupancy could vary for each section of the facility. Use additional sheets if necessary.

Schedules		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Holidays
Schedule 1: Normal	Time of use (e.g. 8:00 am to 5:00 pm)								
	Hours per day								
Schedule 2 (specified above)	Time of use								
	Hours per day								
Schedule 3 (specified above)	Time of use								
	Hours per day								

4. Building Heating/Cooling System Description

Heating Systems

Fill the table below for each heating system at the site.

Description	Heating System 1	Heating System 2	Heating System 3	Heating System 4
Energy Source				
Heating System Type				
Nominal Capacity				
Efficiency or COP				
If any, changes in building set points (occ./ unocc. temp., % hum)				

Cooling Systems

Fill the table below for each cooling system at the site.

Description	Cooling System 1	Cooling System 2	Cooling System 3	Cooling System 4
Energy Source				
Cooling System Type				
Nominal Capacity				
SEER or COP				
If any, changes in building set points (occ./ unocc. temp., % hum)				

5. Electricity Consumption

Electric company: _____

Electricity Rate: _____

Electricity Tariff: _____

Month	Number of Days	Energy (kWh)	Peak Demand (kW)	Total Cost (\$)
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

6. Pre-Visit Assessment of the Project

Indicate the key observations from the feasibility study and M&V report analysis. These notes will serve on site to guide the visit and identify the main information to collect and/or verify.

7. On-Site Observations and Findings

Report the on-site visit and indicate the key observations and findings made on site.

8. Free-Ridership Assessment

Free Ridership Questionnaire Completed? ☐ (Y/N)

9. Energy and Demand Savings Adjustments

Energy Savings from Tracking Sheet:	#REF! #####	kWh/yr
Demand Savings from Tracking Sheet:	0,0	kW
Diversity Factor Used by ENSC:	-	

Adjustment from the Evaluator

Adjustment - M&V Energy Savings:	#REF!
Adjustment - M&V Demand Savings:	0%
Diversity Factor Used by Econoler:	-

Project Estimated Finish Month:	#REF!
Notes on Project Status:	#REF!

Final Project Impacts at the Meter

Evaluated Energy Savings:	-	kWh/yr
Evaluated Demand Savings:	-	kW

10. Additional Notes



ECONOLÉR

BUSINESS ENERGY SOLUTIONS

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION

Final Report

February 26, 2015



ABBREVIATIONS

BEF	Ballast Efficacy Factor
BER	Business Energy Rebate
BES	Business Energy Solutions
CATI	Computer-assisted Telephone Interviewing
CDI	Commercial Direct Install
CFL	Compact Fluorescent Lamp
CRA	Corporate Research Associates
DA	Delivery Agent
DSM	Demand-side Management
DSMDS	Demand-side Management Data System
ECM	Electronically Commutated Motor
ENSC	Efficiency Nova Scotia Corporation
HSPF	Heating Seasonal Performance Factor
LED	Light Emitting Diode
MURB	Multi-Unit Residential Buildings
NTGR	Net-to-Gross Ratio
OPA	Ontario Power Authority
QA	Quality Assurance
RP&C	Rental Properties and Condos
SEER	Seasonal Energy Efficiency Ratio
TRM	Technical Reference Manual

DEFINITIONS

Accuracy	Reflects the proximity of measurements to the true value.
Bias	Systematic deviations of measurements from the true value.
Confidence interval	The estimated range of values which is likely to include the unknown population parameters.
Base case	A base case details the information on how assumed gross savings used in the tracking sheet have been established. Usually, these savings are calculated with a series of variables such as hours of operation, wattage or base consumption.
Distortion effects	A variety of effects that affect the energy savings generated by a program. Distortion effects may be of different natures, e.g., behavioral or market-related. The most frequently considered distortion effects are free-ridership and internal spillover.
Diversity factor	The ratio of the sum of the individual maximum demands of the various subsystems to the maximum demand of the whole system.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
Evaluation plan	The evaluation plan summarizes the program description, objectives, base cases, documentation, evaluation methodology, budget and schedule.
Free-ridership	Percentage of savings attributable to participants who would have implemented the same or similar energy efficiency measures, with no change in timing, in the absence of the program.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Interactive effects	Interactive effects occur when the installation of an energy efficiency measure has an impact on the energy consumption of other elements in the facility such as heating and cooling.
Internal spillover	Savings attributable to participants who continue to implement the energy efficiency measures introduced by a program after participating in it once, without participating in the program a second time.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Margin of error	The amount of random sampling error.
Net energy savings	Energy savings generated by energy efficiency measures after applying interactive effects and distortion effects.

Net-to-gross ratio	The ratio between the net energy savings and gross energy savings.
Non-sampling error	Errors arising during the course of all survey activities other than sampling. Non-sampling errors tend to lead to bias in measurements and are very difficult to quantify.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Precision	The extent to which repeated measures agree with one another.
Random sampling error	The error in measurement due to the fact that measures are taken from a subset of the population and not the entire population.
Sample size	The number of observations or replicates included in a statistical sample.
Tracked savings	Gross and net savings calculated by ENSC in the program tracking sheet, using the current participation data and parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) from the most recent evaluation.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	IX
1 PROGRAM DESCRIPTION	1
2 METHODOLOGY	3
2.1 Presentation of the Team.....	3
2.2 Evaluation Activities	3
2.2.1 On-site Visits.....	4
2.2.2 Surveys.....	4
2.2.3 Unitary Savings Review	5
3 PROCESS EVALUATION	6
3.1 Participation in BES	6
3.2 Tracking System	7
3.3 On-site Visit during the Installation Process.....	10
4 MARKET EVALUATION	12
4.1 Participant Perspectives.....	12
4.1.1 Motivations and Barriers to Participation	12
4.1.2 Satisfaction with BES	15
4.1.3 Recommendations for Improvement	16
5 IMPACT EVALUATION	17
5.1 Gross Energy Savings	17
5.1.1 Unitary Savings for BES Lighting Measures.....	18
5.1.2 Unitary Savings for BES Non-lighting Measures	23
5.1.3 Unitary Savings for RP&C Common Areas	28
5.1.4 Unitary Savings for LED Blitz Pilot	32
5.2 Gross Peak Demand Savings.....	35
5.3 Revised Gross Savings.....	36
5.3.1 Revised Gross Savings for BES Lighting Measures	36
5.3.2 Revised Gross Savings for BES Non-lighting Measures	39
5.3.3 Revised Gross Savings for RP&C Common Areas	41
5.3.4 Revised Gross Savings for LED Blitz	44
5.4 Interactive Effects	46
5.4.1 Interactive Effects for BES Lighting Measures.....	46
5.4.2 Interactive Effects for BES Non-lighting Measures	48
5.4.3 Interactive Effects for RP&C Common Areas	49
5.4.4 Interactive Effects for LED Blitz	49

5.5	Net-to-Gross Ratios	49
5.5.1	Net-to-Gross Ratio for BES	49
5.5.2	Net-to-Gross Ratio for RP&C Common Areas	50
5.5.3	Net-to-Gross Ratio for the LED Blitz Pilot	51
5.6	Net Savings	51
5.6.1	Net Savings for BES Lighting Measures	51
5.6.2	Net Savings for BES Non-lighting Measures	54
5.6.3	Net Savings Associated with RP&C Common Areas	55
5.6.4	Net Savings Associated with LED Blitz	58
6	OVERALL BES RESULTS	62
	CONCLUSION	63
	APPENDIX I 2014 RECOMMENDATIONS	64
	APPENDIX II ON-SITE VISIT SAMPLING AND PROTOCOL - DURING THE INSTALLATION	67
	APPENDIX III ANNUAL PARTICIPANT SURVEY QUESTIONNAIRE	69
	APPENDIX IV ANNUAL PARTICIPANT SURVEY RESULTS	81
	APPENDIX V QUARTERLY PARTICIPANT SURVEY QUESTIONNAIRE	89
	APPENDIX VI QUARTERLY PARTICIPANT SURVEY RESULTS	98
	APPENDIX VII ALGORITHM FOR FREE-RIDERSHIP CALCULATION (BES)	105
	APPENDIX VIII INTERNAL SPILLOVER METHODOLOGY (BES)	106
	APPENDIX IX ALGORITHM FOR FREE-RIDERSHIP CALCULATION (RP&C)	107
	APPENDIX X CALCULATION EXAMPLE	108
	APPENDIX XI ON-SITE VISIT SAMPLING AND PROTOCOL – AFTER INSTALLATION	111

LIST OF TABLES

Table 1: Distortion Effects and Net-to-Gross Ratio.....	xi
Table 2: Overall Comparison of Tracked and Evaluated Savings at the Generator for BES	xii
Table 3: Annual Survey Sample Size and Margin of Error.....	4
Table 4: Quarterly Survey Sample Size and Margin of Error	5
Table 5: Reasons for Participating	12
Table 6: Barriers to Participation	13
Table 7: Specific Barriers to Participation.....	14
Table 8: Satisfaction with BES Overall	15
Table 9: Time Waited to Receive Contract.....	15
Table 10: Recommendations for Improvement.....	16
Table 11: Installation Rates for BES Lighting Measures.....	23
Table 12: Unitary Savings Values for Each Type of CFLs	30
Table 13: Unitary Savings Values for Each Type of LED Lamps	31
Table 14: Tracked Unitary Savings Values for Each LED Lamp Category	33
Table 15: Calculation of Unitary Savings Associated with Faucet Aerators	35
Table 16: Evaluation of Gross Energy and Peak Demand Savings Associated with BES Lighting Measures	38
Table 17: Evaluation of Gross Energy and Peak Demand Savings Associated with BES Non-lighting Measures	40
Table 18: Evaluation of Gross Energy and Peak Demand Savings Associated with RP&C Common Areas (CFLs).....	42
Table 19: Evaluation of Gross Energy and Peak Demand Savings Associated with RP&C Common Areas Measures (Other Products).....	43
Table 20: Evaluation of Gross Energy and Peak Demand Savings Associated with LED Blitz Lighting Measures	45
Table 21: Evaluation of Gross Energy and Peak Demand Savings Associated with LED Blitz Non-lighting Measures	46
Table 22: Interactive Effects Calculation for Indoor Lighting Products	47
Table 23: Average Interactive Effect Factors for Lighting Products	47
Table 24: Interactive Effect Factor for Hot Water Tank Wraps, Pipe Insulation, Hot Water Heat Pumps, and Vending Machine Misers	48
Table 25: Evaluation of Net Energy and Peak Demand Savings Associated with BES Lighting Measures	52
Table 26: Comparison of Tracked and Evaluated Savings Associated with BES Lighting Measures at the Generator	53
Table 27: Evaluation of Net Energy and Peak Demand Savings Associated with BES Non-lighting Measures	54
Table 28: Comparison of Tracked and Evaluated Savings Associated with BES Non-lighting Measures at the Generator.....	55
Table 29: Evaluation of Net Energy and Peak Demand Savings Associated with RP&C Common Areas (CFLs).....	56
Table 30: Evaluation of Net Energy and Peak Demand Savings Associated with RP&C Common Areas (Other Products).....	57
Table 31: Comparison of Tracked and Evaluated Savings Associated with RP&C Common Area Measures at the Generator.....	58

Table 32: Evaluation of Net Energy and Peak Demand Savings Associated with LED Blitz (Lighting Measures).....	59
Table 33: Evaluation of Net Energy and Peak Demand Savings Associated with LED Blitz (Non- lighting Measures)	60
Table 34: Comparison of Tracked and Evaluated Savings Associated with LED Blitz at the Generator	60
Table 35: Overall Comparison of Tracked and Evaluated Savings at the Generator for BES	62

LIST OF FIGURES

Figure 1: Methodological Model	3
Figure 2: Participation in BES	6
Figure 3: Light Output Equivalency for Incandescent Lamps and CFLs	29

EXECUTIVE SUMMARY

This report presents the results of the 2014 evaluation of Business Energy Solutions (BES), which is the sole component of the Direct Installation program. The 2014 evaluation was based on 55 on-site visits, including five with delivery agents (DAs), an annual and a quarterly telephone survey of 62 and 129 participants respectively, and a unitary savings review.

Program Component Overview

BES offers a complete turnkey implementation, including a free on-site energy assessment of energy-efficient lighting and non-lighting measures to small businesses across Nova Scotia. Eligible businesses pay a portion of the installation and materials costs, while the remaining portion is paid by Efficiency Nova Scotia Corporation (ENSC).

BES offers a wide variety of energy-efficient measures, such as:

- › efficient lighting measures
- › occupancy sensors and lighting controls
- › ductless mini split heat pumps
- › electronically commutated motors (ECMs)
- › outside air economizers
- › hot water heat pumps
- › hot water tank wraps
- › pipe insulation
- › spray valves
- › faucet aerators
- › vending machine misers

In 2012 and 2013, BES carried out a Light Emitting Diode (LED) Blitz pilot, which targeted facilities using more than 350,000 kWh annually, such as shopping malls. This pilot replaced incandescent and halogen light bulbs with LEDs, and offered to install water-related measures free of charge for electrically heated water. The unfinished measures from this pilot were completed in early 2014 and were therefore claimed in this year's evaluation.

BES aimed to achieve net energy savings of 14.0 GWh and net peak demand savings of 2.5 MW in 2014, including the savings generated by measures implemented in common areas under the Rental Properties and Condos (RP&C) service, formerly known as Multi-Unit Residential Buildings (MURB). In fact, the savings generated by the measures implemented in the RP&C common areas are claimed under BES, since the operating conditions for these products differ from typical residential usage.

Key Findings

For 2014, BES totalled 761 participants. In addition, 51 participants implemented RP&C Common Area measures in 105 separate buildings, and 42 participants took part in the LED Blitz pilot, bringing the whole BES component's total number of participants to 854. With all these initiatives combined, BES generated net energy savings of 13.175 GWh and peak demand savings of 2.570 MW in 2014.

Barriers to Participation

Survey results showed that the number of participants reporting a challenge or barrier to participation has increased since 2012. Participants who talked about barriers to BES (23%) most often mentioned problems with contractors, unavailability of measures, lack of financing, poor attitude from the third-party contractor and measures missing or work not completed. In some cases, these issues resulted in significant delays for the work to be completed by the third-party contractor. When asked about ways to improve BES, participants also mentioned "better quality control" as one of the main improvements. These results suggest issues with the quality of the work conducted by third-party contractors.

Satisfaction

In spite of these barriers, satisfaction with BES remains high, with 90 percent of participants indicating that they were either "very satisfied" or "satisfied" with BES overall. Participants who were dissatisfied with BES mentioned that the program took too long, they did not like the installer or they had issues with the products being installed or with the timelines.

On a positive note, the majority of participants did not provide recommendations as to how BES should be improved. Those who did, however, mentioned "better communication", "increased advertising" and "better quality control", as previously mentioned.

On-Site Energy Assessment and Implementation Processes

Five visits were conducted with DAs as part of the evaluation process. One visit with each DA was conducted during the initial on-site assessment of a facility. The three other visits were conducted during the installation of the proposed measures. Overall, the visits showed that the work conducted on site by the DAs is done well and according to ENSC's procedures. Each DA's initial assessment visit included a facility walk-through, which allowed the DA to record fixture location, quantity, type, wattage and operational hours as well as any special considerations that may affect the installation process such as ceiling height. DAs also recorded sources of energy used for space and water heating in order to identify energy efficiency opportunities and propose potential measures.

Similar to 2013, neither DA performed a light intensity analysis, but they mentioned that such an analysis would be beneficial. Also, the use of a ballast discriminator by one of the DAs proved useful to determine whether the ballast of the existing equipment was magnetic or electronic.

The visits also revealed that participants often had questions on how to obtain replacement lamps in lighting projects. Information regarding this aspect should be systematically provided to participants in the future. This could be done by the DAs.

Energy Savings

The 2014 impact evaluation of BES was divided into four categories: BES lighting measures, BES non-lighting measures, measures implemented in RP&C common areas and measures implemented through the LED Blitz pilot.

To calculate the net savings of BES in 2014, the Evaluator reviewed the gross savings estimated by ENSC. More particularly, on-site visit results were used to estimate a self-declaration ratio for the lighting hours of operation and installation rates for the most implemented measures. The unitary savings values used were reviewed based on information found in the literature.

Moreover, the Evaluator took into consideration the distortion effects associated with the BES and RP&C Common Area measures. For BES, free-ridership and internal spillover were measured through the participant annual and quarterly surveys. A free-ridership level of 17 percent was captured, while a spillover effect of 0.3 percent was identified. For RP&C Common Area measures, the free-ridership level was calculated at 17 percent through the landlord survey conducted for the 2014 RP&C evaluation, and no spillover was evaluated. For LED Blitz, the net-to-gross ratio (NTGR) is assumed to be 1.

Table 1: Distortion Effects and Net-to-Gross Ratio

	BES	RP&C Common Area	LED Blitz
Free-ridership Level	17%	17%	-
Spillover Level	0.3%	-	-
Net-to-Gross Ratio	0.83	0.83	1.00

The evaluation revealed that BES, including RP&C Common Areas and LED Blitz, generated net energy savings of 13.175 GWh and peak demand savings of 2.570 MW at the generator in 2014.

Table 2: Overall Comparison of Tracked and Evaluated Savings at the Generator for BES

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR*	Net Savings
Energy Savings					
Tracked Savings from ENSC	17.407 GWh	17.069 GWh	14.967 GWh	0.83	12.372 GWh
Evaluation Results	17.487 GWh	16.585 GWh	15.743 GWh	0.84	13.175 GWh
Peak Demand Savings					
Tracked Savings from ENSC	4.499 MW	4.410 MW	3.901 MW	0.82	3.218 MW
Evaluation Results	4.520 MW	3.213 MW	3.069 MW	0.84	2.570 MW

* NTGRs were different for each component. The NTGRs presented in this table correspond to the rounded averages obtained by dividing the net savings by the installed gross savings (with interactive effects).

Recommendations

Overall, the Econoler team assessed that BES generated important savings in 2014. Even though BES did not reach its targets in 2014, an increase in savings associated with the BES lighting and non-lighting measure categories was observed. In addition to the general recommendations presented for all ENSC program components in the overall executive summary of the 2014 demand-side management (DSM) programs, the team has outlined specific recommendations throughout the report to optimize BES. Based on the evaluation results, the most important recommendations are as follows:

- 2014 BES-R1. Make follow-up telephone calls to ensure participant satisfaction with the work done by the third-party contractor.** Survey results showed that participants encountered issues with third-party contractors and the quality of their work. ENSC already requires that the DAs follow up with customers after installation to ensure their satisfaction. The Evaluator recommends that ENSC itself (instead of the DAs) make some follow-up phone calls with a certain portion of the participants so that ENSC is quickly made aware of any major issues related to DAs' work. Such phone calls by ENSC will help verify whether contractors have properly completed the work and met customer needs.

- 2014 BES-R2. Include a light intensity analysis as part of the on-site energy assessment and provide participants with information on how to obtain replacement products.** DA visits, performed during the initial on-site assessment and the installation process, showed that no lighting intensity analysis was performed. All DAs mentioned that such an analysis would be helpful to identify overlit areas. The Evaluator thus recommends that ENSC evaluate the possibility to include a lighting intensity analysis during the initial assessment. This analysis could include the use of a ballast discriminator. This could help identify potential reballast measures and support participants in their decision to reduce the quantity of fixtures according to their lighting needs. However, additional costs and contractual agreements between DAs and ENSC should be taken into account before adding such an analysis into the assessment. Visits also showed that participants had questions on how to obtain replacement lamps in lighting projects. As it would be beneficial to participant satisfaction, this information should be systematically given to customers during the installation process and should be part of ENSC's procedures.
- 2014 BES-R3. Eliminate adjustment of operating hours of proposed measures to take burnt out lights, safety considerations and delamping into account.** For some projects, the operating hours of the proposed measures have been increased to take existing burnt out lights into account. The Evaluator recommends that no adjustment should be made because of burnt out lights as they are usually replaced even if no lighting retrofit or fixture replacement is done. A similar adjustment to the proposed operating hours have been made for customers who wanted lights to be on 24 hours a day, seven days a week, for safety considerations. Safety considerations are not related to the energy efficiency measures implemented. Safety would have been a concern even without the replacement of lighting systems. For this reason, the Evaluator recommends that no increase in operating hours should be considered in the savings calculations for safety considerations. Operating hours were also adjusted to take the partial delamping of existing measures into account. This reduction should be taken into account through the quantity of lighting systems.
- 2014 BES-R4. Add information about cooling systems and hot water heat pumps in the non-lighting measures tracking report.** The Evaluator reiterates this recommendation for heat pumps, which was first mentioned in the 2013 evaluation report. It is recommended to add new fields to record information regarding the cooling capacity and SEER of the existing cooling systems. This would enable more accurate savings calculations. The tracking report should also contain all hot water heat pump parameters required to perform energy savings calculations.
- 2014 BES-R5. Develop a process for validating savings calculations.** As detailed in the Impact Evaluation section, the Evaluator reviewed the energy savings recorded in the tracking sheet and found small calculation errors. To ensure that the savings

recorded in the tracking sheet correspond to those calculated using the parameters documented for each measure (quantity, unitary wattage value, hours of operation, etc.), ENSC should develop a validation process using a formula that can automatically calculate savings using the parameters entered in the tracking sheet. This will ensure the consistency of the energy savings recorded for each measure.

- 2014 BES-R6. Use ballast efficacy factor when available to evaluate system wattage of fluorescent and LED linear tube lighting system.** For measure categories involving linear fluorescent and linear LED tubes to replace T8, the Evaluator recommends using first and foremost the ballast efficacy factor to evaluate the lighting system wattage. This parameter represents the ratio of the ballast factor to the system input wattage. This represents the most accurate method to calculate the energy consumption of the system wattage. When the ballast efficacy factor is not available, the Evaluator recommends using system wattage data from the literature. Databases for different ballast and lamp combinations are widely available in the literature for conventional T8 fluorescent tubes. For LED tubes, such databases may not be available in the near future. For proposed measures related to LED tubes, the Evaluator recommends using the product of the ballast factor and lamp nominal wattage, unless the ballast efficacy factor values of the system wattage databases become available.
- 2014 BES-R7. Use proposed ratio value when the ballast factor is used as lighting system wattage to lamp nominal wattage ratio in savings calculations.** In 2013, it was recommended to use a ratio of 0.85 instead of ratios ranging between 0.74 and 0.78 when the ballast factor is taken as the ratio of the lighting system wattage to lamps nominal wattage. This recommendation applies for LED linear tubes when the system wattage is taken as the product of the ballast factor and lamp nominal wattage. The Evaluator adjusted the savings calculations, as recommended in last year's evaluation.
- 2014 BES-R8. Plan on the complete and ultimate removal of CFLs and fluorescent T8 tubes from BES.** BES results showed that savings associated with florescent T8 decreased by 53 percent in 2014. So, the Evaluator recommends that either (1) the use of fluorescent T8 be limited to applications with low operating hours next year; or (2) the fluorescent T8 be used for specific applications and that this technology be gradually yet completely phased out and removed in the near future. Similarly, the share of savings associated with CFLs decreased by 64 percent this year. A significant portion of this decrease was attributable to the removal of screw-in CFLs from the program. CFLs are now limited to hardwired lamps and special applications, for which the cost of LED technologies is still high. However, as the cost of LED products continue to drop, ENSC should plan on completely removing this technology from BES in the near future as well.

1 PROGRAM DESCRIPTION

Business Energy Solutions (BES) offers small businesses all across Nova Scotia a complete turnkey implementation, including a free on-site energy assessment of energy-efficient lighting and non-lighting measures.

For BES, a “small business” is defined as any non-residential participant (except for multi-unit residential buildings) with a total annual electricity use of less than 400,000 kWh. Eligible businesses pay a portion of the installation and materials costs, while the remaining portion is paid by Efficiency Nova Scotia Corporation (ENSC). Although BES marketing materials say it covers up to 60 percent of the total project cost, low unitary costs and therefore increased incentives may actually result in financial coverage of up to 100 percent of the total project costs by ENSC. In certain cases, participants can pay their portion of the costs in monthly installments through their Nova Scotia Power bills for up to a 24-month interest-free period. If participants do not use financing from Nova Scotia Power, they must pay their portion of the project cost before any materials are shipped.

BES offers a wide variety of energy-efficient measures such as:

- › Efficient lighting measures
- › Occupancy sensors and lighting controls
- › Ductless mini split heat pumps
- › Electronically commutated motors (ECMs)
- › Outside air economizers
- › Hot water heat pumps
- › Hot water tank wraps
- › Pipe insulation
- › Spray valves
- › Faucet aerators
- › Vending machine misers

BES is implemented through three delivery agents (DAs). The DAs are responsible for all aspects related to the sales, administration, ordering, delivery and installation, as well as the proper recycling of old measures.

In 2012 and 2013, BES carried out a Light Emitting Diode (LED) Blitz pilot, which targeted facilities using more than 350,000 kWh annually, such as shopping malls. This pilot replaced incandescent and halogen light bulbs with LEDs, and offered to install water-related measures free of charge for electrically heated water. The unfinished measures from this pilot were completed in early 2014 and were therefore claimed in this year's evaluation.

BES aimed to achieve net energy savings of 14.0 GWh and net peak demand savings of 2.5 MW in 2014, including the savings generated by measures implemented in common areas under the Rental Properties and Condos (RP&C) service, formerly known as Multi-Unit Residential Buildings (MURB). In fact, the savings generated by the measures implemented in the RP&C common areas are claimed under BES, since the operating conditions for these products differ from typical residential usage.

Electricity savings generated by BES are accounted for under the Direct Installation program.

2 METHODOLOGY

This section presents the Econoler team, the methodology used and the activities carried out for the BES evaluation.

2.1 Presentation of the Team

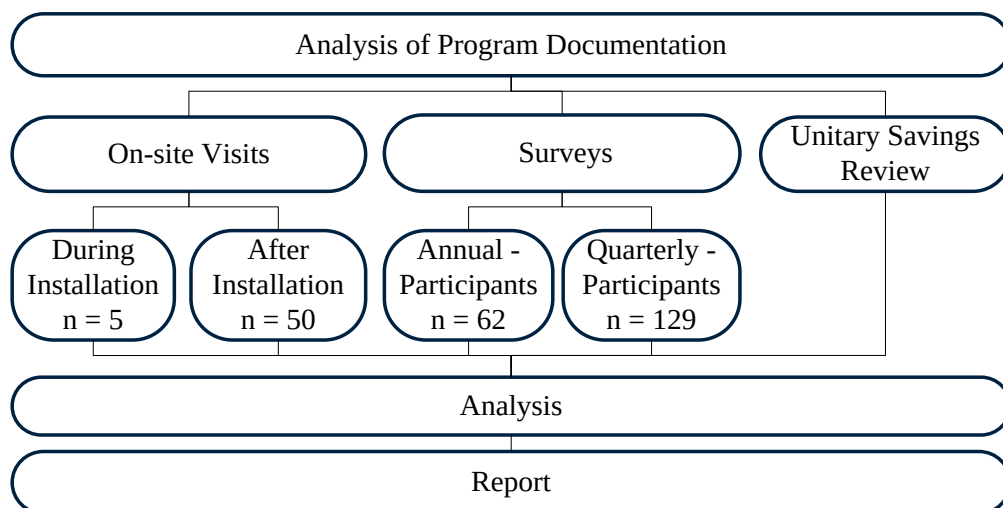
To carry out the 2014 evaluation, Econoler worked with two partner entities: Corporate Research Associates (CRA) and Equilibrium Engineering. Tasks were divided as follows:

- › Econoler acted as the team leader and was responsible for coordinating all the evaluation activities, as well as preparing and reviewing all the deliverables.
- › CRA conducted the annual and quarterly telephone surveys. CRA also analyzed and reported on the data collected from these activities.
- › Equilibrium Engineering conducted the on-site visits, reviewed the tracking sheet and assisted Econoler with certain parts of the impact evaluation. Equilibrium Engineering was also in charge of the analysis and reporting that followed these different activities.

2.2 Evaluation Activities

Figure 1 below illustrates the research strategy and data collection activities used for the 2014 evaluation.

Figure 1: Methodological Model



Each step of this methodological model is further detailed in the following sub-sections.

2.2.1 On-site Visits

In October and November 2014, Equilibrium Engineering conducted 50 on-site visits after project implementation. These visits were meant to verify the implementation status of the measures against the data found in the tracking sheet and then calculate the installation rates as part of the impact evaluation. A copy of the on-site visit sampling methodology and protocol is included in Appendix XI.

Five additional on-site visits were conducted with the DAs during the implementation or the on-site energy assessment audit to validate the overall turnkey implementation process. A different protocol was developed for these five visits and is presented in Appendix II.

2.2.2 Surveys

An annual telephone survey with a total of 62 participants and four rounds of quarterly telephone surveys with a total of 129 participants were conducted by CRA staff in Halifax.

Annual Survey

For the annual survey, the interviews were conducted in October and November 2014 using computer-assisted telephone interviewing (CATI) technology. The average length of the survey was 9 minutes.

The annual survey was used to gain a better understanding of the following aspects of BES:

- › Spillover
- › Program awareness
- › Participant motivations and barriers
- › Satisfaction with the program and ENSC
- › Recommendations for improvements

The questionnaire and complete survey results are presented in Appendix III and Appendix IV. The following table shows the population and sample sizes, as well as the corresponding margin of error at a 90 percent confidence level for the 2012, 2013 and 2014 annual telephone surveys.

Table 3: Annual Survey Sample Size and Margin of Error

Annual Survey	Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
2014 Participants	761 ¹	62	±10.0%
2013 Participants	588	61	±10.0%
2012 Participants	1,239	76	±9.1%

¹ The population of BES participants for the 2014 annual survey was 171 at the time when the survey was being conducted.

Quarterly Surveys

For the quarterly surveys, four rounds of interviews with a total of 129 participants were conducted in April, July, October and December 2014, using CATI technology. These surveys were conducted to shorten the time period from when participants started participating in the program and when they were contacted for evaluation purposes. The average length of the survey was 9 minutes.

The quarterly surveys were used to gain a better understanding of the following aspects of BES:

- › Free-ridership
- › Satisfaction with the program and ENSC

The questionnaire and the complete quarterly survey results are presented in Appendix V and Appendix VI. The following table shows the population and sample size as well as the corresponding margin of error at a 90 percent confidence level for the 2013 and 2014 quarterly telephone surveys.

Table 4: Quarterly Survey Sample Size and Margin of Error

Quarterly Surveys	Population	Sample Size (n)	Margin of Error at 90% Confidence Interval
2014 Participants	761	129	±6.6%
2013 Participants	588	138	±6.1%

The margin of error is used to determine the level of precision² of the measurement, and its associated confidence level indicates the probability that a measure will fall within this margin of error. As part of this evaluation, the confidence level and margin of error only take random sampling errors into account; they do not reflect non-sampling errors or bias, such as data entry errors, respondents providing inaccurate answers or people who could not be contacted.

2.2.3 Unitary Savings Review

To review the unitary savings values used in the tracking sheet, the Econoler team validated the parameters currently used in the tracked savings calculations by conducting a literature review of similar technical reference manuals and public evaluation reports by other jurisdictions and choosing the most recent and accurate data sources. When no reliable or representative sources were found in the literature, engineering calculations were made to estimate the savings.

² Precision refers to how close the measured values are to each other. It does not take into consideration how close the measured value is to the true value, which refers to accuracy.

3 PROCESS EVALUATION

This section presents the findings of the 2014 partial process evaluation of BES. These findings are based on the information and data collected from the tracking system review and the site visits with the DAs.

3.1 Participation in BES

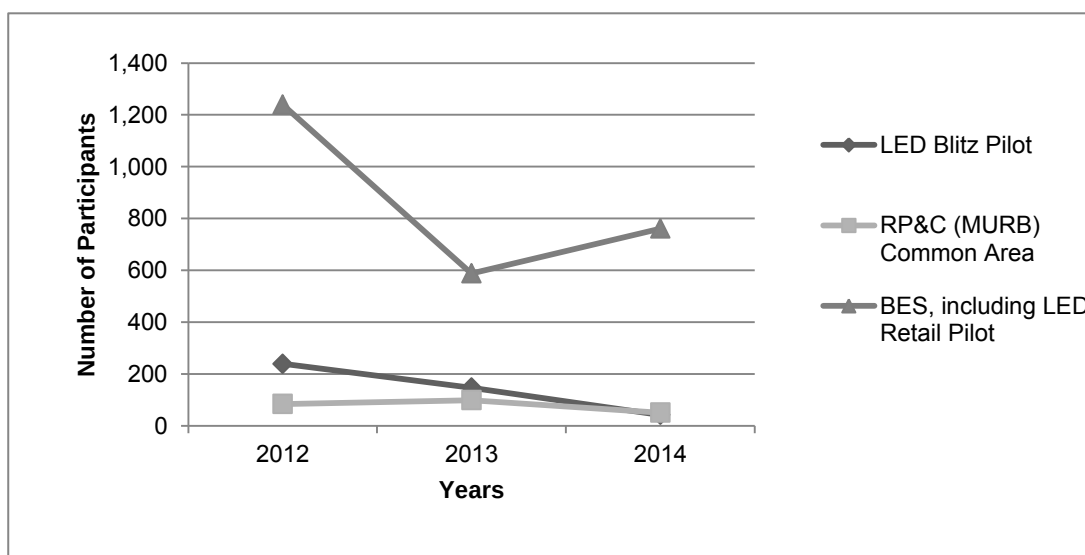
As Figure 2 illustrates, the participation in BES has declined since 2012, but has remained rather stable compared to 2013, all BES initiatives considered. This decrease after 2012 can be partially explained by the fact that the Commercial Direct Install (CDI) component of BES was removed in 2012.

For the year 2012, BES had a total of 4,208 participants, among whom 1,239 implemented BES lighting or non-lighting measures, 2,730 were from the CDI component (including 84 participants from MURB) and 239 took part in the LED Blitz pilot.

For the year 2013, BES had a total of 834 participants, among whom 588 implemented BES lighting or non-lighting measures, 99 implemented MURB Common Area measures in 300 individual buildings and 147 took part in the LED Blitz pilot.

For 2014, BES totalled 854 participants, among whom 761 participants implemented BES lighting or non-lighting measures, 51 participants implemented RP&C Common Area measures in 105 separate buildings and 42 participants took part in the LED Blitz pilot.

Figure 2: Participation in BES



3.2 Tracking System

The content of the 2014 BES tracking sheet was reviewed by the Evaluation team. The tracking data was extracted directly from the demand-side management data system (DSMDS) and the participants' information is presented in two separate reports—one for the lighting measures and one for the non-lighting measures. The Evaluator reviewed the content of both reports.

Lighting Measures Tracking Report

The lighting measures tracking report presents information regarding the participants and their calculated gross energy savings. It includes each participant's detailed contact information and the details about their facility required to conduct surveys and on-site visits. For the vast majority of the participants, the contact names, phone numbers and street addresses were provided (all participants had contact names and street addresses, and 98% had phone numbers). Each measure implemented is given a measure identification number corresponding to a specific lighting measure in a specific location. Each project is also assigned a unique identification number to facilitate monitoring the total number of projects implemented and the level of participation.

The lighting measures tracking report also provides the following information:

- › Portion of project costs paid by the customer
- › Nova Scotia Power account number and associated rate code
- › Heating energy source
- › Winter and summer temperature set-points
- › Weekly operation hours for each implementation area
- › Whether measures are implemented indoors or outdoors
- › Existing measure details
- › Proposed measure details

The measure location, whether indoors or outdoors, has a direct impact on the interactive effects, and is an important parameter to be captured. This information was missing for less than 1 percent of the measures. The heating energy source is also a key parameter for evaluating the interactive effects. In 2013, this information was only documented for 30 percent of the measures. This year, it has gone up to 83 percent—a significant improvement.

The lighting measures tracking report also documents gross energy savings and the values of key parameters required to validate the energy savings calculations. The following is a list of the parameters documented for both the existing and proposed measures:

- › Number of fixtures
- › Number of lamps per fixture

- › Number of ballasts (for proposed measures only) and the associated ballast factor
- › Unitary wattages
- › Hours of operation

Since 2013, the manner in which measures equipped with occupancy sensors are recorded has been changed. Occupancy sensors are now claimed through a reduction of operating hours. Measures with occupancy sensors can easily be identified in the tracking report. A field has been added to indicate the reduction of operating hours between the existing and proposed measures. Another field has been added to describe the reason for the difference between the existing and proposed hours. The “BES Measure Occupancy Sensor Savings” field was however not eliminated. This field should be removed from the tracker since occupancy sensors are now claimed through a reduction of operating hours. Moreover, some of the values presented in this field are not related to occupancy sensors.

In 2013, it was recommended not to make energy savings adjustments to burnt out lights. In 2014, there were two projects for which operating hours have been increased for the proposed measures to take burnt out lights into account. The Evaluator reiterates that no adjustments should be made because burnt out lights are usually replaced even if no lighting retrofit or fixture replacement is done. The same reasoning should apply to measures for which operating hours have been increased for safety considerations. That is the case for three projects where customers wanted lights to be on 24 hours a day, seven days a week. This is not related to the energy efficiency measure itself. It is highly likely that safety would have been a concern even without the replacement of the lighting systems. Finally, operating hours have been increased for one project to take partial delamping of existing measures into account. This reduction should be taken into account through the quantity of lighting systems.

As was the case last year, the lighting measures tracking report contains detailed information about lamp wattage, the number of lamps and decommissioned equipment wattage for all the existing measures.

As for the proposed measures, the information required for making the savings calculations (lamp wattage, quantity and ballast factor) is recorded in separate fields.

Overall, the Evaluator noticed some improvements in the lighting measures tracking report since last year. Only a small percentage of the customers have incomplete data and information documented about them, and the indoors/outdoors field was completed for the majority of measures. Information regarding the heating energy source has been provided for 83 percent, a large increase compared to last year's 30 percent. All 8,276 documented measure locations contain information about their existing hours of operation.

Non-lighting Measures Tracking Report

As for the other data captured in the non-lighting measures tracking report, the contact information has been entered for all the participants. The heating load hours have been set at 2,200 hours for all the participants, instead of 2,750 hours recommended by the Evaluator in 2013.

The non-lighting measures tracking report provides the following information:

- › Project identification number
- › Vendor name
- › The provincial region where the project is located (i.e., Central NS, Southwest NS, Halifax, etc.)
- › Facility name
- › Complete customer contact information, including their Nova Scotia Power account number, applicable rate code, and annual electricity consumption
- › Customer's cost share percentage
- › Type of non-lighting measure installed
- › Heat pump model number, capacity, efficiency ratios, and whether the unit will be used for both heating and cooling
- › Quantity, the heating load hours, unitary savings value, and the calculated energy and peak demand savings

All this information is sufficient for conducting on-site visits for heat pump installations. Similar to the 2013 evaluation, the cooling systems were not identified as part of the information documented regarding the facilities. Information regarding the rated capacity and the SEER value of cooling systems would have allowed making savings calculations more accurately. In fact, as part of last year's evaluation, the Evaluator did recommend collecting information about cooling systems.

To sum up, the lighting measure tab shows some improvement over last year's version; so does the non-lighting measure tab, which also meets the requirements for conducting on-site visits to validate the heat pump installations. However, there is potential for improvement because it appears that some of the 2013 recommendations have not been implemented. Therefore, the Evaluator makes the following recommendations to ENSC:

- › **Develop a process for validating savings calculations:** As detailed in the Impact Evaluation section, the Evaluator reviewed the energy savings recorded in the tracking sheet and found small calculation errors. To ensure that the savings recorded in the tracking sheet correspond to those calculated using the parameters documented for each measure (quantity, unitary wattage value, hours of operation, etc.), ENSC should develop a validation process using a formula that can automatically calculate savings using the parameters entered in the tracking sheet. This will ensure the consistency of the energy savings recorded for each measure.

- › **Add information about cooling systems in the non-lighting measures tracking report:** The Evaluator recommends adding new fields to record the values of cooling capacity and SEER of cooling systems in the facilities. This would enable more accurate savings calculations.

This year's tracking sheet only included remaining measures of the LED Blitz pilot implemented in 2014 to complete the unfinished portion of last year's initiative. Additionally, no changes were made to the tracking sheet and as a result, no tracking sheet review has been done for this component.

3.3 On-site Visit during the Installation Process

Similar to 2013, five visits were conducted with DAs as part of the evaluation process. Two visits with two different DAs were conducted during the initial on-site assessment of a facility. The three other visits were conducted during the installation of the proposed measures. Two of these visits were conducted with one DA and the other with a second DA. The protocol developed for this specific activity includes twenty questions that can be found in Appendix II.

The purpose of the initial assessment visits was to evaluate the extent of the information captured on site. Methods used by DAs to identify energy savings opportunities and lighting and non-lighting measures were also evaluated. Visits during the installation were performed to determine the specific products installed, identify issues encountered during the installation and gather information about the service offered to the participants after the installation.

The initial assessment visits began with a meeting where the reasons of the visit were explained to the on-site personnel. A facility walk-through was then performed by DAs to record the quantity of fixtures, their location, type, wattage, voltage, hours of operation and special considerations that may affect the installation process, such as ceiling height. DAs recorded energy sources for the space heating and domestic hot water heating systems. This information was then used to identify energy efficiency opportunities and to propose potential measures for these systems.

Similar to 2013, neither DA performed a light intensity analysis, though the DAs did mention it would be beneficial to perform such an analysis. The initial assessment is, however, not a paid service. They therefore gather only the information that is required to be submitted to ENSC for approval. One DA did use a ballast discriminator to determine whether the ballast of the existing equipment was magnetic or electronic. This proved to be convenient in areas that were difficult to access (i.e., corridor lighting that is usually shielded by a valence). Similar to last year's evaluation, the Evaluator recommends that ENSC evaluate the possibility of adding a lighting analysis as part of the initial assessment to identify overlit areas. This could help participants in their decision to reduce the quantity of fixtures according to their lighting needs.

Both DAs recommended to replace all of the existing inefficient lighting found on site. One DA indicated, however that in large facilities a subjective decision is made based on the stated hours of use and the amount of the participant's financial contribution, which is a percentage of the total project

cost. The DA declared that some participants have declined the proposed measures due to the long payback period. In rare cases, the participants decided to leave specific fixtures and lamps as found.

The visits also revealed that participants often had questions on how to obtain replacement lamps in lighting projects. Information regarding this aspect should be systematically given to participants in the future—something that could be done by the DAs.

4 MARKET EVALUATION

This section presents the findings of the 2014 BES market evaluation based on an analysis of the participants' perspectives.

4.1 Participant Perspectives

An annual and four quarterly participant surveys were conducted as part of the BES evaluation. In addition to the questions designed for impact evaluation purposes, survey participants were asked questions regarding program awareness, barriers and satisfaction.

4.1.1 Motivations and Barriers to Participation

Businesses and organizations chose to participate in BES for a number of reasons. Like previous years, "saving on energy costs" was identified as the most important motivation. Table 5 summarizes all the different reasons for participating.

Table 5: Reasons for Participating

Reason for Participating	2012		2013		2014	
	Most Important Motivation	Second Most Important Motivation	Most Important Motivation	Second Most Important Motivation	Most Important Motivation	Second Most Important Motivation
<i>Sample Size</i>	76	76	61	61	62	62
Save on energy costs/bills	66%	24%	69%	20%	63%	26%
Improve existing lighting conditions	13%	22%	16%	23%	15%	13%
Energy efficiency in general	3%	12%	-	18%	6%	11%
Take advantage of incentives	9%	9%	5%	13%	3%	13%
Help protect the environment	3%	8%	-	7%	2%	13%
To improve building	4%	-	-	-	2%	2%
Reduce maintenance costs	3%	1%	2%	3%	-	-
Recommended by a contractor	-	-	2%	-	-	-
See what I should be doing as part of a planned project	-	-	-	3%	-	-
Others	-	3%	7%	7%	10%	8%
None/No other reasons	-	20%	-	7%	-	10%
Don't know	-	1%	-	-	-	5%

While most BES participants did not experience any barriers to participation, as seen in Table 6, the number of participants reporting a barrier has increased since 2012, and these barriers warrant further examination.

Table 6: Barriers to Participation

Any Barriers	2012	2013	2014
<i>Sample Size</i>	76	61	62
No	97%	84%	76%
Yes	3%	16%	23%
Don't know	-	-	2%

Those participants who mentioned barriers to BES mentioned a variety of issues. Issues like problems with contractors, unavailability of measures, lack of financing, and measures missing or work not completed were each mentioned by two participants (see Table 7). These complaints about the barriers suggest that third-party contractors may have quality issues. One participant complained, “We waited another 150 to 180 days for the third-party contractor to come and complete the work.” Another participant suggested that the poor attitude of the contractor was a barrier to participation. Additionally, one participant mentioned that the work had never been completed. Given these issues, ENSC may need to make follow-up telephone calls with a sample of participants to verify whether contractors have properly completed the work and met their needs.

Table 7: Specific Barriers to Participation

Specific Barrier	2012		2013		2014	
	Most Important Barrier (#)	Second Most Important Barrier (#)	Most Important Barrier (#)	Second Most Important Barrier (#)	Most Important Barrier (#)	Second Most Important Barrier (#)
<i>Sample Size*</i>	2	2	10	10	14	14
Problem with contractor	-	-	1	-	2	1
Unavailability of measures/products	-	-	1	-	2	-
Lack of financing	-	-	1	-	2	-
Job was not completed/measures/products missed	-	-	-	-	2	-
Problems implementing measures/installing products	-	-	3	-	1	1
Poor communication	-	-	-	-	1	1
Different levels of assistance between similar buildings	-	-	-	-	1	-
Lack of time/too busy	-	-	-	-	1	-
They lost our application/paperwork	-	-	-	-	1	-
Length of time to complete project/took too long to complete project	-	-	-	-	-	2
Approval takes too long	-	-	-	-	-	1
Lack of information to make an informed decision	-	-	2	-	-	-
Do not own building – have to work through owner	-	-	1	-	-	-
Too much work required to obtain funding	1	-	-	-	-	-
Others	1	-	1	1	1	1
None/No other barriers	-	2	-	8	-	7
Don't know	-	-	-	1	-	-
*Base: Respondents who said there were barriers to participating in BES						

4.1.2 Satisfaction with BES

The level of satisfaction with BES was high, with 90 percent of the participants giving a rating of '5' or '4', with '5' indicating 'very satisfied'. Six of the 62 respondents were less satisfied with BES, primarily because they thought the program took too long, they did not like the installer, or they had issues with the products being installed.

Table 8: Satisfaction with BES Overall

Satisfaction with BES	2012*	2013***	2014***
<i>Sample Size**</i>	76	59	62
Overall program	95%	97%	90%
*Base: Percentage of respondents who were very satisfied/satisfied **Don't know/'Refused' removed from calculations ***Percentage of respondents who gave a rating of 5 or 4 on a scale with 5 indicating 'Very satisfied' and 1 indicating 'Not at all satisfied'.			

Some respondents mentioned issues with timelines as both a barrier and the reason why they were dissatisfied with BES. Nearly one-third of the participants mentioned waiting more than a month to receive their contract from ENSC, that is from the time they recalled first contacting ENSC or being contacted by ENSC about the program. Two respondents indicated that their wait time lasted more than a year. ENSC considers that 30 days is an acceptable timeframe to go from first-call to receipt of the contract. Table 9 presents the average time respondents recalled waiting to receive their contracts after their first contact with ENSC.

Table 9: Time Waited to Receive Contract

Time Waited to Receive Contract	2014
<i>Sample Size</i>	62
1-6 days	10%
7-9 days	10%
10-19 days	11%
20-29 days	2%
30+ days	31%
Don't know	37%
Average*	34.4 Days
**Mean excludes 'don't know'/'refused'. Responses indicating more than 365 days were removed from mean calculation.	

4.1.3 Recommendations for Improvement

As shown in Table 10, most participants did not offer any suggestions to improve BES (66%). That said, the issues previously identified were mentioned again, such as “better communication”, “increased advertising” and “better quality control”.

Table 10: Recommendations for Improvement

Suggestion*	2012	2013	2014
<i>Sample Size</i>	76	61	62
Better communication/Hard to get in contact with	7%	8%	6%
Increase advertising/marketing	9%	5%	5%
Better quality control/Ensure job gets done right	-	5%	5%
Quicker process	5%	3%	2%
Cover more products/measures	-	3%	2%
More information/Found process confusing	5%	-	-
Satisfied with BES	4%	-	6%
Others	8%	7%	10%
No recommendations	62%	69%	66%
Refused	3%	-	-
*Multiple responses			

5 IMPACT EVALUATION

The objective of the 2014 BES impact evaluation is to determine the gross and net energy savings associated with the measures implemented through BES, including the BES lighting and non-lighting measures, as well as measures implemented in common areas under RP&C and the LED Blitz pilot. Accordingly, this section reports on the impact evaluation by covering four main types of measures: 1) BES lighting measures; 2) BES non-lighting measures; 3) RP&C Common Areas measures; and 4) LED Blitz measures.

Both electrical energy and peak demand savings were assessed by analyzing the following parameters:

- › Unitary savings values for each measure offered
- › Installation rates
- › Diversity factor or peak demand-to-energy ratio
- › Interactive effects
- › Free-ridership
- › Internal spillover

Evaluating the savings associated with BES lighting measures and BES non-lighting measures involved reviewing the tracking sheet, and the information collected through the 50 on-site visits and the participant surveys. As for the measures implemented in common areas under RP&C, the Evaluator used the unitary savings values established in the 2013 evaluation report because only a tracked savings report was planned for RP&C this year. Since the LED Blitz pilot includes only remaining participants from last year's initiative, the unitary savings value was reviewed for only one product that was not installed last year.

The participant surveys provided information on free-ridership (from the quarterly surveys) and internal spillover (from the annual survey), which was used to calculate the net-to-gross ratio (NTGR) of BES. The information collected from the annual survey conducted with landlords under the RP&C evaluation was also used to establish the free-ridership level for the measures implemented in common areas under RP&C. As for the LED Blitz pilot, no distortion effects were measured and the NTGR is assumed to be 1.

5.1 Gross Energy Savings

The following sections examine the unitary savings values used in the gross savings calculations for each category of measures covered by the program (BES lighting measures, BES non-lighting measures, RP&C Common Areas measures and LED Blitz measures).

5.1.1 Unitary Savings for BES Lighting Measures

Each existing and proposed lighting measure is unique and has its own unitary wattage value. Specific information about the lighting measure is required to allow validating each of these unitary wattage values.

In the 2014 BES tracking system, the following kinds of details are documented for both existing and proposed measures:

- › Number of fixtures
- › Number of lamps per fixture
- › Ballast factor
- › Lamp wattage
- › Replacement type (which only applies to the proposed measures)

The four replacement types are as follows:

- › Fluorescent or LED lamp replacement
- › Lamp and ballast replacement
- › Fixture replacement
- › Fixture cap and abandon

The decommissioned equipment wattage values—i.e., the combination of the ballast and lamp wattages—are documented for all the existing measures.

In 2014, the energy savings associated with LEDs accounted for 67 percent of the total lighting energy savings. Among all of the LED products installed, linear LED T8 lamps—a product used to replace existing T8 fluorescent lamps—accounted for 28 percent of the total lighting energy savings. Due to its easy installation, this product newly introduced in 2014 is quickly gaining popularity. Therefore, the unitary wattage value review has mainly focused on the linear LED T8 lamp measure.

LED T8 Lamps for Replacement of Fluorescent T8 Lamps

Most of the 4' T8 linear LED lamps used to replace fluorescent are Philips InstantFit 14.5 W LED T8 lamps. The Evaluator conducted desktop research to determine the actual tube wattage value of this lamp. It was determined that although this type of lamp contained an integrated driver, it had to be used with an instant-start ballast. According to the manufacturer, however, the integrated driver draws an insignificant amount of power.³ Therefore, in this case, the unitary wattage value is considered to be equal to the lamp nominal wattage. Since decimals cannot be entered in the actual DSMDS, the unitary savings value is rounded to 15 W for the 14.5 W lamp.

³ Philips Lighting, Philips InstantFit LED T8 Lamps, http://www.usa.lighting.philips.com/lightcommunity/trends/tled/assets/PLt-1309BN_LED_T8_InstantFit_bulletin_10.14_Web.pdf, 2014.

The 4' T8 InstantFit LED lamps were also made available in a lower wattage model. The bare lamp wattage is listed as 12 W in the manufacturer's specifications sheet. Once again, the unitary wattage value is considered to be equal to the lamp nominal wattage.

SubstiTube is another T8 LED lamp replacement product available on the market. The Evaluator was unable to determine whether these were installed because product code numbers were not entered in the tracking system. The unitary wattage value for these lamps is 22 watts⁴. The literature review regarding this product indicated that they should be used with instant start electronic T8 ballast and that they should be tested to ensure compatibility before installation of large quantities⁴.

Unitary Savings for LED Lamp Replacements

As for the relamping measures, the savings in the 2014 tracking system are solely based on the wattage differences between the existing and the new lamp types, which is similar to the procedure used in 2013.

Actually, the ballast factor has a big influence on the system wattage. By definition, the ballast factor is the "actual lumen output/nominal lumen output", and as such, it has an effect on the lamp power consumption and the power consumption of the entire lighting system (combination of lamp and ballast power consumption). The higher the value of the ballast factor, the more light is emitted from the lamp and therefore, the more power is consumed. Consequently, the exact savings should be based on the wattage differences between the existing and proposed lighting systems:

$$\text{Wattage Savings} = \text{Existing lighting system wattage} - \text{Proposed lighting system wattage}$$

The ballast factor can be used, along with the ballast efficacy factor (BEF), to evaluate the actual power consumed by a lighting system with the following equation:

$$\text{Lighting system wattage} = \frac{BF \times 100}{BEF}$$

As the last equation shows, the ballast efficacy factor is required to calculate the exact wattage of the system. Its value depends on the ballast exact model, the type of lamp and the number of lamps that are connected to the ballast. Ballast efficacy factor can sometimes be found in technical specification sheets provided by the ballast manufacturer.

As for the relamping measures, it is assumed that the existing ballast will not be removed—it is kept in place and used with new lamps. The exact ballast model, and consequently, the ballast efficacy factor, will likely not be available for these measures. For this reason, the system wattage cannot be calculated using the ballast efficacy factor.

⁴ OSRAM, SubstiTUBE IS LED T8, <https://assets.sylvania.com/assets/Documents/LED417.ac8824e1-3f0b-4310-9fc2-34d64766e5e8.pdf>, 2014.

Databases including system wattage for various fluorescent lamps and ballast factor combinations are widely available in the literature. The Evaluator recommends that ENSC use such databases to evaluate the existing wattage for existing measures consisting of conventional fluorescent lamps.

LED linear tubes being a relatively new product, it is likely that system wattage databases will not be available in the near future. In these circumstances, the Evaluator assumes that the best approximation would be to use the product of the existing ballast factor and proposed lamp nominal wattage. The Evaluator thus recommends that ENSC use the following equation to evaluate the proposed system wattage when LED tubes are used, unless system wattage databases become available:

$$\text{Proposed Lighting System Wattage} = \text{Existing BF} \times \text{Lamp Nominal Wattage} \times \text{Number of Lamps}$$

Unitary Savings for LED Lamp and Ballast Replacements

For measures that involve replacing the lamps and the ballast, savings presented in the tracking report are based on existing measures related to decommissioned equipment wattage and proposed measures related to ballast factor and lamp nominal wattage:

$$\text{Energy Savings} = \frac{\text{Decom. Equip. Wattage} \times \text{Qty} \times \text{hrs}}{1000} - \frac{\text{Qty} \times \text{No. of Lamps} \times \text{BEF} \times \text{Nom. Watt.} \times \text{Hrs}}{1000}$$

The ballast could be used along with the ballast efficacy factor to calculate the system wattage for both the existing and proposed measures. This is the most accurate method to evaluate the energy consumption of the entire fixture.

Unlike relamping measures, the existing and proposed ballast models could easily be obtained from the manufacturer's technical data on measures under which ballast are replaced. For LED lamp and ballast replacements, the Evaluator recommends that ENSC use calculations based on the ballast efficacy factor when this parameter is available.

Using the same approach that is used for relamping measures, the Evaluator recommends using databases to evaluate the system wattage of existing fixtures using conventional fluorescent tubes if the ballast efficacy factor is not available.

Unless such databases become available for LED tubes in the near future, the proposed system wattage should be calculated using the following equation when ballast efficacy factor is not available:

$$\text{Proposed Lighting System Wattage} = \text{Proposed BF} \times \text{Lamp Nominal Wattage} \times \text{Number of Lamps}$$

Unitary Savings for LED Fixture Replacements

Savings presented in the tracking report for this type of measures are calculated using the same method as the one used for LED lamp and ballast replacements.

Again, the Evaluator recommends using the ballast efficacy factor, if available, for both the existing and proposed measures as it is the most accurate method.

The Evaluator recommends using databases to evaluate the system wattage of existing fixtures using conventional fluorescent tubes if the ballast efficacy factor is not available. Unless such databases become available for LED tubes in the near future, the proposed system wattage should be calculated using the following equation when the ballast efficacy factor is not available:

$$\begin{aligned} \text{Proposed Lighting System Wattage} \\ = \text{Proposed BEF} \times \text{Lamp Nominal Wattage} \times \text{Number of Lamps} \end{aligned}$$

In this last equation, the ballast factor is taken as the ratio of the system wattage to lamp nominal wattage (which is not consistent with the ballast factor definition and hence not as accurate as using the ballast efficacy factor). As part of 2013 evaluation, a literature review was performed to evaluate the actual ratio of the lighting system wattage to nominal lamp wattage when low-factor ballasts are used. It was recommended to use a ratio of 0.85 instead of ratios ranging between 0.74 and 0.78. This recommendation should also be applied to LED linear tubes when the last equation above is used. As tracked savings were calculated with a BF value of 0.77 for some measures, including a new fixture as a ballast replacement, an adjustment was calculated based on this recommendation. This resulted in an adjustment ratio of 0.968 which applies to all measures under which new ballasts and LED linear tubes are installed.

Unitary Savings for Other LED Products

Other LED measures were analyzed to verify the accuracy of their unitary wattage values and the ballast factors. The unitary wattage values were found to be consistent with the nominal wattages of the lamps. However, there were discrepancies in ballast factors. The ballast factor for most of LED measures was entered as 1. The ballast was however entered as 0 for some measures. This is especially the case for 12 watt A lamps. Although this parameter has no impact on analyzing the measures' energy consumption, the Evaluator recommends that ENSC continue its efforts to ensure consistency in ballast factor values among all the measures. Since this parameter has no impact on energy savings calculation, no adjustment has been made.

T8 Fluorescent Lamps

As part of 2013 evaluation, a literature review was undertaken to evaluate the typical "total fixture wattage/nominal lamp wattage" ratio when low-factor ballasts are used in T8 fluorescent systems. The goal was to evaluate the validity of using ballast factors ranging between 0.74 and 0.78 in energy savings calculations. It was recommended to use the 0.85 value instead as it is more representative of lamp wattage to system ratio when low-factor ballasts are used. The Evaluator noted that ballast factors ranging between 0.74 and 0.78 were still entered for this type of measures in the tracking report. A revision of the energy savings based on this recommendation resulted in a 0.931 adjustment ratio for the fluorescent T8 measure category.

Metal Halide and Hardwired Compact Fluorescent Lamps (CFLs)

In 2013, it was recommended to use a ballast factor of 1.15 for metal halide wallpacks and a factor of 1.10 for hardwired CFLs to take account of the entire lighting system's power consumption. The Evaluator observed that this recommendation had been implemented for both these types of measures.

Custom Measures

Implementing one of last year's recommendations made by the Evaluator, ENSC stopped approving projects involving custom measures. These measures are now claimed in a regular category which allows disclosing more information regarding the measure implemented. However, some projects involving custom measures already approved in 2013 were implemented in 2014 and have also been documented in the tracking system. Since there were only a small number of such measures this year, the savings from this measure category are claimed without any adjustment.

Calculation Validation

The Evaluator compared the savings recorded in the tracking sheet with the savings established through the engineering calculation using the parameters entered in the tracking sheet and found small errors among the 8,276 records. This has led to a small adjustment of 1.9 percent to the gross savings.

Hours of Operation

No light metering study was conducted for the 2014 impact evaluation. Therefore, the self-declaration ratio of 0.98, established by the Evaluator in 2012 by conducting a metering study, is used to adjust the hours of operation declared in the tracking system. This ratio is considered valid as the methodology used to get participants to report the hours of operation did not change. The only exception to this adjustment is exit signs, which are lit 24 hours a day.

Installation Rate

For this year's BES impact evaluation, 44 on-site visits were conducted for lighting measures. At each site, the quantity of products installed was validated against the quantities claimed in the tracking sheet. In situations where the location was a hospital or some other large facility, a representative sample of the lighting measures was validated.

An installation rate was calculated for each measure category. This rate is based on the proportion of product quantities counted during the on-site visits versus the quantities claimed in the tracking sheet. The following table shows the data and rates established for each measure category.

Table 11: Installation Rates for BES Lighting Measures

Category	Number of Sites Visited	Total Quantity from the 44 Sampled Sites	Total Quantity Validated During On-site Visit	Total Quantity Installed	% Evaluated	% Installed	Margin of Error ⁵	Installation Rate
T8	23	7,466	7,466	7,352	100%	98%	2.1%	98%
CFL	7	43	43	52	100%	121%	20.4%	100%
LED	36	7,919	7,385	7,168	93%	97%	1.9%	97%
Custom	12	400	400	400	100%	100%	0%	100%
T-5	4	576	576	576	100%	100%	0%	100%
Metal Halide	5	90	90	90	100%	100%	0%	100%
Exit signs	4	59	59	59	100%	100%	0%	100%

Based on an acceptable margin of error of 10 percent or less, the above installation rates were applied to all measure categories except for CFLs, for which a margin of error of 20.4% was established. Thus, a calculation rate of 100% was applied to this measure category.

In 2013, it was recommended that ENSC advise the DAs that no CFL lamps were to be left with the client for future installation, especially the screw-in type. During this year's visits, it was observed that—although this type of measures was not prevalent in the sample—the issue seemed to have been resolved.

5.1.2 Unitary Savings for BES Non-lighting Measures

The following are the non-lighting measures eligible under BES in 2014:

- › Ductless mini-split heat pumps
- › ECM
- › Outdoor air economizers
- › Hot water heat pumps
- › Hot water tank wraps
- › Pipe insulation
- › Spray valves
- › Faucet aerators
- › Vending machine misers

⁵ Calculated for a 90% confidence interval.

The only non-lighting measures installed in 2014 were ductless heat pumps, hot water heat pumps, hot water tank wraps, pipe insulation and vending misers. Therefore, the unitary savings review will solely focus on these measures.

Ductless Mini-split Heat Pumps

For 2014, 170 heat pumps were installed in 67 participating facilities.

Tracked Savings

For each heat pump model, the energy and peak demand savings associated with heating were calculated using the following algorithms:

$$\text{Annual Energy Savings } (\Delta \text{ kWh}) = \text{Capacity} \times \left(\frac{1}{\text{HSPF}_{\text{Base}}} - \frac{1}{\text{HSPF}_{\text{EE}}} \right) \times \text{Full Load Hours}$$

$$\text{Annual Peak Demand Savings } (\Delta \text{ kW}) = \text{Capacity} \times \left(\frac{1}{\text{HSPF}_{\text{Base}}} - \frac{1}{\text{HSPF}_{\text{EE}}} \right)$$

Where:

- › **Capacity:** This is the nominal heating capacity of the heat pump (kBTU/hr).
- › **Heating Seasonal Performance Factor (HSPF):** For the old equipment, the HSPF is estimated at 3.412, based on the assumption that electric baseboard heating is used. The HSPF for the proposed energy-efficient heat pump is derived from the manufacturer's specifications sheet and is then adjusted according to the region (Region V).
- › **Full Load Hours:** The annual winter full-load hours value is estimated at 2,200 hours.

This calculation method is based on the equations presented in the 2014 Business Energy Rebate (BER) CIRx Screening Tool v1.2. These equations are based on the Efficiency Vermont Technical Reference Manual (TRM).⁶

The 2013 impact evaluation recommended the full load hours be changed to 2,750 hours per year. According to the Air Conditioning, Heating, and Refrigeration Institute's *Standard for Performance Rating of Air-Source Heat Pump Equipment*⁷, this value corresponds to Region V. ENSC continued, however, to use 2,200 operating hours in energy savings calculations in 2014.

Revised Savings

The Evaluator conducted six on-site visits for this year's evaluation. Adjustments were made to four of the six visits. The adjustments were due to the following reasons:

⁶ Efficiency Vermont, "Technical Reference User Manual (TRM) – Measure Savings Algorithms and Cost Assumptions", September 20, 2011.

⁷ Air Conditioning, Heating, and Refrigeration Institute, *2008 Standard for Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump*, March 2012.

- › The heating capacity was adjusted to the nominal heating capacity for one project.
- › The 2013 recommended value of full load hours of 2,750 was not used.
- › Only cooling savings were applied for one project as the facility's main heat source was oil.
- › Cooling savings were added to one project.

These revisions resulted in adjustments to the gross energy and peak demand savings for each visited project. This resulted in a large margin of error, prompting adjustments to the individual projects only. The gross energy savings increased from 0.0366 to 0.0367 GW and the gross peak demand savings decreased from 0.0184 MW to 0.0167 MW.

Cooling savings were applied to two projects this year as the participants declared that the new heat pumps replaced window air-conditioning units. The specifications of the removed air-conditioning units could not be validated. Consequently, a review of the documentation from the US Department of Energy was carried out to determine the appropriate Seasonal Energy Efficiency Ratio (SEER). The calculation used to determine the cooling savings is as follows:

$$\text{Annual Energy Savings } (\Delta \text{ kWh}) = \text{Capacity} \times \left(\frac{1}{\text{SEER}_{\text{Base}}} - \frac{1}{\text{SEER}_{\text{EE}}} \right) \times \text{Full Load Hours}$$

Where:

- › **Capacity:** The nominal cooling capacity of the heat pump.
- › **SEER:** The SEER of the existing unit is derived from the technology assessment documentation prepared by the US Department of Energy for units over 10 years old.⁸ The SEER of the proposed unit is based on the information provided in the manufacturer's specifications sheet.
- › **Full Load Hours:** The annual summer full load hours value is based on the Air Conditioning, Heating, and Refrigeration Institute's *Standard for Performance Rating of Air-source Heat Pump Equipment*. It is estimated at 400 hours.

For other participants who were not visited, the Evaluator revised energy savings calculations to take the 2,750 operating hours into account, corresponding to climatic Region V. The Evaluator also reviewed the HSPF values to ensure the correct Region 5 values were used.

These adjustments, along with adjustments applied to four of the six participants who were visited, resulted in a total adjustment ratio of 1.192 for energy savings and 0.997 for peak demand savings in heat pumps.

Once again this year, the Evaluator recommends that ENSC use operating hours and HSPF values corresponding to AHRI Region V⁹ for all heat pump measures installed through BES.

⁸ US Department of Energy, Chapter 3 – Market and Technology Assessment, page 41, 2001.

⁹ Air-Conditioning, Heating, and Refrigeration Institute, 2008 Standard for Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump, March 2012.

Hot Water Heat Pumps

There were two hot water heat pumps installed in 2014.

Tracked Savings

This is a new measure in the BES non-lighting measures this year, and the unitary savings are calculated on a case-by-case basis using the following algorithm from BER CIRx Screening Tool v1.3:

$$\Delta kWh = GPD \times days/yr \times C_v \times (T_{hot} - T_{cold}) \times \left(\frac{1}{3412}\right) \times \left(\frac{1}{EF_{Base}} - \frac{1.15}{EF_{EE}}\right) \times IE$$

$$\Delta kW = \Delta kWh \div Hrs$$

Where:

GPD: Gallons of hot water used per day.

C_v: Heat capacity of water (8.33 BTU/gal-°F).

T_{hot}: Temperature of the outlet water (assumed to be 130 °F).

T_{cold}: Temperature of the inlet water (assumed to be 46 °F).

(1/3412): Conversion factor between BTU and kWh.

EF_{Base}: Energy factor for the baseline water heater assumed to be 0.9.

EF_{EE}: Energy factor for the hot water heat pump assumed to be 2.5.

IE: Interactive effects based on the location of the hot water heat pump.

Hrs: Number of hours per year (8,760).

Revised Savings

As no site visits were conducted for this measure, the Evaluator deems the unitary savings value in the tracking report to be valid. It should be noted, however, that the tracking sheet provided to the Evaluator did not contain any of the necessary parameters listed above to validate the savings calculation. It is therefore recommended to include this information in the future. What is more, the peak demand savings in the tracking report were not calculated using the equation above; so, the Evaluator adjusted the calculations accordingly. An adjustment ratio of 0.799 was obtained for the peak demand savings from the hot water heat pump.

Hot Water Tank Wraps

A total of 93 tank wraps were installed in 2014.

Tracked Savings

During last year's evaluation, the unitary savings value for hot water tank wraps were based on the RP&C site visits, and the accompanying detailed engineering calculations were based on the average tank size and thermal resistance of the wrap. This resulted in a unitary savings value of 118 kWh per year.

Revised Savings

Since no site visit was conducted for RP&C Common Areas or for this specific BES measure, the unitary savings value of 118 kWh remains unchanged.

Pipe Insulation

A total of 215 six-foot pieces of pipe insulation were installed in 2014.

Tracked Savings

ENSC recorded pipe insulation in terms of six-foot units. The unitary savings value used by ENSC is 29.8 kWh per six-foot unit of pipe insulation installed.

Revised Savings

In 2013, the Evaluator recommended using the value of 29.8 kWh per year for each foot of pipe insulated and maximum allowable savings of 447 kWh, corresponding to 15 feet of pipe.

ENSC chose, however, to apply this recommended value to a six-foot piece of pipe insulation. The Evaluator therefore adjusted the savings to consider this choice, which resulted in an adjustment ratio of six for pipe insulation.

For this year's evaluation, the Evaluator also decided to remove the maximum allowable savings of 447 kWh. Additional savings should be taken into account for lengths of pipe going over 15 feet as the faucet does not have to be on as long to get hot water when insulation is in place. Actually, ENSC did not include this limit in its calculations. This had consequently no impact on revised energy savings.

Vending Machine Misers

This product is a control device for old beverage vending machines. Equipped with an occupancy sensor, the vending miser alters the performance of the device following a period of inactivity by turning off the machine's lights and cycling the compressor based on the ambient temperature.

A total of 62 vending misers were installed in 2014. Ninety-five percent of these purchases were for one client, to be installed at multiple locations.

Tracked Savings

The unitary savings value of 1,635 kWh is applied to this measure. The value is based on information listed in the Efficiency Vermont TRM.¹⁰ This energy savings value corresponds to relative savings of 46 percent. The calculation is as follows:

$$\text{Unitary Savings} = \frac{120V \times 3.56A \times 0.95 PF \times 8,760\text{hours} \times 46\% \text{ savings}}{1,000 \frac{W}{kW}} = 1,635 \text{ kWh/year}$$

Revised Savings

No visits were conducted for this measure. The unitary savings value of 1,635 kWh per year is thus considered valid and remains unchanged.

5.1.3 Unitary Savings for RP&C Common Areas

In addition to the measures mentioned above, measures implemented in RP&C Common Areas were also accounted for in BES in 2014.

The lighting measures are presented first and include the following:

- › Regular and dimmable CFLs
- › LED lamps
- › LED exit signs

All unitary savings values for these measures, both tracked and revised, were calculated using the following equation:

$$\text{Annual Unitary Savings} \left[\frac{kWh}{yr} \right] = \frac{(\text{Old Wattage} - \text{New Wattage}) \times \frac{h}{day} \times 365 \frac{day}{yr}}{1000 \frac{W}{kW}}$$

Other measures aiming to reduce the energy use of domestic hot water include hot water tank wraps, pipe insulation, faucet aerators and low-flow showerheads and showerwands.

CFLs

In the RP&C tracking sheet, the quantity of CFLs installed is recorded by lamp type (e.g., regular or dimmable) and wattage. The following five types of CFLs are listed in the 2014 tracking sheet:

- › 13-watt CFLs
- › 14-watt CFLs

¹⁰ Efficiency Vermont, Technical Reference User Manual (TRM) – Measure Savings Algorithms and Cost Assumptions, September 20, 2011.

- › 23-watt CFLs
- › 14-watt dimmable CFLs
- › 16-watt dimmable CFLs

Displaced Wattage

The displaced wattages were estimated using (1) the 2013 on-site visit results, and (2) a comparison of the wattage value of each type of CFLs installed through the program with the average equivalent wattage of incandescent lamps it replaced using the set of light output equivalency values presented in the figure below.

Figure 3: Light Output Equivalency for Incandescent Lamps and CFLs¹¹

LIGHT OUTPUT EQUIVALENCY		
INCANDESCENT BULBS (WATTS)	MINIMUM LIGHT OUTPUT (LUMENS)	COMMON ENERGY STAR QUALIFIED LIGHT BULBS (WATTS)
40	450	9 TO 13
60	800	13 TO 15
75	1,100	18 TO 25
100	1,600	23 TO 30
150	2,600	30 TO 52

Hours of Operation

The hours of operation are based on a metering study conducted for Hydro-Québec's residential lighting program to estimate daily CFL usage.¹² It was assumed that all lamps installed in common areas were located indoors—the indoor value found in the study (2.68 hr/day) was consequently used for all lamps. This value differs from the hours of operation value used in last year's evaluation (16.2 hours per day).

In 2014, ENSC installed CFLs and LED A-lamps in less frequently used sockets (i.e., community rooms, guest restrooms) and PAR20, PAR30 and BR30 lamps in fixtures located in areas lit up to 24 hours a day. As a result, ENSC elected to use residential hours of operation for CFLs and LED A-lamps, and increased the hours of operation of other lamps.

¹¹ ENERGY STAR, "ENERGY STAR Qualified Light Bulbs – 2006 Partner Resource Guide".

¹² Econoler, "Evaluation Report: Programme Produits Mieux Consommer – Éclairage résidentiel, presented to Hydro-Québec", Québec, March 30, 2011.

Unitary Savings

Based on the displaced wattage values and the hours of operation described above, the table below presents the unitary savings values used in the tracking sheet for each category of CFLs.

Table 12: Unitary Savings Values for Each Type of CFLs

Type of CFL	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (hrs/day)	Tracked Unitary Savings Value (kWh/year)
13W CFL (Indoors)	60.0	13.0	47.0	2.68	46.0
14W CFL (Indoors)	60.0	14.0	46.0	2.68	45.0
23W CFL (Indoors)	93.5	23.0	70.5	2.68	69.0
14-Watt Dimmable	60.0	14.0	46.0	2.68	45.0
16-Watt Dimmable	60.0	16.0	44.0	2.68	43.0

LED Lamps

The following seven types of LED lamps are included in the RP&C tracking sheet for Common Areas:

- › 10-watt LED A-lamp
- › 10-watt dimmable A-lamp
- › 3-watt LED chandelier
- › LED exit lights
- › 12-watt BR30 LED lamp
- › 9-watt PAR20 LED lamp
- › 14-watt PAR30 LED lamp
- › 7-watt MR16 LED lamp

The 12-watt BR30 and 9-watt PAR20 LED lamps were new products under RP&C this year, and so ENSC established the unitary savings based on similar products that were revised in previous evaluations.

Displaced Wattage

Similarly to CFLs, the displaced wattage for LEDs, as determined in the 2013 evaluation, was based on either the results of on-site visits or an analysis of the light output equivalency.

Hours of Operation

As mentioned in the CFL section, a higher hours of operation value was used for LED lamps that were specifically installed in locations where they would be on most of the time. Consequently, hours of operation for all LEDs, with the exception of the LED chandeliers, were set to 24 hours per day. LED

chandeliers kept their hours of operation at 16 hours, as per the 2013 evaluation, as they were installed both in hallways and in less frequently occupied spaces.

Based on the displaced wattage values and the hours of operation described above, the table below presents the unitary savings values used in the tracking sheet for each category of LED lamps.

Table 13: Unitary Savings Values for Each Type of LED Lamps

Type of CFL	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (hrs/day)	Tracked Unitary Savings Value (kWh/year)
10W LED A-lamp	60.0	10.0	50.0	24	438
3W LED Chandelier	40.0	5.0	35.0	16	128
LED Exit Light	40.0	2.4	38.8	24	340
12W BR30 LED Lamp	85.0	12.0	73.0	24	639
9W PAR20 LED Lamp	50.0	9.0	41.0	24	359
14W PAR30 LED Lamp	90.0	14.0	76.0	24	666
7W MR16 LED Lamp	43.0	7.0	36.0	24	315

LED Exit Signs

LED exit signs of 2.3 watts were installed in RP&C Common Areas in 2014.

For this measure, ENSC uses a displaced wattage of 36.4 W. The hours of operation are 24 hours per day. This results in a unitary savings value of 319 kWh per year.

Low-flow Showerheads and Showerwands

For low-flow showerheads and showerwands, a 330 kWh value, equivalent to that of the products installed under RP&C tenant units, is applied.

Faucet Aerators

The same unitary savings as for faucet aerators installed in RP&C tenant units are applied to the common areas faucet aerators, at 122 kWh per unit.

Hot Water Tank Wraps

The tank wraps installed under RP&C in common areas have an thermal resistance value of 0.90 m².°C/W. The tracked savings value of 198 kWh is based on an engineering calculation performed for the same product installed on tank wraps of the RP&C tenant units.

Pipe Insulation

The tracked savings for pipe insulation correspond to the value used for the same product under RP&C tenant units—76 kWh by each six-foot unit or 12.7 kWh per foot.

5.1.4 Unitary Savings for LED Blitz Pilot

The remaining energy-efficient lighting and non-lighting measures of the LED Blitz pilot were implemented at the beginning of 2014. To verify the claimed savings resulting from these installed measures, the Evaluator established the total number of pieces of equipment installed in each measure category based on the entries documented in a separate tracking sheet for the other BES initiatives. LED Blitz only included the remaining measures to complete the unfinished portion of last year's initiative. The Evaluator thus applied the unitary savings values determined by the 2013 evaluation except for the 7-Watt MR16 since the unitary savings value of this product was not reviewed in 2013. A review was thus performed for this product only.

LED Blitz Lighting Measures

The LED Blitz initiative included the following eligible lighting products:

- › LED A-Lamp
- › LED MR16
- › LED GU10
- › LED BR30
- › LED BR40
- › LED PAR20
- › LED PAR30
- › LED PAR38
- › LED exit sign
- › LED chandelier

Tracked Savings

All unitary savings values were calculated using the following equation.

$$\text{Annual Unitary Savings} \left[\frac{kWh}{yr} \right] = \frac{(\text{Old Wattage} - \text{New Wattage}) \times \frac{h}{day} \times 365 \frac{days}{yr}}{1000 \frac{W}{kW}}$$

For each type of LED lamp, the unitary savings value is calculated by applying the parameters shown in the following table.

Table 14: Tracked Unitary Savings Values for Each LED Lamp Category

LED Lamp Category	Old Wattage (W)	New Wattage (W)	Displaced Wattage (W)	Hours of Operation (h/day)	Unitary Savings Value (kWh/year)
8-Watt A-Lamp	50	8	42	12.8	196.6
12-Watt A-Lamp	60	12	48	12.8	224.6
10-Watt MR16	50	10	40	12.8	187.2
7-Watt MR16	-	-	-	-	100.6
5-Watt GU10	50	5	45	12.8	210.6
11-Watt BR30	-	-	-	-	243.0
13-Watt BR30	65	13	52	12.8	243.4
11-Watt BR40	-	-	-	-	384.0
18-Watt BR40	100	18	82	12.8	383.8
7-Watt PAR20	50	7	43	12.8	201.2
14-Watt PAR30	75	14	61	12.8	285.5
17-Watt PAR38	90	17	73	12.8	341.6
3-Watt LED Exit Sign	25	3	22	24	192.7
3-Watt Chandelier	25	3	22	12.8	103.0

By taking into account the specific types of businesses where the LED products were installed, the value of 12.8 hours of operation per day was established based on the following assumption:

- › For retail stores, restaurants, and malls: 12 hours per day from Monday to Saturday and 6 hours per day on Sunday
- › For hotel hallways: 24 hours per day, 7 days per week

This value of 12.8 hours does not apply to the LED exit sign, which is lit 24 hours a day.

Revised Savings

In the 2013 impact evaluation, the unitary savings values of the 11-Watt BR30 and 11-Watt BR40 lamps were revised to 252 kWh each. However, ENSC continued to use the 2013 tracked savings values of 243 kWh and 384 kWh respectively. The Evaluator therefore adjusted the unitary savings value to 252 kWh for both of these products.

Compared to 2013, the only difference in the LED lamp categories installed in 2014 was the 7-Watt MR16 lamp. For this product, ENSC uses a unitary savings value of 100.6 kWh, and no information regarding displaced wattage and hours of operation was entered in the tracking sheet. The Evaluator has decided to apply the 7-Watt PAR20's displaced wattage and hours of operations also to the 7-Watt MR16 lamp. Therefore, a unitary savings value of 201.2 kWh has been used to calculate this lamp type's energy savings. The unitary savings for the 7-watt LED MR16 are calculated as follows:

$$\text{Annual Unitary Savings} \left[\frac{\text{kWh}}{\text{yr}} \right] = \frac{(\text{Old Wattage} - \text{New Wattage}) \times \frac{h}{\text{day}} \times 365 \frac{\text{days}}{\text{yr}}}{1000 \frac{W}{kW}}$$

$$\text{Annual Unitary Savings} \left[\frac{\text{kWh}}{\text{yr}} \right] = \frac{(50W - 7W) \times \frac{12.8h}{\text{day}} \times 365 \frac{\text{days}}{\text{yr}}}{1000 \frac{W}{kW}}$$

$$\text{Annual Unitary Savings} \left[\frac{\text{kWh}}{\text{yr}} \right] = 201.2 \text{ kWh/year}$$

Vending Machine Misers

Vending machine misers were installed through LED Blitz in 2014.

ENSC used the same tracked savings value used for BES non-lighting measures. The calculation is as follows:

$$\text{Unitary Savings} = \frac{120V \times 3.56A \times 0.95 PF \times 8,760\text{hours} \times 46\% \text{ savings}}{1,000 \frac{W}{kW}} = 1,635 \text{ kWh/year}$$

Faucet Aerators

As for the faucet aerators installed through the LED Blitz pilot, ENSC uses an average unitary savings value of 261 kWh per year. This value has been calculated based upon the 2011 Ontario Power Authority (OPA) Prescriptive Measures and Assumptions report, which states that installation of a faucet aerator reduces the flow rate from 2.2 gallons per minute (8.33 L/min) to 1.5 gallons per minute (5.68 L/min), representing a reduction of 32 percent. During the 2012 CDI impact evaluation, the value of 261 kWh was established by considering the unitary savings values according to the facility types and the proportion of the facilities in each facility type recorded in the tracking sheet.

Table 15: Calculation of Unitary Savings Associated with Faucet Aerators

Type of Commercial Facility	Proportion in the 2012 CDI Tracking Sheet	Unitary Savings (kWh/year)
Hotel	29%	93
Restaurant	12%	1,561
Office	8%	68
Retail	8%	180
School	3%	101
Other	40%	52
Average	100%	261

Spray Valves

For pre-rinse spray valves installed under the LED Blitz pilot, ENSC uses a unitary savings value of 2,500 kWh per year. This value is an average based on two studies conducted by Veritec Consulting in 2005. The study looked at twenty different locations: 10 locations in Calgary, Alberta,¹³ and 10 locations in Waterloo, Ontario.¹⁴ In 2013, the Veritec study was found to be the most accurate information available, as it is based on metered data.

Installation Rate

As there were no on-site visits for the LED Blitz pilot, the installation rate is assumed to be 100 percent for all the lighting and non-lighting products.

5.2 Gross Peak Demand Savings

Diversity Factor

Based on information provided by ENSC, the peak period for electricity demand in Nova Scotia occurs weekdays from 7 a.m. to 12 p.m. and 4 p.m. to 11 p.m. in December, January and February. Similar to evaluations completed in the past three years, Econoler used the 5 p.m. to 7 p.m. and Monday through Friday timeframe as the peak load period.

The on-site protocol sheets used by the Evaluator included a section to verify the declared operational schedules. It was determined whether the implemented measures were operational during the peak period load hours for electricity in Nova Scotia or even a portion of those hours. For each location, the percentage of the total demand savings occurring during the peak demand period was established.

¹³ Veritec Consulting Inc., "City of Calgary Pre-Rinse Spray Valve Pilot Study: Final Report", December 2005, Mississauga, Ontario.

¹⁴ Veritec Consulting Inc., "Region of Waterloo Pre-Rinse Spray Valve Pilot Study: Final Report", January 2005, Mississauga, Ontario.

For the BES lighting measures a diversity factor of 69 percent was determined by calculating the weighted average of diversity factors obtained for the 44 visited sites. This factor was applied to all lighting products, excluding LED exit signs, which are always illuminated, and thus set to 100 percent.

For the BES heat pump measures, the operational schedules and the building types for each participant were collected during the on-site visit. In one case, the diversity factor equalled 0 percent as only cooling savings were claimed. The remaining five sampled heat pumps installations are operational during the heating season. Therefore, the weighted average diversity factor was calculated to be 98 percent.

For the lighting products installed in RP&C Common Areas, peak demand savings from lighting products are calculated using the displaced wattage and a 25 percent and 100 percent diversity factor for CFLs (which have shorter operation hours) and LED lamps respectively.

For the lighting products installed under the LED Blitz pilot, peak demand savings are calculated using the displaced wattage and a 100 percent diversity factor, considering the large hours of operation estimated for those products, resulting in a high probability that the lights would be turned on during the peak load period.

Peak Demand-to-Energy Ratio

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.177 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by BES in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

5.3 Revised Gross Savings

The Evaluator revised the gross energy and peak demand savings calculated in the BES final tracking system for each main category of the program.

5.3.1 Revised Gross Savings for BES Lighting Measures

As presented in section 5.1.1, the Evaluator revised the gross energy and peak demand savings of BES lighting measures calculated in the final tracking system based on the adjustments made to the following:

- › Calculation errors
- › Self-declaration ratio for hours of operation
- › Installation rates
- › Diversity factors

A line loss factor of 1.070 was used to compensate for the electricity losses between the meter and the generator. This line loss factor is a weighted average of the energy savings associated with each rate code category. The rate codes were extracted from the final tracking system for BES lighting measure participants. Nova Scotia Power provided the line loss factors for each rate code.

The total revised savings obtained for each eligible lighting measure category are presented in the following table. The total gross energy savings for the BES lighting measures are estimated at 13.058 GWh at the meter and 13.972 GWh at the generator respectively. The total gross peak demand savings are 2.331 MW at the meter and 2.495 MW at the generator respectively.

Table 16: Evaluation of Gross Energy and Peak Demand Savings Associated with BES Lighting Measures

Category of Product	LEDs		Fluorescent T8		CFLs	Custom	T5	Exit Signs	Metal Halide	Others	Total
	Reballast (linear)	Other	Reballast	Other							
Tracking Sheet											
Initial Tracked Savings (GWh)	1.136	8.322	3.030	0.125	0.196	0.490	0.416	0.063	0.330	0.022	14.131
Calculated Tracked Savings (GWh)	1.174	8.483	3.017	0.136	0.195	0.490	0.482	0.058	0.343	0.022	14.399
Tracked Demand Savings (MW)	0.210	1.784	1.054	0.063	0.075	0.135	0.125	0.006	0.077	0.007	3.536
Evaluated Energy Savings											
Adjustment Ratio for the Ballast Factor	0.968	-	0.931	-	-	-	-	-	-	-	-
Self-declaration Ratio for Hours of Operation	0.98	0.98	0.98	0.98	0.98	0.98	0.98	1.00	0.98	0.98	-
Installation Rate	97%	97%	98%	98%	100%	100%	100%	100%	100%	100%	-
Total Gross Energy Savings – at Meter (GWh)	1.080	8.064	2.697	0.131	0.191	0.480	0.000	0.058	0.336	0.022	13.058
Line Loss Factor	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	-
Total Gross Energy Savings – at Generator (GWh)	1.156	8.628	2.885	0.140	0.204	0.513	0.000	0.062	0.360	0.024	13.972
Evaluated Peak Demand Savings											
Adjustment Ratio for the Ballast Factor	0.968	-	0.931	-	-	-	-	-	-	-	-
Installation Rate	97%	97%	98%	98%	100%	100%	100%	100%	100%	100%	-
Total Gross Demand Savings – at Meter (MW)	0.197	1.731	0.961	0.062	0.075	0.135	0.125	0.006	0.077	0.007	3.376
Diversity Factor	69%	69%	69%	69%	69%	69%	69%	100%	69%	69%	-
Total Gross Peak Demand Savings – at Meter (MW)	0.136	1.194	0.663	0.043	0.052	0.093	0.086	0.006	0.053	0.005	2.331
Line Loss Factor	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	-
Total Gross Demand Savings – at Generator (MW)	0.189	1.661	1.018	0.065	0.086	0.144	0.134	0.007	0.082	0.007	3.612
Total Gross Peak Demand Savings – at Generator (MW)	0.145	1.278	0.710	0.046	0.056	0.100	0.092	0.007	0.057	0.005	2.495

Based on evaluated gross savings results, the share of savings attributed to T8 lamps decreased by 56 percent in 2014, compared to 2013. BES lighting savings are now mainly attributable to the installation of LED lamps. This change and other market signals suggest that T8 lamps have penetrated the market and are progressively becoming the baseline instead of T12. However, the results show that LED tubes have mainly replaced fluorescent T8 as energy efficiency measure for applications having high hours of operation. The high cost of LED products still justifies the use of fluorescent T8 when operating hours are low, but this situation is likely to change in the future as the cost of LED tubes keeps dropping. For this reason, the Evaluator recommends that ENSC adjust eligibility criteria next year to limit the use of T8 to applications with low run times. ENSC should however plan on removing this technology completely from BES in the near future.

For similar reasons, the Evaluator also recommends that ENSC plan on removing all CFLs in the near future. The share of savings associated with this measure decreased by 68 percent in 2014 compared to 2013. A significant portion of this decrease was attributable to the removal of screw-in CFLs from the program. Hardwired CFLs are still eligible, and the use of this technology should be limited to special applications, for which the cost of LED technologies is still high. However, as the cost of LED products continues to drop, the complete removal of CFLs from BES in the near future should be planned on.

5.3.2 Revised Gross Savings for BES Non-lighting Measures

The Evaluator revised the gross energy and peak demand savings calculated for the BES non-lighting measures (section 5.1.2) based on the adjustments made to the following:

- › Adjustment ratios for heat pumps and pipe insulation
- › Installation rates
- › Diversity factors or peak demand-to-energy ratios

A line loss factor of 1.084 was used to compensate for the electricity losses between the meter and the generator. This line loss factor is a weighted average of the energy savings associated with each rate code category. The rate codes were extracted from the final tracking system for BES non-lighting measure participants. Nova Scotia Power provided the line loss factors for each rate code.

The total revised savings obtained for each eligible measure category are presented in Table 17. The total gross energy savings for the BES non-lighting portion are 1.377 GWh at the meter and 1.493 GWh at the generator respectively. The total gross peak demand savings are 0.486 MW at the meter and 0.526 MW at the generator respectively.

Table 17: Evaluation of Gross Energy and Peak Demand Savings Associated with BES Non-lighting Measures

Category of Product	Heat Pumps	Hot Water Tank Wraps	Pipe Insulation	Vending Machine Misers	Hot Water Heat Pumps	Total
Tracked Energy Savings (GWh)	1.017	0.011	0.006	0.101	0.015	1.150
Tracked Peak Demand Savings (MW)	0.497	-	-	-	0.002	0.499
Number of Units	170	92	214	62	2	540
Installation Rate	100%	100%	100%	100%	100%	-
Number of Units Installed	170	92	214	62	2	-
Energy Savings						
Unitary Savings Value (kWh)	-	118	29.8	1635	-	-
Adjustment Ratio for Energy Savings	1.192	-	6.000	-	-	-
Total Gross Energy Savings – at Meter (GWh)	1.212	0.011	0.038	0.101	0.015	1.377
Line Loss Factor	1.084	1.084	1.084	1.084	1.084	-
Total Gross Energy Savings – at Generator (GWh)	1.314	0.012	0.041	0.110	0.016	1.493
Peak Demand Savings						
Peak Demand-to-Energy Ratio	-	0.177	0.177	0.177	-	-
Adjustment Factor for Demand Savings	0.997	-	-	-	0.799	-
Total Gross Demand Savings – at Meter (MW)	0.496	0.002	0.007	0.018	0.002	0.524
Diversity Factor	98%	-	-	-	-	-
Total Gross Peak Demand Savings – at Meter (MW)	0.486	-	-	-	-	0.486
Line Loss Factor	1.084	1.084	1.084	1.084	1.084	-
Total Gross Demand Savings – at Generator (MW)	0.537	-	0.007	0.019	-	0.564
Total Gross Peak Demand Savings – at Generator (MW)	0.526	-	-	-	-	0.526

5.3.3 Revised Gross Savings for RP&C Common Areas

The annual gross savings for each type of product installed in RP&C Common Areas are presented in Table 18. They were calculated using the unitary savings values presented in section 5.1.3.

The total gross energy and peak demand savings amount to 0.425 GWh and 0.052 MW at the meter respectively.

The gross savings at the generator level presented in Table 18 have been established using a line loss factor of 1.099 between the meter and the generator. This value was estimated by using the RP&C Common Areas participants' rate code included in the tracking sheet and the values provided by Nova Scotia Power Inc.

Based on these input values, the gross energy and peak demand savings at the generator for RP&C Common Areas were evaluated at 0.467 GWh and 0.057 MW respectively.

Table 18: Evaluation of Gross Energy and Peak Demand Savings Associated with RP&C Common Areas (CFLs)

Category of Product	13-Watt CFL	14-Watt CFL	23-Watt CFL	14-Watt Dim. CFL	16-Watt Dim. CFL	3-Watt LED Chandelier	10-Watt LED A-lamp	9-Watt PAR20	14-Watt PAR30
Number of Units	108	76	161	12	25	105	585	45	137
Installation Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Units Installed	108	76	161	12	25	105	585	45	137
Energy Savings									
Unitary Savings Value (kWh)	46.0	45.0	70.3	45.0	43.0	128	438	359.0	666.0
Total Gross Energy Savings – at Meter (GWh)	0.005	0.003	0.011	0.001	0.001	0.013	0.256	0.016	0.091
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Gross Energy Savings – at Generator (GWh)	0.005	0.004	0.012	0.001	0.001	0.015	0.282	0.018	0.100
Peak Demand Savings									
Diversity Factor	25%	25%	25%	25%	25%	75%	100%	100%	100%
Peak Demand-to-Energy Ratio	-	-	-	-	-	-	-	-	-
Hours of Operation	978	978	978	978	978	5 840	8 760	8 760	8 760
Total Gross Peak Demand Savings – at Meter (MW)	0.001	0.001	0.003	0.000	0.000	0.002	0.029	0.002	0.010
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Gross Peak Demand Savings – at Generator (MW)	0.001	0.001	0.003	0.000	0.000	0.002	0.032	0.002	0.011

Table 19: Evaluation of Gross Energy and Peak Demand Savings Associated with RP&C Common Areas Measures (Other Products)

Category of Product	12-Watt BR30	7-Watt MR16	LED Exit Lights	Low-flow Faucet Aerator	Low-flow Showerhead	Low-flow Showerwand	Pipe Insulation	Hot Water Tank Wrap (RSI-0.90)	Total for All Products
Number of Units	2	8	46	29	4	3	3	8	1,357
Installation Rate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Number of Units Installed	2	8	46	29	4	3	3	8	1,357
Energy Savings									
Unitary Savings Value (kWh)	639.0	315.0	340	122.0	330.0	330.0	12.7	198.0	-
Total Gross Energy Savings – at Meter (GWh)	0.001	0.003	0.016	0.004	0.001	0.001	0.000	0.002	0.425
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Gross Energy Savings – at Generator (GWh)	0.001	0.003	0.017	0.004	0.001	0.001	0.000	0.002	0.467
Peak Demand Savings									
Diversity Factor	100%	100%	100%	-	-	-	-	-	-
Peak Demand-to-Energy Ratio	-	-	-	0.177	0.177	0.177	0.177	0.177	-
Hours of Operation	8 760	8 760	8 760	-	-	-	-	-	-
Total Gross Peak Demand Savings – at Meter (MW)	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.052
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Gross Peak Demand Savings – at Generator (MW)	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.057

5.3.4 Revised Gross Savings for LED Blitz

The annual gross savings calculated for each category of product installed through LED Blitz are presented in Table 20 for lighting measures and in Table 21 for non-lighting measures. The calculations were completed by applying the unitary savings values for both types of measures provided in section 5.1.4. The gross energy and peak demand savings amount to 0.613 GWh and 0.127 MW at the meter respectively.

The gross savings at the generator level as displayed in Table 20 are have been established using a line loss factor of 1.064 between the meter and the generator. This is a weighted line loss factor based on the energy savings associated with each rate code extracted from the tracking sheet. Nova Scotia Power provided the line loss factors for each rate code. Energy savings and peak demand savings at the generator were established at 0.653 GWh and 0.135 MW, respectively.

Table 20: Evaluation of Gross Energy and Peak Demand Savings Associated with LED Blitz Lighting Measures

Category of Product	LED A-Lamp 8W	LED A-Lamp 12W	LED MR16 7W	LED GU10 5W	LED BR30 11W	LED BR30 13W	LED BR40 11W	LED BR40 18W	LED PAR20 7W	LED PAR30 14W	LED PAR38 17W	LED Exit Light 3W	LED Chand 3W
Number of Units	439	0	805	17	179	0	0	0	16	0	590	0	82
Installation Rate	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number of Units Installed	439	0	805	17	179	0	0	0	16	0	590	0	82
Energy Savings													
Unitary Savings Value (kWh)	197	225	201	211	252	243	252	384	201	285	342	193	103
Total Gross Energy Savings – at Meter (GWh)	0.086	0.000	0.162	0.004	0.045	0.000	0.000	0.000	0.003	0.000	0.202	0.000	0.008
Line Loss Factor	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064
Total Gross Energy Savings – at Generator (GWh)	0.092	0.000	0.172	0.004	0.048	0.000	0.000	0.000	0.003	0.000	0.214	0.000	0.009
Peak Demand Savings													
Diversity Factor	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Hours of Operation	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	4,680	8,760	4,680
Total Gross Peak Demand Savings – at Meter (MW)	0.018	0.000	0.035	0.001	0.010	0.000	0.000	0.000	0.001	0.000	0.043	0.000	0.002
Line Loss Factor	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.065	1.064	1.064	1.064	1.064	1.064
Total Gross Peak Demand Savings – at Generator (MW)	0.020	0.000	0.037	0.001	0.010	0.000	0.000	0.000	0.001	0.000	0.046	0.000	0.002

Table 21: Evaluation of Gross Energy and Peak Demand Savings Associated with LED Blitz Non-lighting Measures

Category of Product	Vending Machine Misers	Faucet Aerators	Pre-Spray Valves	Total for All LED Blitz Measures
Number of Units	60	1	2	2,191
Installation Rate	100%	100%	100%	-
Number of Units Installed	60	1	2	2,191
Energy Savings				
Unitary Savings Value (kWh)	1,635	261	2,500	-
Total Gross Energy Savings – at Meter (GWh)	0.098	0.000	0.005	0.613
Line Loss Factor	1.064	1.064	1.064	-
Total Gross Energy Savings – at Generator (GWh)	0.104	0.000	0.005	0.653
Peak Demand Savings				
Peak Demand-to-Energy Ratio	0.177	0.177	0.177	-
Total Gross Peak Demand Savings – at Meter (MW)	0.017	0.000	0.001	0.127
Line Loss Factor	1.064	1.064	1.064	-
Total Gross Peak Demand Savings – at Generator (MW)	0.018	0.000	0.001	0.135

5.4 Interactive Effects

Installing energy efficiency measures has an impact on the energy consumption of other building systems, such as heating and cooling equipment. This impact—either positive or negative—is referred to as interactive effects.

5.4.1 Interactive Effects for BES Lighting Measures

Installing new efficient lighting products to replace old lighting fixtures inside a conditioned space brings out an increase in the heating load during winter, as less waste heat from lighting systems is dissipated into space. Reversely, this reduction in dissipated heat contributes to reducing the cooling load during summer.

The calculation of a weighted interactive effect is based on a study conducted by ADS for Hydro-Québec in 1992.¹⁵ This study provides a table which contains cooling and heating interactive effect

¹⁵ ADS ASSOCIÉS, “Évaluations des effets énergétiques combinés des mesures d’économies d’énergie – secteur commercial,” report presented to Hydro-Québec, 1992.

coefficients for different types of buildings in the commercial sector. The interactive effect values provided in Table 22 have been calculated from the ADS study as follows:

- › For electric heating with air conditioning, the total interactive effect coefficient (i.e., for both heating and cooling combined) is obtained by averaging the total interactive effect coefficients for all building types considered in the reference study from ADS mentioned above.
- › For electric heating with no air conditioning, the interactive effect coefficient is the average heating coefficient for all building types considered in the ADS study.
- › For air conditioning, the interactive effect coefficient is the average cooling coefficient for all building types considered in the ADS study.

The resulting weighted interactive effect coefficient is -5.4 percent. This average value takes into account the coefficients mentioned above and the proportions of participating facilities for each building conditioning category which were directly obtained from the 44 on-site visits conducted for the 2014 BES lighting evaluation.

Table 22: Interactive Effects Calculation for Indoor Lighting Products

Building Conditioning Category	Proportion of Buildings	Interactive Effects
Electric Heating with Air Conditioning	10.3%	-43.4%
Electric Heating without Air Conditioning	2.6%	-49.0%
Heating and Cooling via Heat Pump	17.9%	-10.6%
No Electric Heating with Air Conditioning	38.5%	+5.7%
No Electric Heating without Air Conditioning	30.8%	0.0%
Weighted Interactive Effect Coefficient	-	-5.4%

As these interactive effect coefficients are only valid for products installed indoors, a further analysis was conducted to account for the proportion of lighting products installed outdoor. An average coefficient that takes into account the proportion of lighting products installed outside was developed. The percentage of products installed outdoors was obtained from the 44 on-site visits conducted. This resulted in an interactive effect coefficient of -5.2 percent, which was applied to all lighting products. The only exception was exit signs, which are only installed indoors. An interactive effect coefficient of -5.4 percent is thus applied for this product.

Table 23: Average Interactive Effect Factors for Lighting Products

Category of Product	% Indoor	% Outdoor	Interactive Effect Coefficient
Exit Signs	100%	0%	$(100\% \times -5.4\%) + (0\% \times 0\%) = -5.4\%$
All Other Lighting Products	97%	3%	$(97\% \times -5.4\%) + (3\% \times 0\%) = -5.2\%$

5.4.2 Interactive Effects for BES Non-lighting Measures

Interactive effects occur for hot water tank wraps, pipe insulation, hot water heat pumps and vending machine misers.

Heat released by non-insulated hot water tanks and pipes located in heated rooms are used for heating during the heating season and must be removed through air conditioning during summer. Installing hot water tank wraps and pipe insulation causes a reduction in dissipated heat, which causes an equivalent increase in the heating load during the heating season. Conversely, the reduction in dissipated heat causes an equally reduced cooling load in summer. Interactive effects of -100 percent are thus considered for the heating season. Assuming a COP of 2.5 for air conditioning, interactive effects of 40 percent are considered for the cooling season. The same interactive effects apply for vending machine misers since all the savings generated by this measure result in an equivalent reduction in dissipated heat.

For hot water heat pumps, savings are equivalent to the heat that is extracted from the indoor space. Interactive effects of -100 percent for heating and 40 percent for cooling are thus considered for this product.

Using the heating and cooling degree-days for the Halifax region¹⁶, an eight-month heating period and a two-month cooling period were deemed appropriate and used in the interactive effects calculation. The following table presents the detailed interactive factor calculation for hot water tank wraps, pipe insulation, hot water heat pumps and vending machine misers installed in participating facilities.

Table 24: Interactive Effect Factor for Hot Water Tank Wraps, Pipe Insulation, Hot Water Heat Pumps, and Vending Machine Misers

Parameters	% of Facilities	Interactive Effects During Heating Period	Interactive Effects During Cooling Period
Electric Heating with Air Conditioning	10.3%	$-100\% \times 8/12 = -67\%$	$+40\% \times 2/12 = +7\%$
Electric Heating without Air Conditioning	2.6%	$-100\% \times 8/12 = -67\%$	$0\% \times 2/12 = 0\%$
Heating and Cooling via Heat Pump	17.9%	$-40\% \times 8/12 = -27\%$	$+40\% \times 2/12 = +7\%$
No Electric Heating with Air Conditioning	38.5%	$0\% \times 8/12 = 0\%$	$+40\% \times 2/12 = +7\%$
No Electric Heating without Air Conditioning	30.8%	$0\% \times 8/12 = 0\%$	$0\% \times 2/12 = 0\%$
Weighted Interactive Effect Factor		-13.4%	+4.7%
		-8.7%	

¹⁶ RETScreen International, Normalized climate data for Halifax International Airport, Natural Resources Canada, 1997-2010.

5.4.3 Interactive Effects for RP&C Common Areas

Because savings for RP&C are only being tracked this year, no revision of the interactive effects was performed. The same interactive effect factors as last year—based on the BES values—were used. For lighting measures, the interactive effect factor was estimated at -13.2 percent, as all measures are implemented inside. For hot water tank wraps and pipe insulation, an interactive effect factor of -18.9 percent was used.

5.4.4 Interactive Effects for LED Blitz

For lighting measures implemented through LED Blitz, the Evaluator applied an interactive effect factor of -5.4 percent. This value was derived from the BES lighting measures installed in interior spaces. The interactive effect factor of -8.7 percent calculated for BES non-lighting measures was applied to vending machine misers. For all other non-lighting measures implemented—i.e., faucet aerators and pre-rinse spray valves—their interactive effects are considered to be negligible.

5.5 Net-to-Gross Ratios

To evaluate the NTGR of BES measures and RP&C Common Area measures, a self-report survey was conducted using a set of questions designed to measure the influence of the program on participants' decision on whether or not to implement eligible energy efficiency measures.

This section presents the methodology used to transform survey responses into an NTGR.

5.5.1 Net-to-Gross Ratio for BES

For BES lighting and non-lighting measures, to establish an NTGR, two kinds of distortion effects were assessed, namely free-ridership and internal spillover.

Free-ridership

In the case of BES, free-ridership can occur when participants would have still implemented the energy efficiency measures in the absence of the program. The free-ridership level was measured through the quarterly surveys on a sample of 129 participants, using the same algorithm as for the 2011, 2012 and 2013 evaluations. The algorithm behind the free-ridership calculation is presented in Appendix VII.

The survey results revealed an overall free-ridership level of 17 percent for BES. This free-ridership level is similar to the level established in the evaluations of the last two years and slightly higher than the levels established three years ago, namely 19 percent in 2013, 17 percent in 2012 and 12.8 percent in 2011.

Internal Spillover

The annual participant survey was used to assess internal spillover, which can occur when participants purchase and install additional energy efficiency measures following their previous participation in the program because of its influence, thereby demonstrating the value and advantages of such measures.

The methodology used to determine the level of internal spillover is presented in Appendix VIII.

Based on the survey results, an internal spillover factor of 0.3 percent was established for 2014. The past evaluations also established similar levels of internal spillover (1% in 2013, 0% in 2012 and 0.8% in 2011).

NTGR Calculation

The NTGR for BES has been calculated using the following equation:

$$NTGR = (1 - \% \text{ free-ridership} + \% \text{ internal spillover}).$$

Using the free-ridership and spillover levels established for BES, the NTGR value is estimated at 0.83.

5.5.2 Net-to-Gross Ratio for RP&C Common Areas

To determine the NTGR for RP&C Common Areas, one distortion effect was assessed, namely free-ridership.

Free-ridership

Free-ridership for RP&C Common Area was evaluated through the RP&C phone survey conducted with participating landlords, and targeted the same variable as BES. The specific algorithm behind its free-ridership calculation is presented in Appendix IX.

The questions from the survey were asked for up to two of the four measures implemented in the common areas of the building:

- › CFL
- › LED bulb
- › LED exit sign
- › Pipe insulation or tank wrap

To come up with the overall free-ridership level, the results of all participants were averaged for each of those four types of measures. Then, a weighted average was applied based on the proportion of total gross savings represented by each measure. However, since too few participants could be reached for the LED exit lights, pipe insulation and tank wraps measures, and since savings for these measures represent less than 5 percent of the total savings, they were left out of the free-ridership calculation. For measures that were not included in the free-ridership measurement, a nil value was used.

A free-ridership level of 17 percent for the CFLs and LED lamps was calculated using this approach. This value is much lower than in 2013 (28%). The free-ridership level was much lower than last year for the CFLs,. The fact that CFLs were mostly installed in less frequently occupied spaces, where landlords had less interest in installing energy efficiency measures, may have had an impact on the reduced free-ridership level for this measure. The free-ridership level of LED lamps was similar to that of CFLs, and so their relative importance in the commons areas savings did not affect the overall free-ridership level.

NTGR Calculation

Using the established free-ridership level, the NTGR value for CFLs and LED lamps is estimated at 0.83, and applied to the gross savings. For other products, an NTGR value of 1.00 was applied.

5.5.3 Net-to-Gross Ratio for the LED Blitz Pilot

For all lighting and non-lighting measures implemented through the LED Blitz pilots, an NTGR of 1.00 has been applied.

5.6 Net Savings

The net savings for the program were estimated using the interactive effect factors and the NTGR mentioned above. The following equation was used to calculate the program net savings.

$$Net\ Savings = Gross\ Evaluation\ Savings \times (1 + Interactive\ Effect\ Factor) \times NTGR$$

This equation was used to calculate both peak demand and energy savings. The results obtained for BES lighting and non-lighting measures, RP&C Common Areas as well as the LED Blitz pilot are presented in the sub-sections below.

5.6.1 Net Savings for BES Lighting Measures

The table below shows the net savings established for BES lighting measures. The total net energy and peak demand savings amount to 10.274 GWh and 1.834 MW at the meter respectively and 10.993 GWh and 1.963 MW at the generator respectively.

Table 25: Evaluation of Net Energy and Peak Demand Savings Associated with BES Lighting Measures

Category of Product	LEDs		Fluorescent T8		CFLs	Custom	T5	Exit Signs	Metal Halide	Others	Total
	Reballast (linear)	Other	Reballast	Other							
Energy Savings											
Total Gross Energy Savings – at meter (GWh)	1.080	8.064	2.697	0.131	0.191	0.480	0.000	0.058	0.336	0.022	13.058
Interactive Effect Factor	-5.2%	-5.2%	-5.2%	-5.2%	-5.2%	-5.2%	-5.2%	-5.4%	-5.2%	-5.2%	-
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-
Total Net Energy Savings – at meter (GWh)	0.850	6.345	2.122	0.103	0.150	0.378	0.000	0.045	0.265	0.017	10.274
Line Loss Factor	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	-
Total Net Energy Savings – at generator (GWh)	0.909	6.789	2.270	0.110	0.161	0.404	0.000	0.049	0.283	0.019	10.993
Peak Demand Savings											
Total Gross Peak Demand Savings – at Meter (MW)	0.136	1.194	0.663	0.043	0.052	0.093	0.086	0.006	0.053	0.005	2.331
Interactive Effect Factor	-5.2%	-5.2%	-5.2%	-5.2%	-5.2%	-5.2%	-5.2%	-5.4%	-5.2%	-5.2%	-
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	-
Total Net Peak Demand Savings – at meter (MW)	0.107	0.940	0.522	0.034	0.041	0.073	0.068	0.005	0.042	0.004	1.834
Line Loss Factor	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	-
Total Net Peak Demand Savings – at generator (MW)	0.114	1.005	0.558	0.036	0.044	0.078	0.073	0.005	0.044	0.004	1.963

The following table compares the energy and peak demand savings established by this evaluation and those calculated in the 2014 tracking system.

Table 26: Comparison of Tracked and Evaluated Savings Associated with BES Lighting Measures at the Generator

	Initial Gross Savings	Adjusted Gross Savings	Gross with Interactive Effects	NTGR	Net Savings
Energy Savings					
Tracked Savings from ENSC	15.134 GWh	14.796 GWh	12.843 GWh	0.82	10.531 GWh
Evaluation Results	15.120 GWh	13.972 GWh	13.245 GWh	0.83	10.993 GWh
Peak Demand Savings					
Tracked Savings from ENSC	3.787 MW	3.698 MW	3.210 MW	0.82	2.632 MW
Evaluation Results	3.787 MW	2.495 MW	2.365 MW	0.83	1.963 MW

The net energy savings evaluated for BES lighting measures are 4 percent higher than those tracked by ENSC. This difference can be explained by the reduction in interactive effects and the revised NTGR value, which is slightly lower than the tracked value. The increase in savings has been limited by the revision made to the ballast factor.

For peak demand savings, the difference between the tracked and evaluated results can be explained by the addition of a diversity factor of 69 percent in the calculation.

5.6.2 Net Savings for BES Non-lighting Measures

Table 27 presents the net energy and peak demand savings associated with BES non-lighting measures. The total net energy and peak demand savings amount to 1.131 GWh and 0.403 MW at the meter respectively, and 1.226 GWh and 0.437 MW at the generator respectively.

Table 27: Evaluation of Net Energy and Peak Demand Savings Associated with BES Non-lighting Measures

Category of Product	Heat Pumps	Hot Water Tank Wraps	Pipe Insulation	Vending Machine Misers	Hot Water Heat Pumps	Total
Energy Savings						
Total Gross Energy Savings – at meter (GWh)	1.212	0.011	0.038	0.101	0.015	1.377
Interactive Effect Factor	-	-8.7%	-8.7%	-8.7%	-8.7%	-
NTGR	0.83	0.83	0.83	0.83	0.83	-
Total Net Energy Savings – at meter (GWh)	1.006	0.008	0.029	0.077	0.011	1.131
Line Loss Factor	1.084	1.084	1.084	1.084	1.084	-
Total Net Energy Savings – at Generator (GWh)	1.091	0.009	0.031	0.083	0.012	1.226
Peak Demand Savings						
Total Gross Peak Demand Savings – at meter (MW)	0.486	-	-	-	-	0.486
Interactive Effect Factor	-	-8.7%	-8.7%	-8.7%	-8.7%	-
NTGR	0.83	0.83	0.83	0.83	0.83	-
Total Net Peak Demand Savings – at meter (MW)	0.403	-	-	-	-	0.403
Line Loss Factor	1.084	1.084	1.084	1.084	1.084	
Total Net Peak Demand Savings – at generator (MW)	0.437	-	-	-	-	0.437

The following table compares the energy and peak demand savings established by this evaluation and those calculated in the 2014 tracking system.

Table 28: Comparison of Tracked and Evaluated Savings Associated with BES Non-lighting Measures at the Generator

	Initial Gross Savings	Adjusted Gross Savings	Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings					
Tracked Savings from ENSC	1.240 GWh	1.240 GWh	1.213 GWh	0.82	0.995 GWh
Evaluation Results	1.247 GWh	1.493 GWh	1.478 GWh	0.83	1.227 GWh
Peak Demand Savings					
Tracked Savings from ENSC	0.538 MW	0.538 MW	0.537 MW	0.82	0.440 MW
Evaluation Results	0.541 MW	0.526 MW	0.526 MW	0.83	0.437 MW

The net energy and peak demand savings evaluated for BES non-lighting measures are 23 percent higher and one percent lower, respectively, than those tracked by ENSC.

The main factor explaining the increase in energy savings is the adjustment made to heat pumps operating hours. This adjustment considered 2,750 hours, while ENSC used 2,200 hours in its calculations. The impact of this adjustment is significant, as energy savings from heat pumps account for 89 percent of BES non-lighting savings.

5.6.3 Net Savings Associated with RP&C Common Areas

Table 29 presents the details of the net savings calculation for each measure. The total net energy and peak demand savings amount to 0.310 GWh and 0.038 MW at the meter respectively, and 0.341 GWh and 0.042 MW at the generator respectively.

Table 29: Evaluation of Net Energy and Peak Demand Savings Associated with RP&C Common Areas (CFLs)

Category of Product	13-Watt CFL	14-Watt CFL	23-Watt CFL	14-Watt Dim. CFL	16-Watt Dim. CFL	3-Watt LED Chandelier	10-Watt LED A-lamp	9-Watt PAR20	14-Watt PAR30
Energy Savings									
Total Gross Energy Savings – at meter (GWh)	0.005	0.003	0.011	0.001	0.001	0.013	0.256	0.016	0.091
Interactive Effect Factor	-13.8%	0.0%	-13.8%	0.0%	-13.8%	0.0%	-13.8%	-13.8%	-13.8%
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Total Net Energy Savings – at meter (GWh)	0.004	0.003	0.008	0.000	0.001	0.011	0.183	0.012	0.065
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Net Energy Savings – at generator (GWh)	0.004	0.003	0.009	0.000	0.001	0.012	0.201	0.013	0.072
Peak Demand Savings									
Total Gross Peak Demand Savings – at meter (MW)	0.001	0.001	0.003	0.000	0.000	0.002	0.029	0.002	0.010
Interactive Effect Factor	-13.8%	0.0%	-13.8%	0.0%	-13.8%	0.0%	-13.8%	-13.8%	-13.8%
NTGR	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Total Net Peak Demand Savings – at meter (MW)	0.001	0.001	0.002	0.000	0.000	0.001	0.021	0.001	0.007
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099
Total Net Peak Demand Savings – at generator (MW)	0.001	0.001	0.002	0.000	0.000	0.002	0.023	0.001	0.008

**Table 30: Evaluation of Net Energy and Peak Demand Savings Associated
 with RP&C Common Areas (Other Products)**

Category of Product	12-Watt BR30	7-Watt MR16	LED Exit Lights	Low-flow Faucet Aerator	Low-flow Showerhead	Low-flow Showerwand	Pipe Insulation	Hot Water Tank Wrap (RSI-0.90)	Total for All Products
Energy Savings									
Total Gross Energy Savings – at meter (GWh)	0.001	0.003	0.016	0.004	0.001	0.001	0.000	0.002	0.425
Interactive Effect Factor	-13.8%	0.0%	-13.8%	-13.8%	0.0%	-13.8%	0.0%	-13.8%	-
NTGR	0.83	0.83	1.00	1.00	1.00	1.00	1.00	1.00	-
Total Net Energy Savings – at meter (GWh)	0.001	0.002	0.013	0.003	0.001	0.001	0.000	0.001	0.310
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	-
Total Net Energy Savings – at generator (GWh)	0.001	0.002	0.015	0.003	0.001	0.001	0.000	0.002	0.341
Peak Demand Savings									
Total Gross Peak Demand Savings – at meter (MW)	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.052
Interactive Effect Factor	-13.8%	0.0%	-13.8%	-13.8%	0.0%	-13.8%	0.0%	-13.8%	-
NTGR	0.83	0.83	1.00	1.00	1.00	1.00	1.00	1.00	-
Total Net Peak Demand Savings – at meter (MW)	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.038
Line Loss Factor	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	-
Total Net Peak Demand Savings – at generator (MW)	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.042

The following table presents the energy and peak demand savings established by this evaluation.

Table 31: Comparison of Tracked and Evaluated Savings Associated with RP&C Common Area Measures at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings					
Verified Savings	0.467 GWh	0.467 GWh	0.406 GWh	0.83	0.341 GWh
Peak Demand Savings					
Verified Savings	0.057 MW	0.057 MW	0.050 MW	0.83	0.042 MW

5.6.4 Net Savings Associated with LED Blitz

Table 32 and Table 33 show the net savings established for LED Blitz lighting and non-lighting measures respectively. The total net energy and peak demand savings for all the measures implemented through LED Blitz amount to 0.577 GWh and 0.120 MW at the meter respectively, and 0.614 GWh and 0.128 MW at the generator respectively.

**Table 32: Evaluation of Net Energy and Peak Demand Savings Associated
 with LED Blitz (Lighting Measures)**

Category of Product	LED A- Lamp 8 W	LED A- Lamp 12 W	LED MR16 10 W	LED GU10 5 W	LED BR30 11 W	LED BR30 13 W	LED BR40 11 W	LED BR40 18 W	LED PAR20 7 W	LED PAR30 14 W	LED PAR38 17 W	LED Exit Light 3 W	LED Chand. 3 W
Energy Savings													
Total Gross Energy Savings – at meter (GWh)	0.086	0.000	0.162	0.004	0.045	0.000	0.000	0.000	0.003	0.000	0.202	0.000	0.008
Interactive Effects Factor	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%
NTGR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Net Energy Savings – at meter (GWh)	0.082	0.000	0.153	0.003	0.043	0.000	0.000	0.000	0.003	0.000	0.191	0.000	0.008
Line Loss Factor	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064
Total Net Energy Savings – at generator (GWh)	0.087	0.000	0.163	0.004	0.045	0.000	0.000	0.000	0.003	0.000	0.203	0.000	0.008
Peak Demand Savings													
Total Gross Peak Demand Savings – at meter (MW)	0.018	0.000	0.035	0.001	0.010	0.000	0.000	0.000	0.001	0.000	0.043	0.000	0.002
Interactive Effect Factor	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%	-5.4%
NTGR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Net Peak Demand Savings – at meter (MW)	0.017	0.000	0.033	0.001	0.009	0.000	0.000	0.000	0.001	0.000	0.041	0.000	0.002
Line Loss Factor	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064
Total Net Peak Demand Savings – at generator (MW)	0.019	0.000	0.035	0.001	0.010	0.000	0.000	0.000	0.001	0.000	0.043	0.000	0.002

Table 33: Evaluation of Net Energy and Peak Demand Savings Associated with LED Blitz (Non-lighting Measures)

Category of Product	Vending Machine Misers	Faucet Aerators	Pre-Spray Valves	Total for All Measures
Energy Savings				
Total Gross Energy Savings – at meter (GWh)	0.098	0.000	0.005	0.613
Interactive Effect Factor	-8.7%	0.0%	0.0%	-
NTGR	1.00	1.00	1.00	-
Total Net Energy Savings – at meter (GWh)	0.090	0.000	0.005	0.577
Line Loss Factor	1.064	1.064	1.064	-
Total Net Energy Savings – at generator (GWh)	0.095	0.000	0.005	0.614
Peak Demand Savings				
Total Gross Peak Demand Savings – at meter (MW)	0.017	0.000	0.001	0.127
Interactive Effect Factor	-8.7%	0.0%	0.0%	-
NTGR	1.00	1.00	1.00	-
Total Net Peak Demand Savings – at meter (MW)	0.016	0.000	0.001	0.120
Line Loss Factor	1.064	1.064	1.064	-
Total Net Peak Demand Savings – at generator (MW)	0.017	0.000	0.001	0.128

The following table compares the energy and peak demand savings established by this evaluation and those calculated in the 2014 tracking system.

Table 34: Comparison of Tracked and Evaluated Savings Associated with LED Blitz at the Generator

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR	Net Savings
Energy Savings					
Tracked Savings from ENSC	0.566 GWh	0.566 GWh	0.505 GWh	1.00	0.505 GWh
Evaluation Results	0.653 GWh	0.653 GWh	0.614 GWh	1.00	0.614 GWh
Peak Demand Savings					
Tracked Savings from ENSC	0.117 MW	0.117 MW	0.104 MW	1.00	0.104 MW
Evaluation Results	0.135 MW	0.135 MW	0.128 MW	1.00	0.128 MW

The net energy and peak demand savings obtained through the evaluation for the LED Blitz pilot are respectively 22 percent and 23 percent higher than the tracked savings. The main factor explaining

this difference is the adjustment that was made to 7 W MR16 LED lamps. The unitary savings value used by the Evaluator was 201 kWh compared to the 101 kWh value used by ENSC. Moreover, the quantity of 7 W MR16 LED lamps represents 38 percent of all units installed under LED Blitz lighting. The revision of interactive effects for lighting products also accounts for the difference between tracked and revised results. For tracked savings, the interactive effect factor used by ENSC was -13.2 percent, while the interactive effect factors used for the evaluation results are -5.4 percent for the lighting measures.

6 OVERALL BES RESULTS

This section summarizes the overall results of the impact evaluation for BES. When combining the net savings generated from the measures implemented through BES, including LED Blitz, RP&C Common Areas and LED Blitz, the total energy and peak demand savings amount to 13.175 GWh and 2.570 MW respectively. The table below presents the total gross and net savings established for the 2014 impact evaluation of BES.

Table 35: Overall Comparison of Tracked and Evaluated Savings at the Generator for BES

	Initial Gross Savings	Installed Gross Savings	Installed Gross Savings with Interactive Effects	NTGR*	Net Savings
Energy Savings					
Tracked Savings from ENSC	17.407 GWh	17.069 GWh	14.967 GWh	0.83	12.372 GWh
Evaluation Results	17.487 GWh	16.585 GWh	15.743 GWh	0.84	13.175 GWh
Peak Demand Savings					
Tracked Savings from ENSC	4.499 MW	4.410 MW	3.901 MW	0.82	3.218 MW
Evaluation Results	4.520 MW	3.213 MW	3.069 MW	0.79	2.570 MW
* NTGRs differed for each component. The NTGRs presented in this table correspond to the rounded averages obtained by dividing the net savings by the installed gross savings (with interactive effects).					

CONCLUSION

The 2014 evaluation of BES demonstrated that the program component generated important electrical savings in 2014. Even though BES did not reach its targets in 2014, an increase in savings associated with the BES lighting and non-lighting measure categories was observed. Furthermore, savings associated with the implementation of LED lighting products have also increased, thus proving the efficiency of BES in promoting the use of the technology.

The evaluation revealed that participants' overall satisfaction with BES remains high (90%). The survey results however showed that the percentage of participants reporting a challenge or barrier to participation in 2014 increased to 23% of all the participants. Respondents who reported having experienced barriers cited problems with contractors, unavailability of measures and lack of financing.

The on-site visits performed as part of 2014 evaluation showed that work conducted by DAs is done according to ENSC's procedure. No lighting intensity measurement was performed during visits. DAs did mention, however, that such an analysis would be useful to identify overlit areas and to support participants in their decision to reduce the quantity of fixtures according to their lighting needs. Visited participants were also concerned about how to get replacement lamps. This information was not always given to participants and should be included in ENSC's procedures in the future.

For the year 2014, BES totalled 761 participants. In addition, 51 participants implemented RP&C Common Area measures and 42 participants took part in the LED Blitz pilot, which makes for a total of 854 participants for the whole BES component.

The impact evaluation revealed that, when all initiatives are considered together, BES generated net energy savings of 13.175 GWh and peak demand savings of 2.570 MW at the generator in 2014. To calculate the net savings of BES in 2014, the Econoler team reviewed the gross savings estimated by ENSC and included interactive effects for lighting and non-lighting measures. On-site visits were used to establish installation rates for the most installed products and to calculate diversity factors. The Econoler team also took into consideration the free-ridership and spillover calculated from participant annual and quarterly survey results.

APPENDIX I

2014 RECOMMENDATIONS

This Appendix summarizes all the recommendations made by the Evaluator throughout this report as well as the sections from which the recommendations originated.

Sections	Recommendations
Executive Summary	1 Make follow-up telephone calls to ensure participant satisfaction with the work done by the third-party contractor. Survey results showed that participants encountered issues with third-party contractors and the quality of their work. ENSC already requires that the DAs follow up with customers after installation to ensure their satisfaction. The Evaluator recommends that ENSC itself (instead of the DAs) make some follow-up phone calls with a certain portion of the participants so that ENSC is quickly made aware of any major issues related to DAs' work. Such phone calls by ENSC will help verify whether contractors have properly completed the work and met customer needs.
	2 Include a light intensity analysis as part of the on-site energy assessment and provide participants with information on how to obtain replacement products. DA visits, performed during the initial on-site assessment and the installation process, showed that no lighting intensity analysis was performed. All DAs mentioned that such an analysis would be helpful to identify overlit areas. The Evaluator thus recommends that ENSC evaluate the possibility to include a lighting intensity analysis during the initial assessment. This analysis could include the use of a ballast discriminator. This could help identify potential reballast measures and support participants in their decision to reduce the quantity of fixtures according to their lighting needs. However, additional costs and contractual agreements between DAs and ENSC should be taken into account before adding such an analysis into the assessment. Visits also showed that participants had questions on how to obtain replacement lamps in lighting projects. As it would be beneficial to participant satisfaction, this information should be systematically given to customers during the installation process and should be part of ENSC's procedures.
	3 Eliminate adjustment of operating hours of proposed measures to take burnt out lights, safety considerations and delamping into account. For some projects, the operating hours of the proposed measures have been increased to take existing burnt out lights into account. The Evaluator recommends that no adjustment should be made because of burnt out lights as they are usually replaced even if no lighting retrofit or fixture replacement is done. A similar adjustment to the proposed operating hours have been made for customers who wanted lights to be on 24 hours a day, seven days a week, for safety considerations. Safety considerations are not related to the energy efficiency measures implemented. Safety would have been a concern even without the replacement of lighting systems. For this reason, the Evaluator recommends that no increase in operating hours should be considered in the savings calculations for safety considerations. Operating hours were also adjusted to take the partial delamping of existing measures into account. This reduction should be taken into account through the quantity of lighting systems.

Sections	Recommendations
	4 Add information about cooling systems and hot water heat pumps in the non-lighting measures tracking report. The Evaluator reiterates this recommendation for heat pumps, which was first mentioned in the 2013 evaluation report. It is recommended to add new fields to record information regarding the cooling capacity and SEER of the existing cooling systems. This would enable more accurate savings calculations. The tracking report should also contain all hot water heat pump parameters required to perform energy savings calculations. 5 Develop a process for validating savings calculations. As detailed in the Impact Evaluation section, the Evaluator reviewed the energy savings recorded in the tracking sheet and found small calculation errors. To ensure that the savings recorded in the tracking sheet correspond to those calculated using the parameters documented for each measure (quantity, unitary wattage value, hours of operation, etc.), ENSC should develop a validation process using a formula that can automatically calculate savings using the parameters entered in the tracking sheet. This will ensure the consistency of the energy savings recorded for each measure. 6 Use ballast efficacy factor when available to evaluate system wattage of fluorescent and LED linear tube lighting system. For measure categories involving linear fluorescent and linear LED tubes to replace T8, the Evaluator recommends using first and foremost the ballast efficacy factor to evaluate the lighting system wattage. This parameter represents the ratio of the ballast factor to the system input wattage. This represents the most accurate method to calculate the energy consumption of the system wattage. When the ballast efficacy factor is not available, the Evaluator recommends using system wattage data from the literature. Databases for different ballast and lamp combinations are widely available in the literature for conventional T8 fluorescent tubes. For LED tubes, such databases may not be available in the near future. For proposed measures related to LED tubes, the Evaluator recommends using the product of the ballast factor and lamp nominal wattage, unless the ballast efficacy factor values of the system wattage databases become available. 7 Use proposed ratio value when the ballast factor is used as lighting system wattage to lamp nominal wattage ratio in savings calculations. In 2013, it was recommended to use a ratio of 0.85 instead of ratios ranging between 0.74 and 0.78 when the ballast factor is taken as the ratio of the lighting system wattage to lamps nominal wattage. This recommendation applies for LED linear tubes when the system wattage is taken as the product of the ballast factor and lamp nominal wattage. The Evaluator adjusted the savings calculations, as recommended in last year's evaluation.

Sections	Recommendations
	8 Plan on the complete and ultimate removal of CFLs and fluorescent T8 tubes from BES. BES results showed that savings associated with florescent T8 decreased by 53 percent in 2014. So, the Evaluator recommends that either (1) the use of fluorescent T8 be limited to applications with low operating hours next year; or (2) the fluorescent T8 be used for specific applications and that this technology be gradually yet completely phased out and removed in the near future. Similarly, the share of savings associated with CFLs decreased by 64 percent this year. A significant portion of this decrease was attributable to the removal of screw-in CFLs from the program. CFLs are now limited to hardwired lamps and special applications, for which the cost of LED technologies is still high. However, as the cost of LED products continue to drop, ENSC should plan on completely removing this technology from BES in the near future as well.
Tracking System	9 Remove the “BES Measure Occupancy Sensor Savings” field from the tracking report. Savings associated with occupancy sensors are now claimed through a reduction of operating hours. Moreover, some of the values presented in this field are not related to occupancy sensors.

APPENDIX II ON-SITE VISIT SAMPLING AND PROTOCOL - DURING THE INSTALLATION

BES Delivery Agent Visit Protocol

Site Visit Date: _____

DA Representative Name: _____

Visit Location: _____

Initial Assessment or Installation Visit (please circle one)

1. Does the DA properly identify and recommend lighting and non-lighting measures to reduce energy consumption? If not, explain why. List the recommended measures below.
2. Does the DA clearly explain the advantages of those measures?
3. Is/was a lighting survey performed during the initial audit? If not, explain why.
4. Were (or will) any fixtures (be) completely eliminated due to excess light levels?
5. Did the installed products replace less efficient products? List both replaced and installed product specification. If not, provide an explanation.
6. What is the typical lamp wattage and ballast factor currently being replaced?
7. What is the typical lamp wattage and ballast factor currently being installed?
8. Are DAs replacing lighting products that had previously been installed in the early years of the BES program?
9. Is light output (lumens) considered when making lighting recommendations to the participant?
10. Were the energy efficient products installed properly? If not, provide an explanation.
11. Were the original equipment specifications considered prior to recommending the non-lighting measures? (i.e. ECMs for walk-in freezers)
12. Were any products provided to the customer as “spares”? If so, is this the standard procedure for the DA?
13. Are all less efficient products removed and replaced with more efficient styles or is there a subjective decision made by the DA representative? If so, explain how the decision is made.



14. Is product information provided to the customer (i.e. where to buy replacements and their costs, life span, procedure to follow for pre-mature failure)?
15. How are the removed products disposed of?
16. What is the DA's procedure for dealing with participant complaints with respect to the newly installed products?
17. What was the lead-time from participant contract signing to product installation?
18. Was an electrical permit issued for this lighting installation?
19. Has this participant participated in other ENSC programs? If so, which one(s) and when?
20. What information is being captured by the DA during the initial assessment visit? (i.e. hours of operation, main heating source)

APPENDIX III ANNUAL PARTICIPANT SURVEY QUESTIONNAIRE

Could I speak with [INSERT NAME]?

1. Yes [GO TO INTRODUCTION]
2. No [SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]

INTRODUCTION

Hello, I am with CRA, Corporate Research Associates, a Halifax-based survey research company. We are performing an evaluation of energy efficiency services and programs provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your firm recently participated in Efficiency Nova Scotia Corporation's Business Energy Solutions Program. We would appreciate your cooperation in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. Are you the right person to answer this survey?

1. Yes [CONTINUE]
2. No [PROMPT: "Is there someone else in your organization who would know about having participated in the Business Energy Solutions Program?"]
___ Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
___ No [THANK & TERMINATE]
3. Don't know [PROMPT: "Is there someone else in your organization who would know about having participated in the Business Energy Solutions Program?"]
___ Yes [ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]
___ No [THANK & TERMINATE]
4. Refused [THANK AND TERMINATE]

The survey will take about ten minutes. Is this a good time for you?

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"]

[SCHEDULED, IF NECESSARY, FOR: _____]

Verification and Recall (Series V)

- V1. Our records indicate that your company or organization participated in Efficiency Nova Scotia's Business Energy Solutions Program. Is this correct?
1. Yes (GO TO V2)
 2. No (GO TO V1A)
 3. (Don't know) (GO BACK TO INTRODUCTION TO SPEAK TO SOMEONE ELSE)
 4. (Refused) (THANK AND TERMINATE)
- V1a. [ASK IF NO IN V1] Are you sure? The Business Energy Solutions program offers up to a 60% incentive to upgrade energy efficient lighting and non-lighting measures.
1. Yes (GO TO V2)
 2. No (THANK AND TERMINATE)
 3. (Don't know) (GO BACK TO INTRODUCTION TO SPEAK TO SOMEONE ELSE)
 4. (Refused) (THANK AND TERMINATE)
- V2. According to our information, through its participation in the Business Energy Solutions Program, your business or organization installed energy-efficient products in the facility located at [FACILITY ADDRESS STREET]. When answering the survey questions, please take into account only this facility.

Program Awareness and Participation (Series P)

- P2. What was the SINGLE most important reason your company or organization chose to participate in the Business Energy Solutions program? (DO NOT READ – accept one response]
1. (To take advantage of program incentives)
 2. (To see what else I should be doing as part of a planned project)
 3. (To save on energy costs/bills)
 4. (To reduce maintenance costs)
 5. (To improve existing lighting conditions)
 6. (To help protect the environment)
 7. (Recommended by contractor)
 8. (Energy efficiency in general)
 9. (Improve building in general)
 96. (Other (Please explain _____))
 98. (Don't know/Don't recall) (GO TO SECTION S)
 99. (Refused) (GO TO SECTION S)

P3. [DO NOT POSE IF 98 OR 99 IN Q.P2] What was the SECOND most important reason your company or organization chose to participate in the Business Energy Solutions Program? [DO NOT READ – ACCEPT ONE RESPONSE – SAME LIST AS P2]

97. No other reasons

Satisfaction (Series S)

CS1. How did your company first learn of the programs offered by Efficiency Nova Scotia?
DO NOT PROVIDE RESPONSE CATEGORIES - CODE AS MANY AS APPLICABLE.

- 1 Media advertising
- 2 Someone at Efficiency Nova Scotia contacted the business
- 3 Through a third-party contractor
- 4 The business contacted Efficiency Nova Scotia about the program
- 5 Word-of-mouth
- 6 Efficiency Nova Scotia website
- 7 Facebook or other social media
- 9 Other [SPECIFY: _____]
- 8 Cannot recall

S1. Thinking of your OVERALL experience with the Business Energy Solutions Program, including any services or energy efficient products received and installed, how satisfied were you overall with the program on a scale from 1 to 5, where 1='not at all satisfied' and 5='very satisfied'? [RECORD NUMBER, DO NOT ACCEPT A RANGE, 98 = Don't know, 99 = Refused]

S2. [IF DISSATISFIED, S1 = 1, 2 or 3] You indicated that you were not satisfied with the Business Energy Solutions program overall. What was the SINGLE most important reason you were not satisfied with the Business Energy Solutions program overall? [DO NOT READ. PROBE FOR SPECIFIC REASONS. ACCEPT ONE RESPONSE]

1. (The energy evaluation took too long)
2. (Products installed don't suit my needs)
3. (I expected more savings)
4. (I did not like the evaluator who visited the building)
5. (I expected faster savings)
6. (I did not like the payment plan)
7. (I would have liked a higher incentive/Incentive too low)
96. (Other [SPECIFY: _____])
98. (Don't know) (GO TO CS2)
99. (Refused) (GO TO CS2)

S3. [IF DISSATISFIED, S1 = 1, 2 or 3] Were there any other reasons you were not satisfied? [DO NOT READ - PROBE FOR SPECIFIC REASONS - ACCEPT MULTIPLE - SAME LIST AS S2 ABOVE]

97. No other reasons

CS2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent? **CODE ONE ONLY**

1. Directly with Efficiency Nova Scotia
2. Third-party contractor or agent **Skip to CS6**
3. Both

CS4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with **READ AND ROTATE**

CODE ONE RESPONSE FOR EACH FACTOR

- a. The technical expertise of Efficiency Nova Scotia employees related to the program
- b. The responsiveness of Efficiency Nova Scotia employees to your requests and enquiries in a timely manner
- c. The length of time between your initial audit and when you received your project proposal
- d. The value of the program relative to the time and cost involved
- j. The ability to provide estimates of the savings or return on investment associated with the program.

CS5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia’s overall performance in working with your business?

CODE ONE RESPONSE

- 01 Not at all satisfied
- 02
- 03
- 04
- 05
- 06
- 07
- 08
- 09
- 10 Completely satisfied
- 98 Don’t know/No answer

CS6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives?

[DO NOT READ RESPONSES – CODE ONE ONLY]

- 1. Yes
- 2. No

- 98. (Don't know)
- 99. (Refused)

IF YES IN CS6, CONTINUE, OTHERWISE SKIP TO CS28.

CS7. Overall, how satisfied were you with the level of service provided, by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied

- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

CS9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's... **[READ AND ROTATE FACTORS]? [CODE ONE RESPONSE FOR EACH FACTOR]**

- a. Service attitude
- b. Knowledge of programs available
- c. Ability to provide advice

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied

VOLUNTEERED

- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

CS28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia?

CODE ONE ONLY

1. Definitely
2. Probably
3. Probably not
4. Definitely not

7. [VOLUNTEERED] Not eligible for any other programs
8. [VOLUNTEERED] Don't know/No answer

CS29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others? **CODE ONE ONLY**

1. Definitely
2. Probably
3. Probably not
4. Definitely not

8. [VOLUNTEERED] Don't know/No answer

[IF CS2 = 2 OR 3, then ask:]

CS30. How satisfied were you overall with the service provided by your third-party contractor on managing the process of securing a payment from Efficiency Nova Scotia? Were you:

READ RESPONSES IN ORDER – CODE ONE ONLY

1. Completely satisfied
2. Mostly satisfied
3. Mostly dissatisfied
4. Completely dissatisfied
5. [VOLUNTEERED] Neither satisfied nor dissatisfied

8. [VOLUNTEERED] Don't know
9. [VOLUNTEERED] Refused

[IF CS2 = 2 OR 3, then ask:]

CS32. Based on your personal experience would you definitely, probably, probably not, or definitely not recommend this third-party contractor to others? **CODE ONE ONLY**

1. Definitely
2. Probably
3. Probably not
4. Definitely not

8. [VOLUNTEERED] Don't know
9. [VOLUNTEERED] Refused

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before you received your contract? [RECORD NUMBER OF DAYS, PROBE FOR SPECIFIC ANSWER. 98 = Don't know, 99 = Refused]

Barriers (Series B)

B1. Were there any challenges or barriers that your company or organization faced in implementing the energy efficiency measures provided through the Business Energy Solutions program?

1. Yes
2. No (GO TO R1)

98. (Don't know/Don't recall) (GO TO R1)
99. (Refused) (GO TO R1)

B5. What was the SINGLE most important challenge or barrier? [DO NOT READ - ONE RESPONSE]

1. (Lack of information about the program to make an informed decision)
2. (Too little incentive)
3. (Too much work required to obtain funding)
4. (Approval takes too long)
5. (Lack of financing)

- 6. (Decision made elsewhere)
- 7. (Do not own building – have to work through owner)
- 8. (Lack of technical knowledge)
- 9. (Lack of time / too busy)
- 10. (Focused on core business)
- 11. (Problems implementing/installing measures/products)
- 12. (Unavailability of measures/products)
- 96. (Other (Specify: _____))
- 98. (Don't know/Don't recall) (GO TO R1)
- 99. (Refused) (GO TO R1)

B6. What was the SECOND most important challenge or barrier? [DO NOT READ - ONE RESPONSE – SAME LIST AS B5]

- 97. No other barriers

Recommendations to Improve the Program (Series R)

R1. Do you have any suggestions to improve the Business Energy Solutions program? Consider all aspects of the program: Process, marketing, interactions with program staff, interactions with contractors and program forms. PROBE: Anything else? [RECORD VERBATIM]

- 98. Don't know

Spillover (Series SP)

SP1. Now I'd like you to think of the time **since you participated** in the Business Energy Solutions program. Has your company purchased and installed any additional energy-efficient products on its own for this facility?

- 1. Yes
- 2. No [GO TO F1]
- 98. (Don't know [GO TO F1])
- 99. (Refused) [GO TO F1]

SP2. IF SP1= YES, THEN ASK: I just want to make sure I understand - **After** you participated in the Business Energy Solutions program, your company installed additional energy-efficient products on its own for this facility. Is that correct?

- 1. Yes [GO TO SP3]
- 2. No [GO TO F1]
- 98. (Don't know) [GO TO F1]
- 99. (Refused) [GO TO F1]

From now on, I will specifically talk about the additional energy-efficient products your company installed on its own after participating in the Business Energy Solutions Program.

SP3. [IF SP2 = 'YES'] In purchasing the additional energy-efficient products, did you receive any other financing or incentive from any other Efficiency Nova Scotia program, or do you plan to submit a funding request for these purchases in the future?

1. Yes [GO TO F1]
2. No
98. (Don't know [GO TO F1])

SP4. [IF SP3 = 2 'NO'] I would like to know what are the additional energy-efficient products that you have installed on your own after participating in the Business Energy Solutions program. Did you install... [READ AND ROTATE, CODE ONE ONLY PER OPTION.

- a. Compact Fluorescent Lamps (CFLs)?
- b. Fixtures with T8 fluorescent lamps?
- c. Fluorescent high-performance ballasts?
- d. L-E-D exit signs?
- e. L-E-D lamps?
- f. Occupancy sensors?
- g. Mini-split heat pumps?
- h. Electronically commutated motors (ECM)
- i. Outdoor air economizers
- j. Hot water heat pumps
- k. Hot water tank wraps
- l. Pipe wraps
- 1 Yes
- 2 No
- 8 Don't know
- 9 Refused

[ASK FOR EACH 'YES' IN RESPONSE IN SP4A-G] SP4b_1. How many additional [INSERT PRODUCT] have you installed since participating in the Business Energy Solutions Program? [ENTER NUMBER. PROBE FOR A SPECIFIC ANSWER. DON'T KNOW=98, REFUSED=99]

SP4i. Are there any other energy-efficient products that you have installed on your own after participating in the Business Energy Solutions program?

1. Yes
2. No
98. (Don't know)

[IF YES]

SP4i_1. What are the other energy-efficiency products that you have installed since participating in the Business Energy Solutions Program? [RECORD VERBATIM. RECORD DIFFERENT PRODUCTS SEPARATELY. PROBE FOR A SPECIFIC ANSWER. DON'T KNOW=98, REFUSED=99) CODE UP TO FIVE DIFFERENT PRODUCTS]

SP4i_2. [ASK FOR EACH ANSWER TO SP4i_1] How many of these [INSERT RESPONSE FROM SPI_1 HERE] energy-efficiency products have you installed since participating in the Business Energy Solutions Program?

SP5. [IF SP3 = 2 'NO'] Did your experience with the energy-efficient products installed through the Business Energy Solutions Program influence your decision to install some or all of these additional energy-efficient products on your own? Please, give your answer on a scale of 0 to 10, where 0 indicates that the Business Energy Solutions program "had no influence at all on your decision to install the energy-efficient products" and 10 indicates that the program was "extremely influential to your decision to install the energy-efficient products." [RECORD RESPONSE 0-10, 98 = Don't know, 99 = REFUSED] [DO NOT ACCEPT A RANGE]

Firmographics (Series F)

These final questions are asked for statistical purposes only. The information collected is strictly confidential.

F1. What is the main activity of the facility where the energy efficiency improvements were implemented under the Business Energy Solutions Program? [DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]

1. (Education)
2. (Food Sales (grocery))
3. (Food Service (restaurant))
4. (Health Care – Inpatient)
5. (Health Care – Outpatient)
6. (Lodging)
7. (Mercantile – Enclosed and Strip Malls)

- 8. (Mercantile – Retail (Other than Mall))
- 9. (Office)
- 10. (Public Assembly)
- 11. (Public Order and Safety)
- 12. (Religious Worship)
- 13. (Service)
- 14. (Warehouse and Storage)
- 15. (Manufacturing) (Identify Industry Type _____
(e.g., chemical, food, paper, etc.)
- 16. (Other: please explain _____)
- 17. (Vacant building)
- 98. (Don't know)
- 99. (Refused)

F2. Approximately how many full-time equivalent workers are employed at this facility? [DO NOT READ, CODE APPROPRIATE CATEGORY]

- 1. (Fewer than 5)
- 2. (5 to 9)
- 3. (10 to 19)
- 4. (20 to 49)
- 5. (50 to 99)
- 6. (100 to 249)
- 7. (250 or More)
- 98. (Don't know)
- 99. (Refused)

F4. We want to estimate the number of operating hours of the building where the energy efficiency improvements were implemented.

- F4a. On average, how many hours per day is the facility open?
[RECORD NUMBER OF HOURS 0-24, ACCEPT DECIMAL] [98 = Don't know/don't recall, 99 = Refused]
- F4b. How many days per week is the facility open?
[RECORD NUMBER OF DAYS 0-7, ACCEPT DECIMAL] [98 = Don't know/don't recall, 99 = Refused]
- F4c. And how many weeks per year is the facility open?
[RECORD NUMBER OF WEEKS 0-52, ACCEPT DECIMAL] [98 = Don't know/don't recall, 99 = Refused]

F5. Is your company independent, or part of a larger company?

- 1. (Independent)
- 2. (Part of a larger company)
- 96. (Other: please explain: _____)
- 98. (Don't know)
- 99. (Refused)

F6. How many business locations does your organization have in Nova Scotia? [RECORD A NUMBER 1-99; 998 = Don't know, 999 = Refused]

END: Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

APPENDIX IV ANNUAL PARTICIPANT SURVEY RESULTS

The BES participant survey results are presented in the following tables.

P2. What was the SINGLE most important reason your company or organization chose to participate in the Business Energy Solutions program?

P3. What was the SECOND most important reason your company or organization chose to participate in the Business Energy Solutions Program?

Reasons for Participating	2012		2013		2014	
	Most Important Motivation	Second Most Important Motivation	Most Important Motivation	Second Most Important Motivation	Most Important Motivation	Second Most Important Motivation
<i>Sample Size</i>	76	76	61	61	62	62
Save on energy costs/bills	66%	24%	69%	20%	63%	26%
Improve existing lighting conditions	13%	22%	16%	23%	15%	13%
Energy efficiency in general	3%	12%	-	18%	6%	11%
Take advantage of incentives	9%	9%	5%	13%	3%	13%
Help protect the environment	3%	8%	-	7%	2%	13%
To improve building	4%	-	-	-	2%	2%
Reduce maintenance costs	3%	1%	2%	3%	-	-
Recommended by a contractor	-	-	2%	-	-	-
See what I should be doing as part of a planned project	-	-	-	3%	-	-
Others	-	3%	7%	7%	10%	8%
None/No other reasons	-	20%	-	7%	-	10%
Don't know	-	1%	-	-	-	5%

B1. Were there any challenges or barriers that your company or organization faced in implementing the energy efficiency measures provided through the Business Energy Solutions program?

Any Barriers	2012	2013	2014
<i>Sample Size</i>	76	61	62
No	97%	84%	76%
Yes	3%	16%	23%
Don't know	-	-	2%

B5. What was the SINGLE most important challenge or barrier?

B6. What was the SECOND most important challenge or barrier?

Specific Barriers	2012		2013		2014	
	Most Important Barrier (#)	Second Most Important Barrier (#)	Most Important Barrier (#)	Second Most Important Barrier (#)	Most Important Barrier (#)	Second Most Important Barrier (#)
<i>Sample Size*</i>	2	2	10	10	14	14
Problem with contractor	-	-	1	-	2	1
Unavailability of measures/products	-	-	1	-	2	-
Lack of financing	-	-	1	-	2	-
Job was not completed/ measures/products missed	-	-	-	-	2	-
Problems implementing measures/installing products	-	-	3	-	1	1
Poor communication	-	-	-	-	1	1
Different levels of assistance between similar buildings	-	-	-	-	1	-
Lack of time/too busy	-	-	-	-	1	-
They lost our application/ paperwork	-	-	-	-	1	-
Length of time to complete project/took too long to complete project	-	-	-	-	-	2
Approval takes too long	-	-	-	-	-	1
Lack of information to make an informed decision	-	-	2	-	-	-
Do not own building – have to work through owner	-	-	1	-	-	-
Too much work required to obtain funding	1	-	-	-	-	-
Others	1	-	1	1	1	1
None/No other barriers	-	2	-	8	-	7
Don't know	-	-	-	1	-	-
*Base: Respondents who said there were barriers to participating in BES						

S1. Thinking of your OVERALL experience with the Business Energy Solutions Program, including any services or energy efficient products received and installed, how satisfied were you overall with the program on a scale from 1 to 5, where 1='not at all satisfied' and 5='very satisfied'?

Satisfaction with BES	2012*	2013***	2014***
<i>Sample Size**</i>	76	59	62
Overall program	95%	97%	90%
*Base: Percentage of respondents who were very satisfied/satisfied **Don't know/'Refused' removed from calculations ***Percentage of respondents who gave a rating of 5 or 4 on a scale where 5='Very satisfied' and 1='Not at all satisfied'			

S2. You indicated that you were not satisfied with the Business Energy Solutions program overall. What was the SINGLE most important reason you were not satisfied with the Business Energy Solutions program overall?

S3. Were there any other reasons you were not satisfied?

Reasons Less Satisfied with BES	2012		2013		2014	
	Most Important Reason (#)	Second Most Important Reason (#)	Most Important Reason (#)	Second Most Important Reason (#)	Most Important Reason (#)	Second Most Important Reason (#)
<i>Sample Size*</i>	4	4	2	2	6	6
Process/program took too long	-	-	-	-	3	1
I did not like the evaluator who visited the building	-	-	-	-	2	-
Poor installation/Products not installed properly	-	-	-	-	1	-
Poor communication/hard to contact	-	-	-	-	-	1
Expected more to be done/ They didn't replace fixtures	-	-	-	-	-	1
Had to pay more money after the implementation	-	-	1	-	-	-
Unhelpful service after the implementation	-	-	1	-	-	-
I expected more savings	2	-	-	-	-	-
Measures implemented/ products installed don't suit my needs	1	-	-	-	-	-
Others	1	-	-	-	-	-
None/No other reasons	-	3	-	2	-	2
Don't know	-	1	-	-	-	1
*Base: Respondents who were less satisfied with BES						

S10. Thinking of when you first contacted ENSC about the program, or ENSC contacted you, how long, in days, was it before you received your contract?

Time to Receive Contract	2014
<i>Sample Size</i>	62
1-6 days	10%
7-9 days	10%
10-19 days	11%
20-29 days	2%
30+ days	31%
Don't know	37%
Average*	34.4 Days
*Mean excludes don't know/'refused'. Responses of more than 365 days were removed from mean calculation.	

R1. Do you have any suggestions to improve the Business Energy Solutions program? Consider all aspects of the program: Process, marketing, interactions with program staff, interactions with contractors and program forms. PROBE: Anything else?

Suggestions*	2012	2013	2014
<i>Sample Size</i>	76	61	62
Better communication/Hard to get in contact with	7%	8%	6%
Increase advertising/marketing	9%	5%	5%
Better quality control/Ensure job gets done right	-	5%	5%
Quicker process	5%	3%	2%
Cover more products/measures	-	3%	2%
More information/Found process confusing	5%	-	-
Satisfied with BES	4%	-	6%
Others	8%	7%	10%
No recommendations	62%	69%	66%
Refused	3%	-	-
*Multiple responses			

F1. What is the main activity of the facility where the energy efficiency improvements were implemented under the Business Energy Solutions Program?

Business Type	2012	2013	2014
<i>Sample Size</i>	76	61	62
Mercantile-Retail – Enclosed mall or strip mall	8%	5%	18%
Mercantile-Retail – other than mall	16%	15%	6%
Religious worship	7%	8%	6%
Lodging	-	7%	6%
Service	5%	5%	6%
Manufacturing	8%	3%	6%
Food service/Restaurant	1%	3%	6%
Office	9%	3%	5%
Museum/ Art Gallery	-	-	5%
Property management	-	5%	3%
Recreation centre/ Community hall	8%	3%	3%
Health care – Outpatient	1%	3%	3%
Transportation	-	-	3%
Automotive repair	9%	7%	2%
Maintenance /Depot facility	3%	3%	2%
Public order and safety	1%	3%	2%
Non-profit organization	-	3%	2%
Education	3%	2%	2%
Health care – Inpatient	-	-	2%
Warehouse and storage	3%	7%	-
Food sales/Grocery	4%	3%	-
Farming	3%	2%	-
Food manufacturing	1%	2%	-
Electrical distribution	-	2%	-
Financial institution	1%	-	-
Government	-	-	-
Public assembly	1%	-	-
Car dealership/repair	-	-	-
Others	8%	7%	10%
Refused	-	-	1%

F2. Approximately how many full-time equivalent workers are employed at this facility?

Full-time Employees	2012	2013	2014
<i>Sample Size</i>	76	61	62
Fewer than 5	53%	61%	44%
5 to 9	21%	18%	19%
10 to 19	18%	13%	16%
20 to 49	4%	3%	6%
50 to 99	1%	3%	3%
100 to 249	-	-	2%
250 or more	-	-	3%
Don't know/Refused	3%	2%	6%

F4. We want to estimate the number of operating hours of the building where the energy efficiency improvements were implemented.

F4a. On average, how many hours per day is the facility open?

F4b. How many days per week is the facility open?

F4c. And how many weeks per year is the facility open?

Hours of Operation	2012	2013	2014
<i>Sample Size</i>	76	61	62
Less than 40	12%	8%	13%
40 to 79	64%	57%	55%
80 to 119	18%	21%	15%
120 or more	4%	13%	15%
Don't know	-	-	3%
Average hours	60	73	72

F5. Is your company independent, or part of a larger company?

Type of Company	2012	2013	2014
<i>Sample Size</i>	76	61	62
Independent	79%	72%	61%
Part of a larger company	13%	20%	31%
Franchise	-	-	-
Others	7%	7%	6%
Don't know	-	2%	-
Refused	1%	-	2%

F6. How many business locations does your organization have in Nova Scotia?

Number of Locations	2012	2013	2014
<i>Sample Size</i>	76	61	62
1	78%	64%	50%
2-10	11%	20%	21%
11-30	4%	2%	13%
More than 30	4%	5%	5%
Don't know	3%	10%	8%
Refused	1%	-	3%

APPENDIX V QUARTERLY PARTICIPANT SURVEY QUESTIONNAIRE

Could I speak with **[INSERT NAME]**?

1. Yes **[GO TO INTRODUCTION]**
2. No **[SAY "Perhaps you can help me anyway." GO TO INTRODUCTION]**

INTRODUCTION

Hello, I am with CRA (Corporate Research Associates), and we are performing an evaluation of energy efficiency services provided by Efficiency Nova Scotia Corporation. Our records indicate that you or your firm recently participated in Efficiency Nova Scotia Corporation's Business Energy Solutions Program. We would appreciate your cooperation in answering questions related to your participation in this program. The information you provide will be used to help Efficiency Nova Scotia Corporation evaluate and improve the program. Are you the right person to answer this survey?

1. Yes **[CONTINUE]**
2. No **[PROMPT: "Is there someone else in your organization who would know about having participated in the Business Energy Solutions Program?"]**
___ Yes **[ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]**
___ No **[THANK & TERMINATE]**
3. Don't know **[PROMPT: "Is there someone else in your organization who would know about having participated in the Business Energy Solutions Program?"]**
___ Yes **[ASK TO SPEAK TO THEM AND REPEAT INTRODUCTION]**
___ No **[THANK & TERMINATE]**
4. Refused **[THANK AND TERMINATE]**

The survey will take about five minutes. Is this a good time for you?

[IF REFUSED, ASK "Can we schedule a more convenient time for you to conduct this survey?"]

[SCHEDULED, IF NECESSARY, FOR: _____]



Verification and Recall (Series V)

- V1. Our records indicate that your company or organization participated in Efficiency Nova Scotia's Business Energy Solutions Program. Is this correct?
1. Yes (**GO TO V2**)
 2. No (**GO TO V1a**)
 3. (Don't know) (**GO BACK TO INTRODUCTION TO SPEAK TO SOMEONE ELSE**)
 4. (Refused) (**THANK AND TERMINATE**)
- V1a. [**ONLY ASK IF 'NO' IN V1**] Are you sure? The program offers incentive to upgrade energy efficient lighting and non-lighting measures.
1. Yes (**GO TO V2**)
 2. No (**THANK AND TERMINATE**)
 3. (Don't know) (**GO BACK TO INTRODUCTION TO SPEAK TO SOMEONE ELSE**)
 4. (Refused) (**THANK AND TERMINATE**)
- V2. According to our information, through its participation in the Business Energy Solutions Program, your business or organization installed energy-efficient products in the facility located at [**FACILITY ADDRESS STREET**]. When answering the survey questions, please take into account only this facility.

Satisfaction (Series S)

- S1. How did your company first learn of the programs offered by Efficiency Nova Scotia? [DO NOT PROVIDE RESPONSE CATEGORIES]. [CODE AS MANY AS APPLICABLE].
1. Media advertising
 2. Someone at Efficiency Nova Scotia contacted the business
 3. Through a third-party contractor
 4. The business contacted Efficiency Nova Scotia about the program
 5. Word-of-mouth
 6. Efficiency Nova Scotia website
 7. Facebook or other social media
97. Other [SPECIFY: _____]
98. Cannot recall
- S2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent? [CODE ONE ONLY].
1. Directly with Efficiency Nova Scotia
 2. Third-party contractor or agent → **SKIP TO S28**
 3. Both

S4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with... **[READ AND ROTATE. CODE ONE RESPONSE FOR EACH STATEMENT]**

- a. The technical expertise of ENSC employees related to the program
- b. The responsiveness of ENSC employees to your requests and enquiries in a timely manner
- e. The length of time between your initial audit and when you received your project proposal
- g. The value of the program relative to the time and cost involved
- j. The ability to provide estimates of the savings or return on investment associated with the program.

___ Response ___ 98 Don't Know ___ 99 Refused

S5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia's overall performance in working with your business? **[CODE ONE ONLY]**

___ Response ___ 98 Don't Know ___ 99 Refused

S6. Did you speak directly to any of Efficiency Nova Scotia's contact centre representatives? **[DO NOT READ RESPONSES – CODE ONE ONLY]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

IF YES IN S6, CONTINUE, OTHERWISE SKIP TO S28.

S7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual? **[CODE ONE ONLY]**

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied
- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

S9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's [READ AND ROTATE FACTORS]? [CODE

ONE RESPONSE FOR EACH FACTOR]

- d. Service attitude
- e. Knowledge of programs available
- f. Ability to provide advice

- 1. Completely satisfied
- 2. Mostly satisfied
- 3. Mostly dissatisfied
- 4. Completely dissatisfied

VOLUNTEERED

- 97. (Neither satisfied nor dissatisfied)
- 98. (Don't know)
- 99. (Refused)

S28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia? [CODE ONE ONLY]

- 1. Definitely
- 2. Probably
- 3. Probably not
- 4. Definitely not

- 99. (Not eligible for any other programs)
- 100. (Don't know)
- 101. (Refused)

S29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others? [CODE ONE ONLY]

- 1. Definitely
- 2. Probably
- 3. Probably not
- 4. Definitely not

- 98. (Don't know)
- 99. (Refused)

[IF S2 = 2 OR 3, then ask:]

S30. How satisfied were you overall with the service provided by your third-party contractor on managing the process of securing a payment from Efficiency Nova Scotia? Were you... **[READ RESPONSES IN ORDER – CODE ONE ONLY]**

1. Completely satisfied
2. Mostly satisfied
3. Mostly dissatisfied
4. Completely dissatisfied

VOLUNTEERED

97. (Neither satisfied nor dissatisfied)
98. (Don't know)
99. (Refused)

[IF S2 = 2 OR 3, then ask:]

S32. Based on your personal experience would you definitely, probably, probably not, or definitely not recommend this third-party contractor to others? **[CODE ONE ONLY]**

1. Definitely
2. Probably
3. Probably not
4. Definitely not

VOLUNTEERED

98. (Don't know)
99. (Refused)

Free-Ridership (Series FR)

The following questions will be about the free initial assessment and the energy-efficient products that were installed at a low cost through the Business Energy Solutions program.

FR1. BEFORE participating in the Business Energy Solutions program, did your company or organization have plans to purchase and install the specific energy-efficient products that were installed through the program? **[CODE ONE ONLY]**

1. Yes
2. No
98. (Don't know)
99. (Refused)

[IF FR1=YES, THEN ASK:]

FR1a. I just want to make sure I understand - Before you decided to participate in the program, you had already made the decision to purchase and install the energy-efficient products you installed through the program? **CODE ONE ONLY]**

- 1. Yes
- 2. No
- 98. (Don't know)
- 99. (Refused)

[READ FIRST TIME THROUGH ONLY] Now I would like to ask you to consider what actions you would have taken in the absence of the Business Energy Solutions program. To do so, think about the free initial assessment, financial incentive, ordering materials, proper installation and responsible disposal of old materials offered by the program.

FR2. If your company or organization had not participated in the Business Energy Solutions program, what is the likelihood that you would have taken one of the following actions? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely Would Not Have Taken the Action," and a 10 indicating that you "Definitely Would Have Taken the Action." **[AFTER FIRST TIME THROUGH THE SEQUENCE, START HERE FOR SECOND AND SUBSEQUENT SEQUENCES. START SECOND/SUBSEQUENT SEQUENCES BY SAYING: "AND NEXT, In the absence of the Program, would you have ... DO NOT ACCEPT A RANGE – POSE FR2 SEQUENCE IN ORDER/DO NOT RANDOMIZE]**

FR2a. ... purchased and installed exactly the same quantity of energy-efficient products that you installed through the program?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2b. ... purchased and installed standard products instead of energy-efficient products?

___ Response ___ 98 Don't Know ___ 99 Refused

FR2c. ... purchased and installed the energy-efficient products that you installed through the program but at a later date?

___ Response ___ 98 Don't Know ___ 99 Refused

[IF FR2c > 5, then ask:]

FR2d. **[DO NOT POSE FR2d IF DON'T KNOW OR REFUSED IN Q.FR2c]** You indicated in your previous response that if the Business Energy Solutions program had not been available there was an **[INSERT RESPONSE FROM FR2c]** in 10 likelihood that you would have purchased and installed the same energy-efficient products but at a later date. Approximately how many months later would you have installed these products? **[DO NOT READ RESPONSES - PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

_____ months later

- 96. (Never)
- 97. (At the same time)
- 98. (Don't Know)
- 99. (Refused)

[IF RESPONDENT HAS DIFFICULTY SPECIFYING AN FR2d ANSWER IN MONTHS, READ]:

Would it have been within...

- 1. The last 6 months?
- 2. 6 months to less than 1 year later?
- 3. 1 to less than 2 years later?
- 4. 2 to less than 3 years later?
- 5. 3 to less than 4 years later?
- 6. 4 or more years later?

VOLUNTEERED

- 7. (Never)
- 98. (Don't Know)
- 99. (Refused)

FR3. Efficiency Nova Scotia conducted an initial assessment at no cost in your facility and offered an incentive towards the total project cost. If your company had not received the free assessment and the incentive from Efficiency Nova Scotia, would you have done the project and paid for the full cost of the project, including the portion covered by the incentive? Please answer on a scale of 0 to 10, with a 0 indicating that you "Definitely Would Not Have Paid the full project cost" and a 10 indicating that you "Definitely Would Have Paid the full project cost." [PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]

___ Response ___ 98 Don't Know ___ 99 Refused

FR4. Next, I'm going to ask you to rate the importance of the program as well as other factors that might have influenced your decision to install the energy-efficient products. Please answer on a scale of 0 to 10, where 0 means "Not at all important" and 10 means "Extremely important." Now using this scale please rate the importance of each of the following in your decision to implement the energy-efficient products you installed through the program: **[PROBE FOR SPECIFIC RESPONSE – DO NOT ACCEPT A RANGE]**

Factor (READ AND RANDOMIZE)	Responses
a. Efficiency Nova Scotia Financial Assistance	___ Response ___ 98 Don't Know ___ 99 Refused
b. Information received during the initial contact by the program representative.	___ Response ___ 98 Don't Know ___ 99 Refused
c. Efficiency Nova Scotia funded initial assessment.	___ Response ___ 98 Don't Know ___ 99 Refused
d. Recycling of removed old materials supported by ENSC	___ Response ___ 98 Don't Know ___ 99 Refused
f. The standard practice in your industry	___ Response ___ 98 Don't Know ___ 99 Refused
g. Existing energy efficiency code	___ Response ___ 98 Don't Know ___ 99 Refused
h. Previous experience with the Business Energy Solutions program, or a similar program either from Efficiency Nova Scotia or Nova Scotia Power	___ Response ___ 98 Don't Know ___ 99 Refused

Firmographics (Series F)

F1. What is the main activity of the facility where the energy efficiency improvements were implemented under the program? **[DO NOT READ—BUT CONFIRM WITH RESPONDENT THAT THE CATEGORY YOU CHOOSE IS CORRECT]**

1. (Education)
2. (Food Sales (grocery))
3. (Food Service (restaurant))
4. (Health Care – Inpatient)
5. (Health Care – Outpatient)
6. (Lodging)
7. (Mercantile – Enclosed and Strip Malls)
8. (Mercantile – Retail (Other than Mall))
9. (Office)
10. (Public Assembly)
11. (Public Order and Safety)
12. (Religious Worship)
13. (Service)
14. (Warehouse and Storage)



- 15. (Manufacturing) (**Identify Industry Type** _____
(e.g., chemical, food, paper, etc.)
- 16. (Other: **please explain** _____)
- 17. (Vacant building)
- 98. (Don't know)
- 99. (Refused)

F2. Approximately how many full-time equivalent workers are employed at this facility? [**DO NOT READ, CODE APPROPRIATE CATEGORY**]

- 1. (Fewer than 5)
- 2. (5 to 9)
- 3. (10 to 19)
- 4. (20 to 49)
- 5. (50 to 99)
- 6. (100 to 249)
- 7. (250 or More)
- 98. (Don't know)
- 99. (Refused)

END: Those are all the questions I have for you. I thank you very much for your time and cooperation and have a nice day!

APPENDIX VI

QUARTERLY PARTICIPANT SURVEY RESULTS

The BES participant quarterly survey results are presented in the following tables.

S1. How did your company first learn of the programs offered by Efficiency Nova Scotia?

Sources of Awareness*	2012**	2013***	2014****
<i>Sample Size</i>	87	199	129
Word of mouth	44%	32%	22%
Someone at ENSC contacted the business	18%	19%	19%
Through a third-party contractor	10%	15%	13%
Media advertising	16%	16%	12%
ENSC website	3%	3%	9%
Previous dealings with ENSC	-	3%	9%
Bill insert	-	-	6%
Internet/website	-	3%	4%
Contacted ENSC directly	3%	2%	3%
Facebook or other social media	-	-	1%
Department of Agriculture	-	1%	-
Others	11%	9%	9%
Can't recall	6%	7%	4%
*Multiple responses **Source: 2012 C-Sat Commercial Study ***Source: 2013 annual and 2013 quarterly surveys			

S2. Did your company have any direct contact with any Efficiency Nova Scotia employees or did you only work with a third-party contractor or service delivery agent?

Contact with ENSC	2012**	2013***	2014
<i>Sample Size*</i>	87	184	129
Directly with ENSC	31%	29%	52%
Third-party contractor or agent	57%	43%	32%
Both	11%	28%	16%
Don't know' removed from calculation **Source: 2012 C-Sat Commercial Study *Source: 2013 annual and 2013 quarterly surveys. Due to a programming error, nine respondents did not receive this question.			

- S4. Now I will read you a list of factors, and I would like to know how satisfied you were with each in terms of your experience with Efficiency Nova Scotia. On a scale of 1 to 10, where “1” is not at all satisfied and “10” is completely satisfied, how satisfied were you with...
- S5. Now, using the same 10 point scale, how satisfied are you with Efficiency Nova Scotia’s overall performance in working with your business?

Satisfaction with Overall Performance	2012***		2013****		2014	
	Sample Size*	Satisfied**	Sample Size*	Satisfied**	Sample Size*	Satisfied**
Mean (1=‘Not at all satisfied’, 10= ‘Completely satisfied’)**						
The value of the program relative to the time and cost involved	36	8.9	118	8.8	86	9.3
ENSC’s overall performance in working with your company	37	8.6	117	9.0	88	9.1
The technical expertise of ENSC employees related to the program	37	8.5	114	8.8	84	9.0
The ability to provide estimates of the savings or return on investment associated with the program	36	8.1	105	8.6	84	9.0
The responsiveness of ENSC employees to your requests and enquiries in a timely manner	37	8.6	117	8.5	86	9.0
The length of time between your initial audit and when you received your project proposal	n/a	n/a	114	7.8	86	8.6
*Base: Number of respondents who had contact with ENSC staff **Mean excludes responses of ‘Refused’ and ‘Don’t know’ ***Source: 2012 C-Sat Commercial Study ****Source: 2013 annual and 2013 quarterly surveys						

- S6. Did you speak directly to any of Efficiency Nova Scotia’s contact centre representatives?

Contact with ENSC Contact Centre Staff	2014
Sample Size*	88
Yes	83%
No	11%
Don’t know	6%
*Base: Number of respondents who had contact with ENSC staff	

- S7. Overall, how satisfied were you with the level of service provided by the contact centre representative? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the level of service provided by this individual?
- S9. And how satisfied were you with the contact centre representative on each of the following service aspects? Were you completely satisfied, mostly satisfied, mostly dissatisfied, or completely dissatisfied with the representative's...

Satisfaction with Overall Performance	2014	
	Sample Size*	Satisfied**
Overall level of service provided by ENSC contact centre staff	73	99%
Service attitude	73	99%
Ability to provide advice	73	97%
Knowledge of programs available	72	96%
*Base: Number of respondents who had contact with ENSC staff **Percentage of respondents who gave a rating of completely or mostly satisfied where 5 = 'Very satisfied' and 1 = 'Not at all satisfied'; Don't know removed from calculations		

- S28. Based on your company's experience working with Efficiency Nova Scotia and its third-party contractors, would you definitely, probably, probably not, or definitely not participate in other programs offered by Efficiency Nova Scotia?

Would Participate in Other ENSC Programs	2012**	2013***	2014
Sample Size*	85	198	129
Definitely	72%	69%	81%
Probably	27%	31%	19%
Probably not	1%	1%	-
Definitely not	-	-	-
*'Don't know'/'Refused' removed from calculation **Source: 2012 C-Sat Commercial Study ***Source: 2013 annual and 2013 quarterly surveys			

S29. And based on your experience, how likely are you to recommend the programs offered by Efficiency Nova Scotia to other businesses and companies? Would you definitely, probably, probably not, or definitely not recommend these programs to others?

Would Recommend BES to Other Businesses/Companies	2012**	2013***	2014
<i>Sample Size*</i>	86	199	129
Definitely	77%	80%	88%
Probably	22%	19%	12%
Probably not	1%	1%	-
Definitely not	-	-	-
Don't know/'Refused' removed from calculation **Source: 2012 C-Sat Commercial Study *Source: 2013 annual and 2013 quarterly surveys			

S30. How satisfied were you overall with the service provided by your third-party contractor on managing the process of securing a payment from Efficiency Nova Scotia? Were you...

Satisfaction with Overall Performance*	2012****		2013*****		2014	
	<i>Sample Size**</i>	Satisfied***	<i>Sample Size**</i>	Satisfied***	<i>Sample Size**</i>	Satisfied***
Overall service provided by third-party contractor on managing the process of securing payment from ENSC	63	97%	130	95%	59	100%
*Percentage 'very satisfied'/'satisfied' **Base: Respondents who worked with third-party contractor ***'Don't know'/'No answer' removed from calculation ****Source: 2012 C-Sat Commercial Study *****Source: 2013 annual and 2013 quarterly surveys						

S32. Based on your personal experience would you definitely, probably, probably not, or definitely not recommend this third-party contractor to others?

Recommend Third-Party Contractor**	2012***	2013****	2014
<i>Sample Size*</i>	77	135	62
Definitely	71%	64%	82%
Probably	25%	30%	18%
Probably not	4%	3%	-
Definitely not	-	2%	-
*Don't know/'Refused' removed from calculation **Base: Respondents who worked with third-party contractor ***Source: 2012 C-Sat Commercial Study ****Source: 2013 annual and 2013 quarterly surveys			

FR4. Please answer on a scale of 0 to 10, where 0 means “Not at all important” and 10 means “Extremely important.” Now using this scale please rate the importance of each of the following in your decision to implement the energy-efficient products you installed through the program:

BES Elements	2012		2013		2014	
Average rating: 0 is “Not at all important”, 10 is “Extremely important”	Sample Size*	Mean Score	Sample Size*	Mean Score	Sample Size*	Mean Score
ENSC financial assistance	76	9.3	137	9.1	129	9.1
ENSC-funded initial assessment 2012 wording: ENSC-funded lighting audit	73	7.8	137	8.8	126	8.8
Information received during the initial contact by a program representative	76	8.7	136	8.5	129	8.6
Recycling of removed old materials supported by ENSC 2012 wording: Recycling of removed lamps and fixtures	75	7.9	135	8.3	126	8.3
Standard practice in industry	58	6.4	102	7.5	93	7.5
Existing energy efficiency code	63	7.0	112	7.1	103	7.3
Previous experience with BES or a similar program, either from ENSC or NSP	63	4.6	113	6.5	117	6.6
*‘Don’t know’/‘Refused’ excluded from calculations						

F1. What is the main activity of the facility where the energy efficiency improvements were implemented under the program?

Business Type	2012	2013*	2014
<i>Sample Size</i>	76	199	129
Office	9%	5%	14%
Mercantile-Retail – Enclosed mall or strip mall	8%	9%	11%
Service	5%	8%	10%
Mercantile-Retail – other than mall	16%	14%	8%
Religious worship	7%	8%	5%
Food service/Restaurant	1%	7%	5%
Automotive repair	9%	4%	5%
Recreation centre/ Community hall	8%	7%	4%
Warehouse and storage	3%	5%	4%
Lodging	-	3%	4%
Food sales/Grocery	4%	2%	3%
Health care – inpatient	-	-	3%
Manufacturing	8%	6%	2%
Property management	-	5%	2%
Public order and safety	1%	3%	2%
Farming	3%	2%	2%
Education	3%	2%	2%
Public assembly	1%	-	2%
Museum/Art Gallery	-	-	2%
Maintenance /Depot facility	3%	2%	1%
Health care – outpatient	1%	2%	1%
Food manufacturing	1%	2%	1%
Financial institution	1%	1%	-
Transportation	-	1%	-
Electrical distribution	-	1%	-
Government	-	1%	-
Non-profit organization	-	1%	-
Others	8%	7%	9%
*Source: 2013 annual and 2013 quarterly surveys			

F2. Approximately how many full-time equivalent workers are employed at this facility?

Full-time Employees	2012	2013*	2014
<i>Sample Size</i>	76	199	129
Fewer than 5	53%	53%	41%
5 to 9	21%	17%	24%
10 to 19	18%	16%	16%
20 to 49	4%	11%	6%
50 to 99	1%	1%	3%
100 to 249	-	1%	5%
250 or more	-	-	2%
Don't know/Refused	3%	3%	3%
*Source: 2013 annual and 2013 quarterly surveys			

APPENDIX VII

ALGORITHM FOR FREE-RIDERSHIP CALCULATION (BES)

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

FR2a. If your company had not participated in BES what is the likelihood that you would Have purchased and installed exactly the same quantity of energy-efficient products that you installed through BES? (Scale 0 to 10)	FR2a = Answer x 10%
FR2b. If your company had not participated in BES, what is the likelihood that you would Have purchased and installed standard products instead of energy-efficient products? (Scale 0 to 10)	FR2b = (10 – Answer) x 10%
PA1 Score:	MEAN VALUE OF: (FR2a ; FR2b)
FR1. Before participating in BES, did your company have plans to purchase and install the specific energy-efficient products that were installed through The program?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%
FR1a. I just want to make sure I understand - Before you decided to participate in BES, you had already made the decision to purchase and install the energy-efficient products you installed through the program?	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%
FR3. If your company had not received the free assessment and the incentive from ENSC, would you have done the project and paid for the full cost of the project, including the portion covered by the incentive? (Scale 0 to 10)	FR3 = Answer x 10%
PA2 Score:	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3
FR4. Level of influence (Scale 0 to 10) Factors a, b, c, d and h = Program factors Factor f and g = Non program factors	FR4_P = SUM(a; b; c; d; h) FR4_NP = SUM(f; g)
PA3 Score:	IF [MAX(FR4a; FR4b; FR4c; FR4d; FR4h) - MAX(FR4f; FR4g)] > 1 : 0 Otherwise : 100% - [FR4_P/(FR4_P+FR4_NP)]
FR2c. If your company had not participated in BES, what is the likelihood that you would have installed the energy-efficient products but at a later date? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2d Otherwise: PA4 = EMPTY
FR2d. Approximately how many months later would you have installed these products? 1. The last 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later? 7. (Never) 9. (Don't know / Refused)	IF 1. : FR2d = 100% IF 2. : FR2d = 50% IF 3. : FR2d = 25% IF 4. : FR2d = 0% IF 5. : FR2d = 0% IF 6. : FR2d = 0% IF 7. : FR2d = 0% IF 9. : FR2d = 0%
PA4 Score:	FR2d
Final Free-Ridership	MEAN VALUE OF : (PA1; PA2; PA3; PA4)
Inconsistency Test #1	IF MEAN(FR2a; FR2b) - FR3 > 40% : PA1 = 0 ELSE IF ABS(FR2a - FR2b) ≥ 30% : PA1 = MIN OF (FR2a ; FR2b)
Inconsistency Test #2	IF FR3 ≥ 70% AND IF (FR2a OR FR2b < 70% : PA2 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1; PA2; PA3; PA4)

APPENDIX VIII

INTERNAL SPILLOVER METHODOLOGY (BES)

Internal spillover was measured using a participant survey. Participants were asked whether following their participation in the program, they bought and implemented any additional energy efficiency measures, without benefitting from any rebates offered by ENSC programs. If a participant did admit to having implemented additional measures, they were asked a set of questions designed to identify the additional energy efficiency measures implemented and to quantify their associated savings. Subsequently, another question was asked to quantify the level of influence the program had on the participant's decision to whether implement these additional measures. The value established regarding this level of influence was used to determine the portion of the additional savings attributable to the program.

Then, the level of internal spillover was established by dividing the total quantity of the additional savings attributable to the program by the total quantity of savings achieved by the program for all the survey respondents.

The figure below illustrates the methodology used to calculate the internal spillover level.

SO1. Since the time that you participated in BES, has your company purchased and installed any additional energy-efficient products on its own for this facility?	IF 1. Yes: CONTINUE IF 2. No OR 99 : END
SO2. I just want to make sure I understand - After you participated in the BES program, your company installed additional energy-efficient products on its own for this facility?	IF 1. Yes: CONTINUE IF 2. No OR 99 : END
SO3. In purchasing the additional energy-efficient products, did you receive any other financing or incentive from any other ENSC program, or do you plan to submit a funding request for these purchases in the future?	IF 2. No: CONTINUE IF 1. Yes OR 99 : END
SO4. What are the additional energy-efficient products that you have installed on your own after participating in the BES program. Did you install... ? (Scale 0 to 10)	SO4 = SUM (kWh associated with each upgrade)
Additional Upgrade Savings:	SO4
SO5. Did your experience with the energy-efficient products installed through the BES Program influence your decision to install some or all of these additional energy-efficient products on your own? ? (Scale 0 to 10)	SO5 = Answer x 10%
Attribution Level:	SO5
Spillover Savings:	SO4 x SO5
Final Spillover Level = $\frac{\text{SUM of (SO4 x SO5) for All Respondents}}{\text{SUM of Program Savings for All Respondents}}$	

APPENDIX IX

ALGORITHM FOR FREE-RIDERSHIP CALCULATION (RP&C)

The figure below presents the algorithm for calculating the free-ridership level. The participant survey questionnaire included questions designed to assess the planning, quantity, efficiency, period, cost and influence of the program. Each group of questions was transposed into a level of program attribution, which was used to calculate the free-ridership level associated with each participant.

FR2a. If your company had not participated in RP&C, what is the likelihood that you would have installed exactly the same energy-efficient products that you installed through RP&C? (Scale 0 to 10)	FR2a = Answer x 10%
FR2b. If your company had not participated in RP&C, what is the likelihood that you would have installed standard products instead of energy-efficient products? (Scale 0 to 10)	FR2b = (10 – Answer) x 10%
PA1 Score:	MEAN VALUE OF: (FR2a ; FR2b)
FR1. Did your company have any specific plans to install the energy-efficient products in the common areas of your building(s) prior to talking with anyone about RP&C?	IF 1. Yes: Use FR1a IF 2. No OR 99 : FR1 = 0%
FR1a. I just want to make sure I understand - Before you decided to participate in RP&C, you had already made the decision to install the energy-efficient products throughout the common areas of the building(s)?	IF 1. Yes: FR1 = 100% IF 2. No OR 99 : FR1 = 0%
FR3. If ENSC had not installed energy-efficient products for free, would you have paid the full cost of the energy-efficient products?	IF 1. Yes: FR3 = 100% IF 2. No OR 99 : FR3 = 0%
PA2 Score:	IF FR1 = 0% : FR3 / 2 IF FR1 = 100% : FR3
FR4. Level of influence (Scale 0 to 10) Factors a, b and c = Program factors	FR4_P = MAX(a ; b ; c)
PA3 Score:	(10 - FR4_P) x 10%
FR2c. If your company had not participated in RP&C, what is the likelihood that you would have installed the energy-efficient products but at a later date? (Scale 0 to 10)	IF FR2c > 5 : ASK FR2cc Otherwise: PA4 = EMPTY
FR2d. Approximately how many months later would you have installed these products? 1. Less than 6 months? 2. 6 months to less than 1 year later? 3. 1 to less than 2 years later? 4. 2 to less than 3 years later? 5. 3 to less than 4 years later? 6. 4 or more years later? 7. (Never) 9. (Don't know / Refused)	IF 1. : FR2cc = 100% IF 2. : FR2cc = 50% IF 3. : FR2cc = 25% IF 4. : FR2cc = 0% IF 5. : FR2cc = 0% IF 6. : FR2cc = 0% IF 7. : FR2cc = 0% IF 9. : FR2cc = 0%
PA4 Score:	FR2cc
Final Free-Ridership	MEAN VALUE OF : (PA1 ; PA2 ; PA3 ; PA4)
Inconsistency Test #1	IF ABS(FR2a – FR2b) ≥ 30%: PA1 = MIN OF (FR2a ; FR2b)
Inconsistency Test #2	IF FR3 ≥ 70% AND IF (FR2a OR FR2b) < 70%: PA2 = EMPTY
Revised Free-Ridership	MEAN VALUE OF: (PA1 ; PA2 ; PA3 ; PA4)

APPENDIX X

CALCULATION EXAMPLE

This appendix displays a sample calculation to demonstrate the process of revising the energy and peak demand savings associated with BES for 2014. Since the lighting measure category accounted for the biggest share of savings achieved in 2014 under BES, one of the lighting-measure projects has been chosen as a sample to show the calculation details regarding the following:

- › Algorithms for calculating energy and peak demand savings
- › Comparison of (1) the calculation of *tracked* energy and peak demand savings and (2) the calculation of *revised* energy and peak demand savings
- › Algorithm for establishing the adjustment ratio

Energy Savings and Peak Demand Savings

The following algorithms include the parameters required to determine the annual energy savings and the annual peak demand savings associated with each lighting measure implemented.

$$\text{Energy Savings} \left[\frac{\text{kWh}}{\text{yr}} \right] = \frac{((Qty * \text{Unitary Wattage})_{\text{Baseline}} - (Qty * \text{Unitary Wattage})_{\text{New}}) * \text{Hrs}}{1,000 \text{ W/kW}}$$

$$\text{Peak Demand Savings} \left[\frac{\text{kW}}{\text{yr}} \right] = \frac{(Qty * \text{Unitary Wattage})_{\text{Baseline}} - (Qty * \text{Unitary Wattage})_{\text{New}}}{1,000 \text{ W/kW}}$$

$$\text{Unitary Wattage}_{\text{Baseline}} = \text{Decommissioned Fixture Wattage}$$

$$\text{Unitary Wattage}_{\text{New}} = \text{Lamp Qty} \times \text{Lamp Wattage} \times \text{Ballast Factor}$$

Where:

- › **Unitary Wattage** represents the wattage values of the lighting fixture for the existing (baseline) measure and the proposed (new) measure.
- › **Hrs** represents the annual hours of operation declared by the participants.
- › **Qty** represents the number of light fixtures.
- › **Decommissioned Equipment Wattage** represents the full fixture wattage, including lamps and ballasts, for the existing fixtures.
- › **Lamp Qty** represents the number of lamps per fixture.
- › **Lamp Wattage** represents the nominal lamp wattage.
- › **Ballast Factor** represents the system light output versus the rated light output.

Calculations of Tracked Savings

Each measure's energy and demand savings were calculated based on the information available in the tracking report. Like last year, the existing measure's decommissioned equipment wattage documented in the tracking sheet was used in the calculations.

The following table presents the values used to calculate the savings of a sampled specific case, where thirty 400-watt metal halide fixtures were replaced by thirty 4-lamp T5 HO high bays. There was a difference in the description of the proposed measure: the measure description was "T5 HO high bay", whereas the model number listed in the "Custom Only Comments" field was actually "LED high bay fixture".

Baseline Measure: 400W Metal Halide		
Parameter	Value	Source
Existing Fixture Qty	30	Tracking Report
Number of Lamps per Fixture	1	Tracking Report
Decommissioned Equipment Wattage (W)	455	Tracking Report
Existing Hours per Week	150	Tracking Report
Hours of Operation (hrs/year)	7,800	Calculation based on 52 weeks/year
New Measure: 4-Lamp T5 HO High Bay		
Proposed Fixture Qty	30	Tracking Report
Number of Lamps per Fixture	4	Tracking Report
Proposed Ballast Factor	1	Tracking Report
Proposed Lamp Wattage	69	Tracking Report
Proposed Hours per Week	150	Tracking Report
Hours of Operation (hrs/year)	7,800	Calculation based on 52 weeks/year
Tracked Savings		
Tracked Energy Savings (kWh)	41,886	Calculation
Tracked Demand Savings (kW)	5.37	Calculation

Sample of Revised Savings Calculations

The savings calculations were revised by incorporating two adjustments.

The first adjustment was made to the hours of operation by applying the self-declaration ratio.

The second adjustment was made to the fixture wattage of the new measure. The Evaluator researched the fixture model number indicated in the tracking report and determined that the new measure is actually an LED high bay fixture, and not a T5 HO high bay fixture. The specifications sheet indicated that the correct fixture wattage is 144 W for the LED high bay. This value was used in lieu of the lamp unitary wattage in the tracked savings calculation.

Baseline Measure: 400W Metal Halide		
Parameter	Value	Source
Existing Fixture Qty	30	Tracking Report
Decommissioned Equipment Wattage (W)	455	Tracking Report
Hours of Operation (hrs/year)	7,644	Adjusted value by applying the self-declaration ratio (7,800 hrs/yr * 0.98)
New Measure: 150W LED High Bay Fixture		
Proposed Fixture Qty	30	Tracking Report
Proposed Fixture Wattage	144	Specifications Sheet
Hours of Operation (hrs/year)	7,644	Adjusted value by applying the self-declaration ratio (7,800 hrs/yr * 0.98)
Revised Savings		
Revised Energy Savings (kWh)	71,318	Calculation
Revised Demand Savings (kW)	9.33	Calculation

Algorithm for Establishing the Adjustment Ratios

The adjustment ratio was determined by comparing the revised savings values to the tracked savings values. For this sampled specific measure, the adjustments made to the fixture wattage value and the hours of operation have resulted in an adjustment ratio of 1.70 for the energy savings, and 1.74 for the demand savings, as shown by the following equations:

$$\text{Adjustment Ratio on Energy Savings}_{\text{Measure}} = \frac{\text{Revised kWh}}{\text{Tracked kWh}} = \frac{71,318 \text{ kWh}}{41,886 \text{ kWh}} = 1.70$$

$$\text{Adjustment Ratio on Demand Savings}_{\text{Measure}} = \frac{\text{Revised kW}}{\text{Tracked kW}} = \frac{9.33 \text{ kW}}{5.37 \text{ kW}} = 1.74$$

APPENDIX XI

ON-SITE VISIT SAMPLING AND PROTOCOL – AFTER INSTALLATION

Sampling Methodology

A total of 50 visits were conducted for the BES impact evaluation. The sampling plan was developed in September 2014 based on the available tracking sheet. This tracking sheet included 519 completed projects (505 for lighting measures and 14 for non-lighting measures).¹⁷

The Evaluator initially divided visits between lighting and non-lighting measures based on the percentage of total energy savings. This resulted in only one visit for the non-lighting category, which is not enough to draw general conclusions. The Evaluator has divided the visits according to the distribution of square root of savings. This resulted in the visit distribution presented in the following table.

Table 36: Number of On-Site Visits Performed for Lighting and Non-Lighting Measures

Measure Type	Tracked Gross Savings (MWh)	% of Total Tracked Savings	Square Root of Tracked Savings	% of Total of Square Root of Tracked Savings	Actual Sample Size (n)
Lighting	9,095	99%	3,016	89%	44
Non-Lighting	128	1%	358	11%	6
Total	9,233	100%	3,374	100%	50

Lighting projects were organized by measure category and by total tracked energy savings to identify the most commonly implemented measures. The weight of each category in terms of total tracked savings is presented in the following table.

Table 37: Tracked Gross Energy Savings for Each Lamp Type Implemented¹⁸

Lamp Type	LED	T8	Custom	T5	All-Start Retrofit	CFL	Total
Total Savings (MWh)	5,507	2,089	741	282	239	163	9,021
% of Total Savings	61.0%	23.2%	8.2%	3.1%	2.7%	1.8%	100%

Fluorescent T8 lamps and LEDs represent 84 percent of total tracked savings for BES lighting measures. The sample selection therefore included projects in which at least these two lamp types were installed. One more selection criterion was applied to ensure that all ranges of savings are represented in the sample. Visits were divided into two categories according to their savings. Projects

¹⁷ Projects considered as completed are projects with closed, approved or implemented statuses.

¹⁸ As of September 2014.

that generated savings greater than 40,000 kWh represent 53 percent of total savings, while those that generated savings lower than 40,000 kWh represent 47 percent of total savings. Based on this analysis, 23 sites with energy savings greater than 40,000 kWh and 21 sites with energy savings less than 40,000 kWh were selected.

The non-lighting measures tracking sheet available at the time of the sampling selection included 14 completed projects, all of which were commercial heat pump installations. The six on-site visits were conducted for projects having the higher energy savings in this category.

There were no site visits for the LED Blitz portion of BES as it only included remaining participants from last year's initiative.

On-site Visit Protocol

The 2013 protocol was reviewed and deemed appropriate for use in 2014. The following information was collected to enable the calculation of the energy and peak demand savings associated with each installed measure:

- › quantity, type, and wattage or capacity of measures installed on site compared with the data recorded in the tracking sheet;
- › space heating and cooling system types and energy source, as well as the facility operational schedule;
- › lighting hours of operation.

All of the collected information will be used for the evaluation of interactive effects, diversity factors and installation rates.

Lighting

GENERAL INFORMATION										
#	Site Visit Date	Project ID	Facility Name	Contact Name	Contact Phone #	Address	City	Person met during visit	Type of facility	Notes

HEATING SYSTEMS					
System 1 - Heating Energy Source	System 1 - % of heat	System 1 - Type	System 2 - Heating Energy Source	System 2 - % of heat	System 2 - Type

COOLING SYSTEMS				OCCUPANCY SCHEDULE			
System 1 - % of cooling	System 1 - Type	System 2 - % of cooling	System 2 - Type	Days/yr with normal schedule	Days/yr with no occupancy (i.e. holiday or weekends)	Total Days/Yr (should be 365 days)	Notes

LIGHTING DAILY OPERATION SCHEDULE									
Mon	Tues	Wed	Thu	Fri	Sat	Sun	Holidays	Notes	Location - In tracking sheet

EXISTING MEASURE INFORMATION					
Existing Category - In tracking sheet	Indoors or Outdoors	Existing Measure - In tracking sheet	Existing Quantity- From tracking sheet	Existing Hr/Week - From tracking sheet	Notes

PROPOSED MEASURE INFORMATION (NEW)

Proposed Category - In tracking sheet	Proposed Category - Validation on-site	Proposed Measure - In tracking sheet	Proposed Measure - Validation on-site	Lamps/fixture - In tracking sheet

Lamps/fixture - Validation on-site	Wattage/lamp - in tracking sheet	Wattage/lamp - Validation on-site	Ballast Factor - In tracking sheet	Ballast Factor - Validation on-site	Proposed Fixture Quantity - In tracking sheet

Proposed Fixture Quantity - Validation on-site	Difference	Explain if different.	Have lamps been removed due to light levels? If so, when and how many? (if applicable)	Fixtures Installed in refrigerated areas?

Occupancy sensors? If so, how many fixtures?	Change in HOU due to occ. Sensors	Notes

Heat Pumps

[illegible]

OCCUPANCY SCHEDULE

[illegible]

HEAT PUMP MEASURE						
Measure #	Location - From tracking sheet	Location - Validation on-site	Specify Existing Space Heat Source:	Specify Existing Space Cooling Source:	Existing Quantity - From tracking sheet	Existing Quantity - Validation on-site

Difference	Explanation if different:	Existing Capacity per Unit (kBTU/hr) - From tracking sheet	Existing Capacity per Unit (kBTU/hr) - Validation on-site	Difference	Explanation if different:

New Manufacturer - From tracking sheet	New Manufacturer - Validation on- site	New Cond. Model Number - From tracking sheet	New Cond. Model Number - Validation on- site	New SEER - From tracking sheet	New SEER - Validate on-site or spec. sheet

New EER - Validate on-site or spec. sheet	New HSPF V - From tracking sheet	New HSPF V - Validate on-site or spec. sheet	New Full Load Hours/Year - On-site validation	New Quantity - From tracking sheet	New Quantity - Validate on-site

Is the heat pump operational?	If not, explain.	Heating Temp. Setpoint	Cooling Temp. Setpoint	Is unit properly installed?	Notes



ECONOLER



INTRODUCTION OF NEW CODES AND STANDARDS IN NOVA SCOTIA

2014 DSM EVALUATION

EFFICIENCY NOVA SCOTIA CORPORATION



Final Report



February 26, 2015



ECONOLER

ABBREVIATIONS

BER	Business Energy Rebates
C&S	Codes & Standards
CEM	Consumer Electronics Market
CSA	Canadian Standards Association
EEMAC	Electrical Equipment Manufacturers Association of Canada
EFC	Electro-Federation Canada
ENSC	Efficiency Nova Scotia Corporation
HEA	Home Energy Assessment
HRAI	Heating, Refrigeration, and Air Conditioning Institute of Canada
LED	Light emitting diode
MEPS	Minimum Energy Performance Standards
MNECB	Model, National Energy Code for Buildings
NBC	National Building Code
NECB	National Energy Code for Buildings
NRCan	Natural Resources Canada
OEE	Office of Energy Efficiency
SPVAC	Single Package Vertical Air-conditioner
SPVHP	Single Package Vertical Heat Pumps
UNSM	Union of Nova Scotia Municipalities

DEFINITIONS

Demand savings	Savings occurring at specific peak hours of energy demand.
Diversity factor	The ratio of the sum of the individual maximum demands of the various subsystems to the maximum demand of the whole system.
Evaluated savings	Gross and net savings calculated by the Evaluator using the parameters (unitary savings values, installation rates, distortion effects, interactive effects, etc.) validated or measured during the evaluation process.
EnerGuide rating	An EnerGuide rating shows a standard measure of the home's energy performance. It does not take into account occupants' behaviour and is thus just a measure of the house's efficiency. It shows how energy-efficient the home is through modelled heat losses of the home, based on several factors including heating systems and air leakage.
Gross energy savings	Energy savings generated by energy efficiency measures, before distortion effects and interactive effects are taken into consideration.
Line loss factor	Percentage of the electrical energy losses occurring in the transmission and distribution system between the utility generator and the customer meter.
Peak demand savings	The demand savings that coincide (in time) with the peak demand of the electricity system.
Unitary savings	Energy or demand savings established on a unitary basis. This unit can either be a product (e.g., an 8-watt LED lamp), a capacity (e.g., one-ton capacity of an air-source heat pump) or a participant (e.g., one participant taking part in a behaviour-based program).

TABLE OF CONTENTS

EXECUTIVE SUMMARY	IX
1 CONTEXT AND BACKGROUND	1
2 METHODOLOGY	3
2.1 Objective and Approach of the Impact Evaluation	3
2.2 Methodological Model	3
2.3 Methodology Description	4
2.3.1 Contact with Natural Resources Canada.....	4
2.3.2 Secondary Data Search.....	4
2.3.3 Interviews with Associations and Regulators.....	5
2.3.4 Analysis	5
3 IMPACT EVALUATION.....	7
3.1 Electric Motors	7
3.1.1 Market Size Estimate.....	7
3.1.2 Portion of the Market Impacted by the Regulation.....	7
3.1.3 Unitary Savings Values.....	9
3.1.4 At-meter Energy Savings.....	10
3.1.5 At-meter Peak Demand Savings	11
3.2 General Service Incandescent Reflector Lamps.....	11
3.2.1 Market Size Estimate.....	11
3.2.2 Portion of the Market Impacted by the Regulation.....	13
3.2.3 Unitary Savings Values.....	14
3.2.4 At-meter Energy Savings.....	15
3.2.5 At-meter Peak Demand Savings	15
3.3 Dry-type Transformers	16
3.3.1 Market Size Estimate.....	16
3.3.2 Portion of the Market Impacted by the Regulation.....	16
3.3.3 Unitary Savings Values.....	17
3.3.4 At-meter Energy Savings.....	17
3.3.5 At-meter Peak Demand Savings	18
3.4 Self-contained Commercial Refrigerators and Freezers	18
3.4.1 Market Size Estimate.....	18
3.4.2 Portion of the Market Impacted by the Regulation.....	19
3.4.3 Unitary Savings Values.....	20
3.4.4 At-meter Energy Savings.....	20
3.4.5 At-meter Peak Demand Savings	21

3.5 Large Air conditioners and Heat Pumps.....	21
3.5.1 Market Size Estimate.....	21
3.5.2 Portion of the Market Impacted by the Regulation.....	23
3.5.3 Unitary Savings Values.....	23
3.5.4 At-meter Energy Savings.....	24
3.5.5 At-meter Peak Demand Savings	24
3.6 Single Package Vertical Air-conditioners and Heat Pumps.....	25
3.6.1 Market Size Estimate.....	25
3.6.2 Portion of the Market Impacted by the Regulation.....	26
3.6.3 Unitary Savings Values.....	26
3.6.4 At-meter Energy Savings.....	27
3.6.5 At-meter Peak Demand Savings	27
3.7 Standby Power	28
3.7.1 Market Size Estimate.....	28
3.7.2 Portion of the Market Impacted by the Regulation.....	29
3.7.3 Unitary Savings Values.....	30
3.7.4 At-meter Energy Savings.....	31
3.7.5 At-meter Peak Demand Savings	31
3.8 External Power Supplies	32
3.8.1 Market Size Estimate.....	32
3.8.2 Portion of the Market Impacted by the Regulation.....	33
3.8.3 Unitary Savings Values.....	33
3.8.4 At-meter Energy Savings.....	34
3.8.5 At-meter Peak Demand Savings	34
3.9 Incandescent Lamps(75 W and 100 W).....	34
3.9.1 Product Description	34
3.9.2 Regulation Description.....	34
3.9.3 Market Size Estimate.....	36
3.9.4 Portion of the Market Impacted by the Regulation.....	36
3.9.5 At-meter Energy Savings.....	37
3.9.6 At-meter Peak Demand Savings	38
3.10 LED Street Lighting.....	38
3.10.1 Product Description	38
3.10.2 Regulation Description.....	38
3.10.3 Market Size Estimate.....	39
3.10.4 Portion of the Market Impacted by the Regulation.....	39
3.10.5 Unitary Savings Values.....	40
3.10.6 At-meter Energy Savings.....	41
3.10.7 At-meter Peak Demand Savings	41

3.11 New Energy Code for Houses	42
3.11.1 Product Description	42
3.11.2 Regulation Description.....	42
3.11.3 Market Share Estimate	43
3.11.4 Unitary Savings Values.....	43
3.11.5 At-meter Energy Savings.....	45
3.11.6 At-meter Peak Demand Savings	45
3.12 TOTAL SAVINGS AT GENERATOR	45
APPENDIX I INTERVIEW GUIDE WITH NRCAN	51
APPENDIX II INTERVIEW GUIDES FOR INDUSTRY ASSOCIATIONS.....	53

LIST OF TABLES

Table 1: Products Targeted by Amendment 11	ix
Table 2: Products Targeted by Amendment 12b	x
Table 3: Specific Products Regulation in Nova Scotia	x
Table 4: 2014 Evaluated Energy and Peak Demand Savings at the Generator	xi
Table 5: Products Targeted by Amendment 11	1
Table 6: Products Targeted by Amendment 12b	2
Table 7: Specific Products Regulation in Nova Scotia	2
Table 8: Methodology Used to Estimate Market Sizes	5
Table 9: Three-phase Electric Motor Market Size Estimate for Canada and Nova Scotia, 2014	7
Table 10: Initial Estimate of the Portion of the Three-phase Electric Motor Market Impacted by the Regulation	8
Table 11: Unitary Savings Values for Electric Motors	9
Table 12: Energy Savings Associated with the Introduction of the Electric Motors Regulation in the Nova Scotia Market	10
Table 13: Demand Savings Associated with the Introduction of the Electric Motors Regulation in the Nova Scotia Market	11
Table 14: BR Lamp Market Sizes in Canada, Atlantic Canada and Nova Scotia, 2014	12
Table 15: Portion of the BR Lamp Market Impacted by the Regulation	13
Table 16: Unitary Savings Values for General Service Incandescent Reflector Lamps	14
Table 17: Energy Savings Associated with the Introduction of the General Service Incandescent Reflector Lamps Regulation in the Nova Scotia Market	15
Table 18: Peak Demand Savings Associated with the Introduction of the General Service Incandescent Reflector Lamps Regulation in the Nova Scotia Market	15
Table 19: Three-phase Dry-type Transformer Market Size Estimate in Canada, Atlantic Canada and Nova Scotia, 2014	16
Table 20: Portion of the Three-phase Dry-type Transformer Market Impacted by the Regulation	16
Table 21: Unitary Savings Values for Three-phase Dry-type Transformers	17
Table 22: Energy Savings Associated with the Introduction of the Three-phase Dry-type Transformer Regulation in the Nova Scotia Market	17
Table 23: Demands Savings Associated with the Introduction of the Three-phase Dry-type Transformer Regulation in the Nova Scotia Market	18
Table 24: Self-contained Commercial Ice Cream-type Freezer Market Size Estimate in Canada and Nova Scotia in 2014	19
Table 25: Portion of the Self-contained Commercial Ice Cream-type Freezer Market Impacted by the Regulation	20
Table 26: Unitary Savings Values for Commercial Ice Cream-type Freezers	20
Table 27: Energy Savings Associated with the Introduction of the Commercial Ice Cream-type Freezer Regulation in the Nova Scotia Market	20
Table 28: Peak Demand Savings Associated with the Introduction of the Commercial Ice Cream-type Freezer Regulation in the Nova Scotia Market	21
Table 29: Large Air Conditioner and Heat Pump Market Size Estimates in Canada, Atlantic Canada and Nova Scotia, 2014	22
Table 30: Portion of the Large Air Conditioners and Heat Pumps Market Impacted by the Regulation	23
Table 31: Large Air Conditioner and Heat Pump Unitary Savings Values	23

Table 32: Energy Savings Associated with the Introduction of the Large Air Conditioners and Heat Pumps Regulation in the Nova Scotia Market.....	24
Table 33: Peak Demand Savings Associated with the Introduction of the Large Air Conditioners and Heat Pumps Regulation in the Nova Scotia Market	25
Table 34: Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Market Size Estimate for Canada, Atlantic Canada and Nova Scotia, 2014.....	26
Table 35: Portion of the Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Market Impacted by the Regulation	26
Table 36: Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Unitary Savings Values	26
Table 37: Energy Savings Associated with the Introduction of the Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Regulation in the Nova Scotia Market..	27
Table 38: Peak Demand Savings Associated with the Introduction of the Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Regulation in the Nova Scotia Market	27
Table 39: Standby Power Product Market Size Estimates for Canada and Nova Scotia, 2014	28
Table 40: Estimate of the Portion of the Standby Power Product Market Impacted by the Regulation	29
Table 41: Unitary Savings Values for Standby Power Products	30
Table 42: Energy Savings Associated with the Introduction of the Standby Power Products Regulation in the Nova Scotia Market.....	31
Table 43: External Power Supplies Market Size for Canada and Nova Scotia, 2014.....	32
Table 44: Portion of the Products Sold with an External Power Supply Impacted by the Regulation...	33
Table 45: Unitary Savings Values for Products Sold with an External Power Supply	33
Table 46: Energy Savings Associated with the Introduction of the External Power Supplies Regulation in the Nova Scotia Market	34
Table 47: Schedule of Light Bulbs Meeting New Standards.....	35
Table 48: Energy Savings Associated with the Introduction of Incandescent Bulbs Standards in the Nova Scotia Market.....	37
Table 49: Peak Demand Savings Associated with the Introduction of Incandescent Bulbs Standards in the Nova Scotia Market	38
Table 50: Existing Lighting Units Inventory in Nova Scotia, 2009.....	39
Table 51: Literature Review of LED Street Lighting Study Cases	40
Table 52: Energy Savings Associated with the Introduction of the LED Street Lightings in the Nova Scotia Market	41
Table 53: Demand Savings Associated with the Introduction of the LED Street Lightings in the Nova Scotia Market	41
Table 54: Data on Nova Scotia's Building Permits for January to October 2014.....	43
Table 55: Number of Dwelling Units – Data on Nova Scotia's Residential Building Permits for 2014 ..	43
Table 56: Energy Savings Associated with the Introduction of the Building Code Regulation in the Nova Scotia Market.....	45
Table 57: Peak Demands Savings Associated with the Introduction of the Building Code Regulation in the Nova Scotia Market.....	45
Table 58: Overall Energy and Peak Demand Savings for Codes and Standards.....	47

LIST OF FIGURES

Figure 1: Methodological Model.....	3

EXECUTIVE SUMMARY

This report presents the results of the 2014 impact evaluation of Codes & Standards (C&S). The 2014 evaluation was based on interviews with Natural Resources Canada (NRCAN), Statistics Canada's secondary data research and interviews, and exchanges with three industry associations as well as the Canadian Standards Association (CSA).

Context and Background

In order to improve the efficiency of energy-using products sold in Canada, NRCAN has been implementing "regulated minimum energy efficiency standards through amendments to the *Energy Efficiency Regulations*."¹ As part of Canada's Clean Air Regulatory Agenda,² which was established in 2006, three amendments to the *Energy Efficiency Regulations* were planned "to deliver energy, greenhouse gas and air pollutant reductions".³

These amendments increase the stringency and/or scope of existing minimum energy performance standards (MEPS) and introduce new MEPS. Below are the products for which an updated or new regulation was enacted as part of Amendment 11.

Table 1: Products Targeted by Amendment 11⁴

Products	Existing MEPS prior to Amendment 11	Reference Standard
Electric motors	Yes	CAN/CSA 390-10
General service incandescent reflector lamps	Yes	CAN/CSA 862-09
Dry-type transformers	Yes	CAN/CSA 802.2-06
Commercial self-contained refrigeration	Yes	HRAI Standard 1200-2008
Large air conditioners and heat pumps	Yes	CAN/CSA 746-2006
Single package vertical air conditioners and heat pumps	No	C746-06
Standby for electronic products	No	CAN/CSA 62301-07
External power supplies	No	CSA 381.1-08

¹ Office of Energy Efficiency. ecoENERGY Efficiency for Equipment Standards and Labelling, <http://oee.nrcan.gc.ca/corporate/13752>, October 26, 2011.

² Environment Canada. Clean Air Regulatory Agenda: Backgrounder, <http://www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=295B1964-9737-4F80-B064-B3088D9910BE>, October 28, 2011.

³ Office of Energy Efficiency. Publication of Regulations Amending Canada's Energy Efficiency Regulations, <http://oee.nrcan.gc.ca/regulations/14566>, October 24, 2011.

⁴ *Ibid.*

An additional amendment to the *Energy Efficiency Regulations* was registered and came into force on December 31, 2013. Amendment 12b revises Canada's MEPS for general service incandescent lamps (light bulbs).

Table 2: Products Targeted by Amendment 12b⁵

Products	Existing MEPS prior to Amendment 12b	Reference Standard
Incandescent light bulbs (75 watts and 100 watts)	No	CAN/CSA C862-09

In addition to these products, Nova Scotia decided on its own to enforce MEPS for street lights and an Energy Code for houses and small buildings. Nova Scotia is the first province in Canada to make LED roadway lights a minimum requirement.

Table 3: Specific Products Regulation in Nova Scotia

Products	Existing MEPS prior to Provincial Initiative	Reference Standard
LED street lights ⁶	No	CAN/CSA C653-13
National Energy Code for houses and small buildings – NBC – Revision 2012 – Part 9.36 ⁷	Yes	-

To evaluate the impact of new regulations on these products, Efficiency Nova Scotia Corporation (ENSC) contracted Econoler to assess the achievable energy and peak demand savings once the regulations had been introduced in the Nova Scotia market. Such an evaluation was first carried out in 2012 as part of ENSC's annual evaluation of its programs and was repeated for 2014. The Province of Nova Scotia has yet to implement the new MEPS for residential boilers (gas, oil and electric boilers). The regulations for these three specific products were left out of the evaluation. Since neither market analysis findings nor any shipment data regarding digital television adapters were available, it was assumed that market size for these products is negligible and was therefore decided that this product should not be evaluated.

The Evaluator modified the methodology used in past evaluations by focusing its efforts on interviewing NRCAN, using Statistics Canada sources and collecting sales volume from associations. Indeed, the 2013 evaluation revealed a lack of reliable market size data when contacting distributors and manufacturers directly. Following a recommendation from 2013, the Evaluator elected to conduct interviews with industry associations in 2014 instead.

⁵ <http://www.nrcan.gc.ca/energy/regulations-codes-standards/12342>

⁶ "New Law Means Road Lighting in Nova Scotia Must Be LED", available at <<http://novascotia.ca/news/release/?id=20120912004>> , (Last accessed January 29, 2015).

⁷ "Summary of Changes Nova Scotia Building Code Regulation", July 2013, available at : <http://novascotia.ca/lae/buildingcode/docs/130625SummaryofChangesNovaScotiaBuildingCodeRegulation2.pdf>, (Last accessed January 29, 2015).

Key Findings

The evaluation has estimated the impact in terms of energy and peak demand savings to be achieved by introducing new regulations into the Nova Scotia market for the products targeted by federal Amendment 11, Amendment 12b and provincial regulations featuring increased stringency and/or scope on existing MEPS.

The final total energy and peak demand savings for each type of product evaluated are presented in Table 4:

Table 4: 2014 Evaluated Energy and Peak Demand Savings at the Generator

Products	Total Energy Savings at Generator (GWh)	Total Peak Demand Savings at Generator (MW)
Electric motors	0.686	0.154
General service incandescent reflector lamps	1.330	0.909
Dry-type transformers	0.674	0.078
Large air conditioners and heat pumps	0.334	0.170
Standby for electronic products	3.173	-
External power supplies	3.157	-
Incandescent Lamps - 75W and 100W	18.181	2.873
Led Street Lighting	3.033	0.758
New Energy Code for Houses	0.866	0.223
Total	31.433	5.164

Savings attributable to C&S are a result of increasing the minimum efficiency of targeted products in the market. Even if similar products are targeted by other ENSC components, it should be noted that their savings are distinct from those generated by C&S. Savings from ENSC components are based on an increase of product efficiency compared to the minimum efficiency standard or the current baseline of that product, whereas C&S savings result from an increase in that minimal efficiency standard. Both savings are thus specific to each component and do not overlap.

RECOMMENDATIONS

Based on international experience and our own, evaluating the energy impact of regulations or policies is usually more difficult than calculating the impact of a DSM program, which has a list of participants and a range of products distributed. As for the evaluation of C&S, the main challenge resides in the necessity to understand the whole market of targeted products. This not only involves establishing the quantity of products sold in a specific market, but also making in-depth characterization of that market (e.g., quantity by size, type, efficiency level, etc.). Depending on the product, this information can be

hard or even impossible to obtain in some cases. Based on the outcomes of our activities, the Econoler team makes the following recommendation on how to ensure the success of future C&S impact evaluations:

CS-R1. Focus the evaluation collection activity on industry associations to ensure that the most up-to-date market information is collected. Based on this year's experience and for future evaluations, the Evaluator recommends to keep the focus on working collaboratively with associations to collect up-to-date market data. The 2012 and 2013 evaluations have shown that it is extremely difficult to establish the total market size for some products by widely relying on the understanding of manufacturers and distributors in the market. By contrast, information obtained in 2014 from regulatory organizations and industry associations was useful to effectively assess the provincial market size by product category, even though costs were incurred to purchase the data. Going forward for the next impact evaluation, a more extensive secondary review of existing data may provide more accurate estimates for some of the codes and standards, especially where the analysis relied primarily on outdated studies as for the incandescent bulb products.

1 CONTEXT AND BACKGROUND

In order to improve the efficiency of energy-using products sold in Canada, NRCAN has been implementing “regulated minimum energy efficiency standards through amendments to the *Energy Efficiency Regulations*.”⁸ As part of Canada’s Clean Air Regulatory Agenda,⁹ which was established in 2006, three amendments to the *Energy Efficiency Regulations* were planned “to deliver energy, greenhouse gas and air pollutant reductions”.¹⁰ The second of these amendments, Amendment 11, was published in the *Canada Gazette* on October 12, 2011.

These amendments increased the stringency and/or scope of existing minimum energy performance standards (MEPS) and introduced new MEPS.¹¹ The new regulations came into force on April 12, 2012, six months after being published in the *Canada Gazette*. Table 5 lists the product categories targeted by *Amendment 11*.

Table 5: Products Targeted by Amendment 11¹²

Products	Existing MEPS prior to Amendment 11	Reference Code
Electric motors	Yes	CAN/CSA 390-10
Residential gas boilers	Yes	CSA P.2-07
Residential oil boilers	Yes	CSA P.2-07
Dry-type transformers	Yes	CAN/CSA 802.2-06
Large air conditioners and heat pumps	Yes	CAN/CSA 746-2006
Commercial self-contained refrigeration	Yes	HRAI Standard 1200-2008
General service incandescent reflector lamps	Yes	CAN/CSA 862-09
Standby for electronic products	No	CAN/CSA 62301-07
External power supplies	No	CSA 381.1-08
Electric boilers	No	CSA P.2-07
Single package vertical air conditioners and heat pumps	No	C746-06
Digital television adapters	No	CSA 380-08

⁸ Office of Energy Efficiency. ecoENERGY Efficiency for Equipment Standards and Labelling, <http://oee.nrcan.gc.ca/corporate/13752>, October 26, 2011.

⁹ Environment Canada. Clean Air Regulatory Agenda: Background, <http://www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=295B1964-9737-4F80-B064-B3088D9910BE>, October 28, 2011.

¹⁰ Office of Energy Efficiency. Publication of Regulations Amending Canada’s Energy Efficiency Regulations, <http://oee.nrcan.gc.ca/regulations/14566>, October 24, 2011.

¹¹ *Ibid.*

¹² *Ibid.*

An additional amendment to the Energy Efficiency Regulations was registered and came into force on December 31, 2013. Amendment 12b revises Canada's MEPS for general service incandescent lamps (light bulbs).

Table 6: Products Targeted by Amendment 12b13

Products	Existing MEPS Prior to Amendment 12b	Reference Standard
Incandescent Light Bulbs (75 watts and 100 watts)	No	CAN/CSA C862-09

In addition to these products, Nova Scotia decided to enforce MEPS for street lights and an Energy Code for houses and small buildings. Nova Scotia is the first province in Canada to make LED street lights a minimum requirement.

Table 7: Specific Products Regulation in Nova Scotia

Products	Existing MEPS Prior to Provincial Initiative	Reference Standard
LED street lights ¹⁴	No	CAN/CSA C653-13
National Energy Code for houses and small building – NBC – Revision 2012 – Part 9.36 ¹⁵	Yes	-

To evaluate the impact of these regulations, Efficiency Nova Scotia Corporation (ENSC) contracted Econoler to assess the energy and peak demand savings achievable through their introduction in the Nova Scotia market. This evaluation was first carried out in 2012 as part of ENSC's annual programs evaluation and was repeated in 2014. The Province of Nova Scotia did not implement the new MEPS for residential boilers (gas, oil and electric boilers). The regulations for these three specific products were left out of the evaluation. Moreover, since neither market analysis findings nor any shipment data regarding digital television adapters were available, it was assumed that market size for these products is negligible and was therefore decided that this product should not be evaluated.

¹³ <http://www.nrcan.gc.ca/energy/regulations-codes-standards/12342>

¹⁴ "New Law Means Road Lighting in Nova Scotia Must Be LED", available at <http://novascotia.ca/news/release/?id=20120912004> , (Last accessed January 29, 2015).

¹⁵ "Summary of Changes Nova Scotia Building Code Regulation", July 2013, available at : <http://novascotia.ca/lae/buildingcode/docs/130625SummaryofChangesNovaScotiaBuildingCodeRegulation2.pdf>, (Last accessed January 29, 2015).

2 METHODOLOGY

2.1 Objective and Approach of the Impact Evaluation

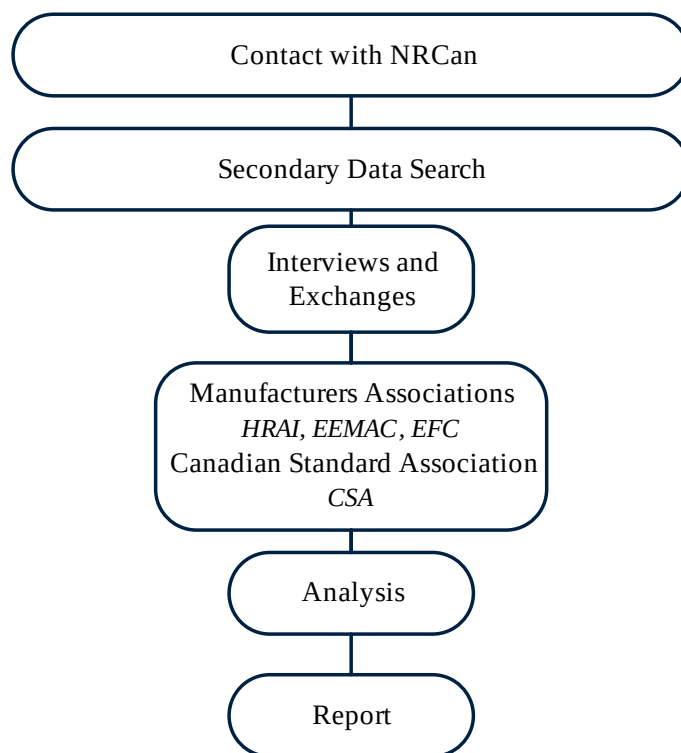
The purpose of the evaluation is to quantify, in terms of energy and peak demand savings, the impact of 11 regulations introduced in the Nova Scotia market for 2014. To this end, three major parameters have been set:

- › market size of each product category;
- › portion of the market on which the regulations have had an impact;
- › unitary savings values for each regulation, i.e., the difference between baseline consumption and consumption of products that meet the regulations.

2.2 Methodological Model

The figure below illustrates the research strategy used and the different activities involved in the 2014 evaluation.

Figure 1: Methodological Model



2.3 Methodology Description

2.3.1 Contact with Natural Resources Canada

NRCan was contacted in October and asked to provide documentation, including market analyses produced for all the evaluated regulations. For reference purposes, the protocol used by the Econoler team and its subcontractor, CRA, for conducting the interview with NRCan is presented in Appendix I.

2.3.2 Secondary Data Search

This evaluation made extensive use of market data provided by industry associations, particularly Electro-Federation Canada (EFC) and the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI). These sources provided monthly, quarterly or annual shipment data for their members and the portion (%) of the market they represent. Shipments were reported by province, or region in the case of Atlantic Canada. Data was provided by the associations for the years initial studies were conducted by Navigant, Ecos, Caneta and Nielsen Engineering, so that shipment categories and volumes could be aligned. Corresponding data for 2014 was then used to produce the market estimates shown in this report. Given the passage of time since the initial reports, using actual shipment data, when available, represented a step forward compared to the extrapolation used in the initial shipment estimates.

To quantify market size in Nova Scotia, the portion of Atlantic Canada shipments was commonly based on provincial population ratios from the latest Statistics Canada data. Consequently, it was estimated that shipments to Nova Scotia of all the evaluated product categories accounted for 39.6% of the total shipments to Atlantic Canada.¹⁶ The current assumption that Nova Scotia is similar to the rest of Atlantic Canada is more tenable than assuming similarity to all of Canada, as was previously the case.

In some cases, data from associations is not available. This report has thus improved the use of Statistics Canada sources. For example, the three-phase electric motors analysis benefited from Statistics Canada's Canadian International Merchandise Trade database.¹⁷ A larger category of motors containing those of interest could be used to show the trend in shipments and Nova Scotia's share since the initial study by Nielsen Engineering. Likewise for standby power and external power supplies, the Survey of Household Spending was used for developing trends over time and determining the estimated share of shipments for Nova Scotia.

¹⁶ Statistics Canada. Annual Demographic Estimates: Canada, Provinces and Territories, 2013.

¹⁷ Statistics Canada. Canadian International Merchandise Trade Database. Merchandise Imports and Exports between "Canada" and "World", by Harmonized System Section, Customs Basis, September 2012.

The methodology used to estimate market size for most products is presented in the table below.

Table 8: Methodology Used to Estimate Market Sizes

	Method to Estimate Total Shipments to Canada or Atlantic Region	Method to Estimate Shipments to Nova Scotia	List of Products
Industry associations	Database for 2014 in units or in dollar amounts (extrapolation was then done with an average cost of equipment)	Using the population ratio of Nova Scotia (compared to Canada or the Atlantic Region)	› Incandescent Reflector Lamps › Dry-type Transformers › Large Air-Conditioners And Heat Pumps
Statistics Canada's Canadian International Merchandise Trade Database	Imports – (Re-exports + Exports)	Imports – (Re-exports + Exports)	› Electric motors › Commercial Refrigeration › Standby power › External Power Supplies › New Energy Code for Houses

Incandescent lamps, LED street Lighting and the New Energy Code for Houses have a specific methodology.

2.3.3 Interviews with Associations and Regulators

From early December to end of January, representatives from associations were instrumental in numerous exchanges by explaining the data, confirming its reliability and indicating how best to use it for the evaluation. In some cases, they could also support the use of complementary Statistics Canada data with direction, advice and insights regarding the appropriate data to obtain.

Interviews with regulators included NRCan staff engaged in the development and implementation of standards, Canadian Standards Association representatives, government staff and building inspectors in the case of LED street lighting and building code standards. These interviews were valuable for understanding expected energy savings, market activity and compliance issues.

The guide used for the interviews with the associations and regulators is presented in Appendix II for reference.

2.3.4 Analysis

Once all interviews were completed and data was collected, market size estimates were developed. Once the market size for each product category and the portion of the market impacted by the regulations was determined, it was possible to estimate: (1) the impact that the introduction of those new regulations had on the market in Nova Scotia, using the unitary savings determined in the secondary data research; and (2) the savings resulting from each of the regulations.

The Evaluator ensured that there was no overlap or no double-counting with savings from ENSC programs. Savings attributable to C&S are a result of increasing the minimum efficiency of targeted

products in the market. Even if similar products are targeted by other ENSC components, it should be noted that their savings are distinct from those generated by C&S. Savings from ENSC components are based on an increase of product efficiency compared to the minimum efficiency standard or the current baseline of that product, whereas C&S savings result from an increase in that minimal efficiency standard. Both savings are thus specific to each component and do not overlap.

3 IMPACT EVALUATION

3.1 Electric Motors

3.1.1 Market Size Estimate

In a report prepared for NRCan, Nielsen Engineering analyzed sales data supplied by the Electrical Equipment Manufacturers Association of Canada (EEMAC).¹⁸ Formerly, shipments were estimated by extrapolating Canada's shipments from the 2007 data provided by Nielsen Engineering.¹⁹ Since shipments vary considerably from year to year, this report employs new methodology whereby Statistics Canada's International Merchandise Trade Database (imports minus re-exports) was used to index annual demand for electric motors.²⁰ Instead of using the demographic weight of Nova Scotia, the Statistics Canada data is also used to determine Nova Scotia's share since shipments are reported by province. The Nielsen Engineering report indicated the average proportion of the Harmonized System Code 850152 and 850153 shipments from 2004 to 2007 that are in scope for the analysis. Using this proportion, the Econoler team was able to approximate the market size of three-phase electric motors in Nova Scotia for 2014 (see Table 9). The fourth quarter data for 2014 was not available at the time, so the first three quarters of shipments were prorated to full-year estimates (first three quarters treated as 75% of 2014 total).

Table 9: Three-phase Electric Motor Market Size Estimate for Canada and Nova Scotia, 2014

Product Class	Shipments to Canada in 2014	Shipments to Nova Scotia in 2014
Three-phase electric motors sized 1 to 5 HP	56,639	1,048
Three-phase electric motors sized 6 to 25 HP	39,940	739
Three-phase electric motors sized 26 to 100 HP	17,026	315
Three-phase electric motors sized 101 to 200 HP	2,797	52
Three-phase electric motors sized 201 to 500 HP	1,093	20

3.1.2 Portion of the Market Impacted by the Regulation

In the report prepared by Nielsen Engineering, the percentage of NEMA Premium efficiency motor sales is provided for 2003 to 2007. This data comes from a survey of motor manufacturers, dealers and distributors across Canada, and a survey conducted by EEMAC among its members.²¹ Since

¹⁹ Nielsen Engineering, "Harmonization of Minimum Efficiency Levels and Standards for Three-phase Induction Motors", 2007, p. 16.

²⁰ HS codes 850152 and 850153

²¹ Nielsen Engineering, "Harmonization of Minimum Efficiency Levels and Standards for Three-phase Induction Motors", 2007, pp. 18-19.

motors of 1-200 HP will have to meet premium efficiency standards, it is easy to estimate the percentage of noncompliant electric motors in that category.

Since the MEPS are less stringent for electric motors sized 201 to 500 HP, the percentage of NEMA Premium efficiency motor sales only allows us to estimate a maximum percentage of noncompliant electric motors. Unfortunately, Nielsen Engineering's report does not provide province-specific information regarding the sales of noncompliant electric motors. The Canadian compliance rates have nevertheless been deemed applicable to all provinces and have therefore been used for Nova Scotia. Table 10 shows the initial estimate of the portion of the market impacted by the regulation.

**Table 10: Initial Estimate of the Portion of the Three-phase Electric Motor
 Market Impacted by the Regulation**

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2013
Three-phase electric motors sized 1 to 5 HP	71.2%
Three-phase electric motors sized 6 to 25 HP	56.1%
Three-phase electric motors sized 26 to 100 HP	48.3%
Three-phase electric motors sized 101 to 200 HP	47.5%
Three-phase electric motors sized 201 to 500 HP	77.1%

Based on an interview with a representative of the Canadian Standards Association (CSA) in 2014, there would be no basis for altering the previous estimates at this time. In terms of products meeting their rated energy usage (claims on product labels), CSA indicates only minor variances of 2% to 3% below the rated efficiency levels are expected due to production issues from manufacturers. Products are otherwise considered fully compliant based on their experience with follow-up sample testing in the marketplace.

3.1.3 Unitary Savings Values

Amendment 11 provides the unitary savings values for some types of electric motors, as presented in Table 11.

Table 11: Unitary Savings Values for Electric Motors²²

Product Class	Demand Savings (W/unit)	Annual Energy Savings (kWh/unit)
5 horsepower	51	133
15 horsepower	103	325
30 horsepower	175	637
75 horsepower	464	2,161
150 horsepower	565	2,677
300 horsepower	1,568	8,536

²² Office of Energy Efficiency. Energy Efficiency Act: Regulations Amending the Energy Efficiency Regulations, <http://canadagazette.gc.ca/rp-pr/p2/2011/2011-10-12/html/sor-dors182-eng.html>, October 12, 2011.

3.1.4 At-meter Energy Savings

The Evaluator estimated the impact of the introduction of this regulation in the Nova Scotia market in terms of “at meter” energy savings by using the data collected on unitary savings, the market size of electric motors in Nova Scotia and the noncompliance rate. Since NRCan has provided only unitary savings values for specific sizes of electric motors, a single value for motors of the same size category had to be used. Also, for three-phase electric motors sized 26-100 HP, the Econoler team used the average of two values (1,399 kWh/yr/unit): the unitary savings values for 30 HP electric motors (637 kWh/yr/unit) and 75 HP electric motors (2,161 kWh/yr/unit). As shown in Table 12, total estimated savings for 2014 are 0.645 GWh.

Table 12: Energy Savings Associated with the Introduction of the Electric Motors Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Standard in 2014	Annual Energy Savings (kWh/yr/unit)	Total Energy Savings (GWh) at Meter for 2014
Three-phase electric motors sized 1 to 5 HP	1,048	71.2%	133	0.099
Three-phase electric motors sized 6 to 25 HP	739	56.1%	325	0.135
Three-phase electric motors sized 26 to 100 HP	315	48.3%	1,399	0.213
Three-phase electric motors sized 101 to 200 HP	52	47.5%	2,677	0.066
Three-phase electric motors sized 201 to 500 HP	20	77.1%	8,536	0.132
Total	2,174	61.0%		0.645

3.1.5 At-meter Peak Demand Savings

Finally, the Evaluator estimated peak demand savings at the meter by using the data collected on demand savings, the market size of electric motors in Nova Scotia, the noncompliance rate and a diversity factor. As for energy savings, a single value for motors of the same size category had to be used and the Econoler team used the average of 30 HP and 75 HP electric motors for three-phase electric motors sized 26 to 100 HP. A diversity factor of 85 percent was used, based on the on-site visits conducted through Business Energy Rebates (BER) in 2014. Most of the on-site visits had an annual operations and only one site had a seasonal operations. The Evaluator therefore assumed this situation reflected the entire electric motor market. As shown in Table 13, the total estimated peak demand savings are 0.145 MW.

Table 13: Demand Savings Associated with the Introduction of the Electric Motors Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Standard in 2014	Demand Savings (W/yr/unit)	Diversity Factor (%)	Total Peak Demand Savings (MW) at Meter for 2014
Three-phase electric motors sized 1 to 5 HP	1,048	71.2%	51	85	0.032
Three-phase electric motors sized 6 to 25 HP	739	56.1%	103	85	0.036
Three-phase electric motors sized 26 to 100 HP	315	48.3%	337	85	0.044
Three-phase electric motors sized 101 to 200 HP	52	47.5%	565	85	0.012
Three-phase electric motors sized 201 to 500 HP	20	77.1%	1,568	85	0.021
Total	2,174	61.0%			0.145

3.2 General Service Incandescent Reflector Lamps

3.2.1 Market Size Estimate

A report commissioned by NRCan and prepared by Navigant Consulting to help prepare the amendment to the regulations targeting general service incandescent reflector lamps provides estimates for Canada's domestic shipments of BR and ER lamps.²³ This data came from a survey done in 2006 by Navigant Consulting among members of EFC and a 2002 study conducted by EFC. However, the survey data on BR lamps was not complete enough to conduct an energy savings

²³ Navigant Consulting. "Evaluation of Updating Regulations for Bulge Reflector Lamps and Elliptical Reflector Lamps", March 31, 2007, p. 20.

analysis.²⁴ Consequently, Navigant Consulting developed estimates of the 2005 Canadian shipments of BR lamps, by applying the same proportions as observed in the 2002 study.

EFC has provided more comprehensive 2005 and 2014 data to support this report, including commercial, institutional and residential shipments of incandescent reflector lamps for Canada and Atlantic Canada. The EFC data is not divided according to power (W) classes—the Navigant reported breakdowns are applied to the EFC data. The Navigant-reported shipments in 2005 are 73% of the EFC-reported shipments in the same year—this percentage is applied to the 2014 EFC data. Nova Scotia’s share of the Atlantic Canada shipments were obtained by applying the population percentage (39.6%) that Nova Scotia represents in Atlantic Canada.

The table below shows the final estimates of BR lamp market sizes in Canada and Nova Scotia, based on the portion of shipments reported by EFC that are within scope. Declining in 2013 with only 2 lamps in Nova Scotia, ER lamp shipments to Nova Scotia are estimated to be negligible in 2014 and were therefore not included in the table.

Table 14: BR Lamp Market Sizes in Canada, Atlantic Canada and Nova Scotia, 2014

Product Class	Shipments to Canada in 2014	Shipments to Atlantic Canada in 2014	Shipments to Nova Scotia in 2014
60–85 W BR – residential	1,809,826	88,099	34,913
86–155 W BR – residential	206,398	10,047	3,982
60–85 W BR – commercial	561,929	20,703	8,204
86–155 W BR – commercial	64,084	2,361	936

²⁴ *Ibid.* p. 22.

3.2.2 Portion of the Market Impacted by the Regulation

In its report, Navigant Consulting does not provide any data regarding the percentage of shipments that would have been affected by Amendment 11 (i.e., the percentage of noncompliant lamp shipments prior to the Regulation that must now be compliant). Based on an interview with a representative of CSA, there would be no basis for altering the 2012 estimates at this time (Table 15). In their view, little if any change has occurred in the marketplace. According to CSA, only minor variances of 2% to 3% below the required energy efficiency levels are expected due to production issues from manufacturers, but products are otherwise considered fully compliant based on their experience with follow-up sample testing in the marketplace.

Table 15: Portion of the BR Lamp Market Impacted by the Regulation

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014
60–85 W BR – residential	82.5%
86–155 W BR – residential	81.3%
60–85 W BR – commercial	77.0%
86–155 W BR – commercial	77.0%

3.2.3 Unitary Savings Values

When Amendment 11 was published in the *Canada Gazette*, the Office of Energy Efficiency (OEE) published the unitary savings values for some of the general service incandescent reflector lamps targeted by the regulations. This information is presented in Table 16.

Table 16: Unitary Savings Values for General Service Incandescent Reflector Lamps²⁵

Product Class	Demand Savings (W/unit)	Annual Energy Savings (kWh/unit)
Residential		
85 watt BR30 – residential	21	18
75 watt BR38 – residential	21	18
120 watt BR40 – residential	26	22
75 watt ER30 – residential	21	18
120 watt ER40 – residential	26	22
Commercial		
85 watt BR30 – commercial	25	89
75 watt BR38 – commercial	25	89
120 watt BR40 – commercial	30	107
75 watt ER30 – commercial	25	89
120 watt ER40 – commercial	30	107

²⁵ Office of Energy Efficiency. Energy Efficiency Act: Regulations Amending the Energy Efficiency Regulations, <http://canadagazette.gc.ca/rp-pr/p2/2011/2011-10-12/html/sor-dors182-eng.html>, October 12, 2011.

3.2.4 At-meter Energy Savings

The Econoler team estimates that 0.518 GWh was saved at the meter in Nova Scotia in 2014 as a result of the introduction of the regulation on general service incandescent reflector lamps.

Table 17: Energy Savings Associated with the Introduction of the General Service Incandescent Reflector Lamps Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
60–85 W BR – residential	34,913	82.5	18	0.518
86–155 W BR – residential	3,982	81.3	22	0.071
60–85 W BR – commercial	8,204	77	89	0.562
86–155 W BR – commercial	936	77	107	0.077
Total	34,913	82.5	18	0.518

3.2.5 At-meter Peak Demand Savings

The Econoler team estimates that 0.869 MW was saved at the meter in Nova Scotia in 2014 as a result of introducing the regulation for general service incandescent reflector lamps. A diversity factor of 100 percent for residential bulb and 84 percent for commercial bulbs was applied to demand savings. These factors come from the 2014 BER evaluation report, for which on-site visits were used to estimate the average diversity factor of lighting products installed inside and outside participating buildings.

Table 18: Peak Demand Savings Associated with the Introduction of the General Service Incandescent Reflector Lamps Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014	Demand Savings W/unit	Diversity Factor (%)	Total Peak Demand Savings at Meter for 2014 (MW)
60–85 W BR – residential	34,913	82.5	21	100	0.605
86–155 W BR – residential	3,982	81.3	26	100	0.084
60–85 W BR – commercial	8,204	77	25	84	0.133
86–155 W BR – commercial	936	77	30	84	0.018
Total	48,034				0.840

3.3 Dry-type Transformers

3.3.1 Market Size Estimate

Since the initial 2008 report by Navigant Consulting²⁶, EFC has been tracking three-phase dry-type transformer sales according to three power size classes. Their membership represents an estimated 85%-89% of the market depending on the power class, and statistics are reported for Canada and by region, including Atlantic Canada. The sales are tracked in dollars rather than units so average prices from manufacturer catalogues are applied to each power size class to estimate shipments. The demographic weight for Nova Scotia is used to estimate the province's share within the region.

**Table 19: Three-phase Dry-type Transformer Market Size Estimate
in Canada, Atlantic Canada and Nova Scotia, 2014²⁷**

Product Class	Shipments to Canada in 2014	Shipments to Atlantic Canada in 2014	Shipments to Nova Scotia in 2014
Three Phase <750 kVA – 1.2 kV Class	8,674	354	140
Three Phase 500–2500 kVA – >1.2 kV	1,072	15	6
Three Phase >2501 kVA – >1.2 kV	331	2	1
Total	10,078	371	147

3.3.2 Portion of the Market Impacted by the Regulation

Based on interviews with manufacturers, Navigant's report indicated that nearly all shipments in Canada were noncompliant in 2008.²⁸ A Canada-wide percentage of 95% for each power class is applied to the Nova Scotia market, as shown in the following table.

**Table 20: Portion of the Three-phase Dry-type Transformer Market
Impacted by the Regulation²⁹**

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014
Three Phase <750 kVA – 1.2 kV Class	95%
Three Phase 500–2500 kVA – >1.2 kV	95%
Three Phase >2501 kVA – >1.2 kV	95%

²⁶ Navigant Consulting, Market Analysis for Dry-type Transformers, June 6, 2008, p. 1.

²⁷ Navigant Consulting, Market Analysis for Dry-type Transformers, June 6, 2008, p. 4.

²⁸ *Ibid.*

²⁹ Navigant Consulting, Market Analysis for Dry-type Transformers, June 6, 2008, pp. 15,17,20.

3.3.3 Unitary Savings Values

Navigant's report indicated annual energy savings for compliant versus noncompliant three-phase dry-type transformers common to each power class. The unitary savings values are considered conservative since they are at the low end of the power classes.

The demand savings are estimated through the energy savings and the transformer is assumed to operate permanently (annual operating hours: 8,760 hours) with a constant load. This hypothesis is a conservative approach since the peak load is smoothed, whereas the demand savings are likely to be high during peak load. Likewise, no precise data in others jurisdictions were available for the diversity factor—the Evaluator assumed the maximum value (100%).

Table 21: Unitary Savings Values for Three-phase Dry-type Transformers

Product Class	Annual Energy Savings (kWh/unit)	Demand Savings (W/unit)
Three Phase <750 kVA – 1.2 kV Class	4,320	493
Three Phase 500–2500 kVA – >1.2 kV	8,034	917
Three Phase >2,501 kVA – >1.2 kV	13,387	1,528

3.3.4 At-meter Energy Savings

The Evaluator estimates that the introduced regulation on three-phase dry-type transformers generated 0.633 GWh in energy savings in Nova Scotia in 2014.

Table 22: Energy Savings Associated with the Introduction of the Three-phase Dry-type Transformer Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
Three Phase <750 kVA – 1.2 kV Class	140	95%	4,320	0.575
Three Phase 751 – 2500 kVA – >1.2 kV	6	95%	8,034	0.046
Three Phase >2501 kVA – >1.2 kV	1	95%	13,387	0.013
Total	147			0.633

3.3.5 At-meter Peak Demand Savings

The Evaluator estimates that the introduced regulation on three-phase dry-type transformers generated 0.072 MW in peak demand savings in Nova Scotia in 2014.

Table 23: Demands Savings Associated with the Introduction of the Three-phase Dry-type Transformer Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Standard in 2014	Demand Savings (W/yr/unit)	Diversity Factor (%)	Total Peak Demand Savings (MW) at Meter for 2014
Three Phase <750 kVA – 1.2 kV Class	140	95%	493	100	0.066
Three Phase 751–2500 kVA – >1.2 kV	6	95%	917	100	0.005
Three Phase >2501 kVA – >1.2 kV	1	95%	1,528	100	0.001
Total	147				0.072

3.4 Self-contained Commercial Refrigerators and Freezers

3.4.1 Market Size Estimate

Caneta Research produced a report in 2010 for NRCan on the market situation and economics of the commercial refrigeration equipment market in Canada.³⁰ Although this report did not provide data or information about the market size of self-contained appliances, it provided interesting insights regarding the whole commercial refrigeration market.

For example, Caneta Research mentioned that “manufacturers of commercial refrigeration equipment occupy niche markets in the industry; as such they do not develop a broad view of the market and therefore have difficulty commenting on the industry as a whole.”³¹ This situation would have made it difficult to estimate the commercial refrigerator and freezer market size.

Despite such a difficulty, Caneta Research provided an estimate of the market size of those products using both the technical support documents of the U.S. DOE for commercial refrigeration equipment regulations and a report developed by HRAI. These sources presented sales figures for the U.S. and North America as a whole, respectively. Caneta Research then used the demographic weight of Canada to make a rough estimate of its commercial refrigeration equipment market size. Using this method, it was estimated that there were approximately 18,400 shipments of commercial refrigeration equipment to Canada in 2009.

³⁰ Caneta Research, Commercial Refrigeration Study, September 27, 2010.

³¹ *Ibid.* pp. 3-4.

Caneta Research also contacted 24 manufacturers and distributors, but obtained a very low response rate. Nevertheless, the responses to these interviews indicated that there were roughly 20,100 shipments of these products in Canada in 2009.

Given the discrepancies among these sales figures, Caneta Research decided to use the average of those two estimates. It was therefore assumed that there were **19,300 shipments** of commercial refrigerators, refrigerator-freezers and freezers to Canada in 2009).

The only product category for which Caneta Research provided a market size estimate was the self-contained commercial ice cream-type freezer. According to the report, there would have been **72 shipments** of self-contained commercial opaque ice cream-type freezers and **1,494 shipments** of self-contained commercial transparent ice cream-type freezers to Canada in 2009. The demographic weight of Nova Scotia was used to determine provincial shipment levels. The historical imports to Canada and Nova Scotia are reported by Statistics Canada³², so these were used to index demand since the 2009 Caneta estimates and derive 2014 shipments to each jurisdiction. The fourth quarter data for 2014 was not available yet so the first three quarters of shipments were prorated to full-year estimates (first three quarters treated as 75% of the 2014 total).

Table 24: Self-contained Commercial Ice Cream-type Freezer Market Size Estimate in Canada and Nova Scotia in 2014³³

Product Class	Shipments to Canada in 2014	Shipments to Nova Scotia in 2014
Opaque ice cream-type freezers	87	1
Transparent ice cream-type freezers	1,811	24

3.4.2 Portion of the Market Impacted by the Regulation

In its report, Caneta Research provided the percentage of shipments that would have been affected by Amendment 11 (i.e., the percentage of noncompliant lamp shipments prior to the Regulation that must now be compliant). Based on an interview with a representative of the CSA, there would be no basis for altering the estimates at this time. According to CSA, only minor variances of 2% to 3% below the required energy efficiency levels are expected due to production issues from manufacturers, but products are otherwise considered fully compliant based on their experience with follow-up sample testing in the marketplace.

³² These products are part of the Statistics Canada HS 6-digit code 841850 respecting "Other refrigerators/freezers, chests, cabinets, display centres, show cases for storage and display.

³³ Based on Statistics Canada reported shipments of HS code 841850 products to Nova Scotia and extrapolation for 2014 based on the Caneta Research. Commercial Refrigeration Study, September 27, 2010.

Table 25: Portion of the Self-contained Commercial Ice Cream-type Freezer Market Impacted by the Regulation

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014
Opaque ice cream-type freezers	100
Transparent ice cream-type freezers	76 ³⁴

3.4.3 Unitary Savings Values

When Amendment 11 was published in the *Canada Gazette*, the OEE published the unitary savings values for some of the commercial ice cream-type freezers targeted by the regulations.

Table 26: Unitary Savings Values for Commercial Ice Cream-type Freezers³⁵

Product Class	Demand Savings (W/unit)	Annual Energy Savings (kWh/unit)
Opaque ice cream-type freezers	144	576
Transparent ice cream-type freezers	443	2,215

3.4.4 At-meter Energy Savings

The Econoler team estimates that 0.041 GWh was saved at the meter in Nova Scotia in 2014 as a result of the introduction of the regulation on commercial refrigerators and freezers.

Table 27: Energy Savings Associated with the Introduction of the Commercial Ice Cream-type Freezer Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014 (%)	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
Opaque ice cream-type freezers	1	100	576	0.001
Transparent ice cream-type freezers	24	76	2,215	0.040
Total	25			0.041

³⁴ This is a weighted average compliance based on Caneta report Table 12 product HCT.SC.1 and VCS.SC.1 compliance rates (69.4% and 100% respectively) applied to the Nova Scotia shipment estimates in 2009.

³⁵ Office of Energy Efficiency. Energy Efficiency Act: Regulations Amending the Energy Efficiency Regulations, <http://canadagazette.gc.ca/rp-pr/p2/2011/2011-10-12/html/sor-dors182-eng.html>, October 12, 2011.

3.4.5 At-meter Peak Demand Savings

The Econoler team estimates that 0.618 MW was saved at the meter in Nova Scotia in 2014 as a result of introducing the regulation on commercial ice cream-type freezers. A diversity factor of 100 percent is used since commercial freezers are assumed to operate permanently.

Table 28: Peak Demand Savings Associated with the Introduction of the Commercial Ice Cream-type Freezer Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014 (%)	Demand Savings W/unit	Diversity Factor (%)	Total Peak Demand Savings at Meter for 2014 (MW)
Opaque ice cream-type freezers	1	100	144	100	0.000
Transparent ice cream-type freezers	24	76	443	100	0.008
Total	25				0.008

3.5 Large Air conditioners and Heat Pumps

3.5.1 Market Size Estimate

In 2008, Caneta Research produced a report for NRCan, entitled *Market, Benchmark and Technical Analysis for Large Air Conditioners and Heat Pumps for Future Regulation Amendment*.³⁶ In this report, Caneta Research notes that the Canadian market of large air conditioners and heat pumps grew from 2002 to 2006.

³⁶ Caneta Research. "Market, Benchmark and Technical Analysis for Large Air-conditioners and Heat Pumps for Future Regulation Amendment", February 2008, p. 8.

For this report, current data from HRAI Canada was obtained for 2014 (prorated to account for December), including Canada-wide and Atlantic Canada shipments. In 2014, the Canadian market showed a significant decrease (75%) compared to 2006 levels. Using Nova Scotia's demographic weight within Atlantic Canada (39.6%)³⁷, it was possible to estimate the market size of large air conditioners and heat pumps in Nova Scotia in 2014. Results are presented in the table below.

Table 29: Large Air Conditioner and Heat Pump Market Size Estimates
in Canada, Atlantic Canada and Nova Scotia, 2014³⁸

Product Class	Shipments to Canada in 2014	Shipments to Atlantic Canada in 2014	Shipments to Nova Scotia in 2014
Medium air conditioners (≥ 19.0 kW and < 39.6 kW (≥ 65,000 Btu/h and < 135,000 Btu/h))	8,580	178	70
Large air conditioners (≥ 39.6 kW and < 73.3 kW (≥ 135,000 Btu/h and < 250,000 Btu/h))	3,407	124	49
Very large and extremely large air conditioners (≥ 73.3 kW (≥ 250,000 Btu/h))	994	44	17
Medium heat pumps (≥ 19.0 kW and < 39.6 kW (≥ 65,000 Btu/h and < 135,000 Btu/h))	452	79	31
Large heat pumps (≥ 39.6 kW and < 70.3 kW (≥ 135,000 Btu/h and < 240,000 Btu/h))	228	51	20
Very large and extremely large heat pumps (≥ 73.3 kW (≥ 250,000 Btu/h))	0	0	0

A few observations should be made about this estimate. First, “the upper capacity limit for large equipment is 250 kBtu/h instead of the 240 kBtu/h” used by the new standard.”³⁹ Large air conditioners with cooling capacities ranging from 70 kW (240,000 Btu/h) to 73.3 kW (250,000 Btu/h) are therefore included in the “large” size category instead of the “very large” size category. Second, very large air conditioners (≥ 73.3 kW and < 223 kW (≥ 250,000 Btu/h and < 760,000 Btu/h)) and extremely large air conditioners (≥ 223 kW (≥ 760,000 Btu/h)) were grouped in the same category, while only the former are regulated by standards. Third, “the shipment data does not distinguish between the use of air-cooled and water-cooled condensers.”⁴⁰

³⁷ *Ibid.*

³⁸ Caneta Research. “Market, Benchmark and Technical Analysis for Large Air-conditioners and Heat Pumps for Future Regulation Amendment”, February 2008, pp. 9-10.

³⁹ *Ibid.* p. 8.

⁴⁰ *Ibid.*

3.5.2 Portion of the Market Impacted by the Regulation

In its report, Caneta Research mentions that “at the time of the study [2008, ed.], of equipment sold in Canada, 90% were minimum-efficiency, 7% were mid-efficiency and only 3% were high-efficiency.”⁴¹ Without more details on noncompliance rates or clear converging estimates as specified in previous reports, it could only be assumed that all types of equipment targeted by the regulation had a 90% rate of noncompliance, whether in Canada as a whole or specifically in Nova Scotia.

Table 30: Portion of the Large Air Conditioners and Heat Pumps Market Impacted by the Regulation

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2012
Medium air conditioners (≥ 19.0 kW and < 39.6 kW (≥ 65,000 Btu/h and < 135,000 Btu/h))	90%
Large air conditioners (≥ 39.6 kW and < 70 kW (≥ 135,000 Btu/h and < 240,000 Btu/h))	90%
Very large air conditioners (≥ 70 kW and < 223 kW (≥ 240,000 Btu/h and < 760,000 Btu/h))	90%
Large heat pumps (≥ 19.0 kW (≥ 65,000 Btu/h))	90%

3.5.3 Unitary Savings Values

In Amendment 11, NRCAN has specified the average unitary savings values for categories of large air conditioners and heat pumps, as presented in the following table.

Table 31: Large Air Conditioner and Heat Pump Unitary Savings Values⁴²

Product Class	Demand Savings (W/unit)	Annual Energy Savings (kWh/unit)
Medium air conditioners (≥ 19.0 kW and < 39.6 kW (≥ 65,000 Btu/h and < 135,000 Btu/h))	652	717
Large air conditioners (≥ 39.6 kW and < 70 kW (≥ 135,000 Btu/h and < 240,000 Btu/h))	2,071	2,279
Very large air conditioners (≥ 70 kW and < 223 kW (≥ 240,000 Btu/h and < 760,000 Btu/h))	1,779	1,975
Large heat pumps (≥ 19.0 kW (≥ 65,000 Btu/h))	3,480	2,871

⁴¹ Caneta Research. “Market, Benchmark and Technical Analysis for Large Air-conditioners and Heat Pumps for Future Regulation Amendment”, February 2008, p. 12.

⁴² Office of Energy Efficiency. Energy Efficiency Act: Regulations Amending the Energy Efficiency Regulations, <http://canadagazette.gc.ca/rp-pr/p2/2011/2011-10-12/html/sor-dors182-eng.html>, October 12, 2011.

3.5.4 At-meter Energy Savings

Based on these unitary savings values, the large air conditioner and heat pump market size estimates for Nova Scotia and the estimates of total shipments to Nova Scotia affected by the regulation in 2013, the Evaluator estimates that the introduction of the regulation on large air conditioners and heat pumps has resulted in energy savings of 0.308 GWh at the meter.

Table 32: Energy Savings Associated with the Introduction of the Large Air Conditioners and Heat Pumps Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014 (%)	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
Medium air conditioners (≥ 19.0 kW and < 39.6 kW (≥ 65,000 Btu/h and < 135,000 Btu/h))	70	90	717	0.045
Large air conditioners (≥ 39.6 kW and < 70 kW (≥ 135,000 Btu/h and < 240,000 Btu/h))	49	90	2,279	0.101
Very large and extremely large air conditioners (≥ 73.3 kW (≥ 250,000 Btu/h))	17	90	1,975	0.030
Large heat pumps and single package vertical heat pumps (≥ 19.0 kW (≥ 65,000 Btu/h))	51	90	2,871	0.132
Total	187			0.308

3.5.5 At-meter Peak Demand Savings

The Econoler team estimates that 0.160 MW was saved at the meter in Nova Scotia in 2014 as a result of introducing the regulation on large air conditioners and heat pumps. A diversity factor of 0 percent was applied to air conditioners since the peak period for electricity demand in Nova Scotia occurs in the months of December, January and February.⁴³ By contrast, a diversity factor of 100 percent was applied to heat pumps based on the 2014 BER evaluation report. During this evaluation, on-site visits were conducted to estimate the diversity factor at facilities where heat pumps of similar sizes were installed. The diversity factor was calculated to be 98%, as all projects involved air-source heat pumps running at maximum capacity in the coldest days of winter. Only one heat pump did not provide heating, which explains why the factor is not 100%.

⁴³ Nova Scotia Power. *Domestic Service Time-Of-Day Tariff*, [www.nspower.ca](http://www.nspower.ca/en/home/aboutnspi/ratesandregulations/electricityrates/domesticservicetimeofdaytariffoptional.aspx), available at <<http://www.nspower.ca/en/home/aboutnspi/ratesandregulations/electricityrates/domesticservicetimeofdaytariffoptional.aspx>>

Table 33: Peak Demand Savings Associated with the Introduction of the Large Air Conditioners and Heat Pumps Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014 (%)	Demand Savings (W/unit)	Diversity Factor (%)	Total Peak Demand Savings at Meter for 2014 (MW)
Medium air conditioners (≥ 19.0 kW and < 39.6 kW (≥ 65,000 Btu/h and < 135,000 Btu/h))	70	90	652	0	0
Large air conditioners (≥ 39.6 kW and < 70 kW (≥ 135,000 Btu/h and < 240,000 Btu/h))	49	90	2,072	0	0
Very large and extremely large air conditioners (≥ 73.3 kW (≥ 250,000 Btu/h))	17	90	1,779	0	0
Large heat pumps and single package vertical heat pumps (≥ 19.0 kW (≥ 65,000 Btu/h))	51	90	3,480	94	0.157
Total	783				0.157

3.6 Single Package Vertical Air-conditioners and Heat Pumps

3.6.1 Market Size Estimate

With regard to the market size of SPVAC and SPVHP, NRCan mentions that the majority of the appliances sold “are less than 65,000 Btu/h in cooling capacity.”⁴⁴ Shipments to Canada were first estimated by Caneta Research using U.S. shipment data from 2006.⁴⁵ According to Caneta Research, “of these shipments, 87% are AC and 13% are HP.”⁴⁶

For this report, current data was obtained from HRAI Canada for 2014 (prorated to account for December), including Canada-wide and Atlantic Canada shipments. Using Nova Scotia’s demographic weight within Atlantic Canada (39.6%), it was possible to estimate market size for single package vertical air conditioners and heat pumps in Nova Scotia in 2014.

⁴⁴ *Ibid.*

⁴⁵ Caneta Research. “Market, Benchmark and Technical Analysis for Large Air-conditioners and Heat Pumps for Future Regulation Amendment”, February 2008, p. 37.

⁴⁶ *Ibid.*

Table 34: Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Market Size Estimate for Canada, Atlantic Canada and Nova Scotia, 2014⁴⁷

Product Class	Shipments to Canada in 2014	Shipments to Atlantic Canada in 2014	Shipments to Nova Scotia in 2014
SPVAC	1,372	13	5
SPVHP	199	2	1

3.6.2 Portion of the Market Impacted by the Regulation

In its report, Caneta Research mentions that “at the time of the study [2008, ed.], of equipment sold in Canada, 90% were minimum-efficiency, 7% were mid-efficiency and only 3% were high-efficiency.”⁴⁸ Without more details on noncompliance rates, it could only be assumed that all types of equipment targeted by the regulation had a 90% noncompliance rate, whether in Canada as a whole or specifically in Nova Scotia.

Table 35: Portion of the Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Market Impacted by the Regulation

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014
SPVAC (< 19.0 kW, < 65,000 Btu/h)	90%
SPVHP (< 19.0 kW, < 65,000 Btu/h)	90%

3.6.3 Unitary Savings Values

In Amendment 11, NRCAN has specified the average unitary savings values for categories of large air conditioners and heat pumps, as presented in the table below.

Table 36: Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Unitary Savings Values⁴⁹

Product Class	Demand Savings (W/unit)	Annual Energy Savings (kWh/unit)
SPVAC (< 19.0 kW, < 65,000 Btu/h)	652	717
SPVHP (< 19.0 kW, < 65,000 Btu/h)	3,480	2,871

⁴⁷ Caneta Research. “Market, Benchmark and Technical Analysis for Large Air Conditioners and Heat Pumps for Future Regulation Amendment”, February 2008, p. 26.

⁴⁸ Caneta Research. “Market, Benchmark and Technical Analysis for Large Air-conditioners and Heat Pumps for Future Regulation Amendment”, February 2008, p. 12.

⁴⁹ Office of Energy Efficiency. Energy Efficiency Act: Regulations Amending the Energy Efficiency Regulations, <http://canadagazette.gc.ca/rp-pr/p2/2011/2011-10-12/html/sor-dors182-eng.html>, October 12, 2011.

3.6.4 At-meter Energy Savings

Based on these unitary savings values, the market size estimates for large air conditioners and heat pumps in Nova Scotia and the estimates of total shipments to Nova Scotia affected by the regulation in 2014, the Evaluator estimates that the introduction of the regulation on large air conditioners and heat pumps has resulted in energy savings of 0.006 GWh at the meter.

Table 37: Energy Savings Associated with the Introduction of the Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014 (%)	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
SPVAC (< 19.0 kW, < 65,000 Btu/h)	5	90	717	0.003
SPVHP(< 19.0 kW, < 65,000 Btu/h)	1	90	2,871	0.003
Total	6			0.006

3.6.5 At-meter Peak Demand Savings

The Econoler team estimates that 0.003 MW was saved at the meter in Nova Scotia in 2014 as a result of introducing the regulation on large air conditioners and heat pumps. A diversity factor of 0 percent was applied to air conditioners since the peak period for electricity demand in Nova Scotia occurs in the months of December, January and February.⁵⁰ By contrast, a diversity factor of 98 percent was applied to heat pumps based on the 2014 BER evaluation report. During this evaluation, on-site visits were conducted to estimate the diversity factor at facilities where heat pumps of similar sizes had been installed.

Table 38: Peak Demand Savings Associated with the Introduction of the Single Package Vertical Air Conditioner and Heat Pump (SPVAC and SPVHP) Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014 (%)	Demand Savings (W/unit)	Diversity Factor (%)	Total Peak Demand Savings at Meter for 2014 (MW)
SPVAC (< 19.0 kW, < 65,000 Btu/h)	5	90	652	0	0
SPVHP (< 19.0 kW, < 65,000 Btu/h)	1	90	3,480	98	0.003
Total	6				0.003

⁵⁰ Nova Scotia Power. Domestic Service Time-Of-Day Tariff, [www.nspower.ca](http://www.nspower.ca/en/home/aboutnspi/ratesandregulations/electricityrates/domesticservicetimeofdaytariffoptional.aspx).
<http://www.nspower.ca/en/home/aboutnspi/ratesandregulations/electricityrates/domesticservicetimeofdaytariffoptional.aspx>.

3.7 Standby Power

3.7.1 Market Size Estimate

The initial market size estimate for these products was based on a study conducted by Ecos. Using different sources, such as the *2008 Consumer Electronics Market (CEM) Trends and Forecast* and Navigant Consulting's *Canadian Retail Store Survey* of 2008, Ecos has developed data for Canadian shipments for 2002 - 2007.⁵¹ The Survey of Household Spending undertaken by Statistics Canada⁵² tracks annual expenditures related to these consumer products, providing a shipment index over time and a basis for determining the Nova Scotia portion of national sales. The shipment estimates for Canada and Nova Scotia are shown in the table below.

Table 39: Standby Power Product Market Size Estimates for Canada and Nova Scotia, 2014⁵³

Product Class	Shipments to Canada in 2014	Shipments to Nova Scotia in 2014
Integrated stereo	364,000	23,740
Portable audio	107,408	7,005
Televisions	2,742,939	26,914
Non-recording video players	879,193	8,627
Recording video players	498,656	4,893

⁵¹ Ecos. Market Analysis for Standby Power, October 22, 2008, pp. 14, 19, 22.

⁵² Statistics Canada. Table 203-0010 - Survey of household spending (SHS), household spending on recreation, by province and territory, annual, (latest accessed January 23, 2015).

⁵³ Ecos. Market Analysis for Standby Power, October 22, 2008, pp. 15, 20, 24.

3.7.2 Portion of the Market Impacted by the Regulation

Ecos provided the noncompliance rate for standby power products for 2007 only. Since there is no data from more recent years, Ecos' information is still assumed to be valid to evaluate the impact of the regulation for the year 2014. Furthermore, since no province-specific statistics are available, the noncompliance rate for Nova Scotia has been assumed to be the same as for the rest of Canada. The Table below shows the estimated portion of the market impacted by the regulation on standby power products.

Table 40: Estimate of the Portion of the Standby Power Product Market Impacted by the Regulation⁵⁴

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014
Integrated stereo	51%
Portable audio	5%
Televisions	7%
Non-recording video players	17%
Recording video players	48%

⁵⁴ Ecos. Market Analysis for Standby Power, October 22, 2008, pp. 15, 20, 24.

3.7.3 Unitary Savings Values

In Amendment 11, NRCan has provided unitary savings values for integrated stereos, portable audio products, television, non-recording video players and recording video players. It has also estimated average unitary savings values for clock radios.⁵⁵ However, in its report, Ecos did not provide a specific market size for clock radios in Canada because that information did not exist. Those products were instead included in the “integrated stereo” category.⁵⁶ The Econoler team decided to do the same for this study. Table 41 shows the average unitary savings values for standby power products covered by the regulation.

Table 41: Unitary Savings Values for Standby Power Products⁵⁷

Product Class	Annual Energy Savings (kWh/unit)
Integrated stereo	199
Portable audio	15
Clock radios	44
Televisions	80
Non-recording video players	71
Recording video players	112

⁵⁵ Office of Energy Efficiency, Energy Efficiency Act: Regulations Amending the Energy Efficiency Regulations, <http://canadagazette.gc.ca/rp-pr/p2/2011/2011-10-12/html/sor-dors182-eng.html>, October 12, 2011.

⁵⁶ Ecos. Market Analysis for Standby Power, October 22, 2008, p. 14.

⁵⁷ *Ibid.*

3.7.4 At-meter Energy Savings

The Evaluator estimates that the introduction of new MEPS for standby power products generated 2.933 GWh in total savings in Nova Scotia for 2014.

Table 42: Energy Savings Associated with the Introduction of the Standby Power Products Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
Integrated stereo	23,740	51%	199	2.409
Portable audio	7,005	5%	15	0.005
Televisions	26,914	7%	80	0.151
Non-recording video players	8,627	17%	71	0.104
Recording video players	4,893	48%	112	0.263
Total	71,179			2.933

3.7.5 At-meter Peak Demand Savings

Given the different nature of each product class and the lack of information required to establish a diversity factor for each product class, the Econoler team was unable to estimate peak demand savings with a sufficient level of accuracy for this regulation. Taking into account the features of the various standby power products, however, the Econoler team believes the diversity factor would be minimal for each product and therefore result in negligible peak demand savings.

3.8 External Power Supplies

3.8.1 Market Size Estimate

In 2012, Ecos performed a market analysis of external power supplies. Based on data from 2008, the Ecos report estimated shipments by power supply class to Canada and indicated the dominant consumer product in each size class (e.g., power shavers/clippers are under 1 W, mobile phones are 1 to 5 W, etc.).⁵⁸ The Survey of Household Spending undertaken by Statistics Canada tracks annual expenditures related to these consumer products, providing a shipment index over time and a basis for determining the Nova Scotia's portion of national sales. The shipment estimates for Canada and Nova Scotia are as follows:

Table 43: External Power Supplies Market Size for Canada and Nova Scotia, 2014⁵⁹

External Power Supplies Class	Shipments to Canada in 2014	Shipments to Nova Scotia 2014
Less than 1 W	2,987,943	75,812
1 to 5 W	34,672,735	961,215
5 to 10 W	14,384,233	398,767
11 to 20 W	3,269,328	166,244
21 to 50 W	3,706,492	102,070
51 to 100 W	2,725,933	80,186
More than 100 W	779,140	22,919
Total	62,525,804	1,807,212

⁵⁸ Ecos. 2008 External Power Supply Market Analysis, October 26, 2012, p. 1.

⁵⁹ *Ibid.*

3.8.2 Portion of the Market Impacted by the Regulation

Ecos' report estimated noncompliance rates for shipments to Canada in 2008.⁶⁰ However, without province-specific statistics, Canada-wide percentages were applied to the Nova Scotia market. Table 44 below shows these noncompliance rates.

Table 44: Portion of the Products Sold with an External Power Supply Impacted by the Regulation⁶¹

Product Class	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014
<1 watts	78%
1-5 watts	63%
5-10 watts	63%
11-20 watts	75%
21-50 watts	80%
51-100 watts	63%
> 100 watts	83%

Since interviewees were unable to estimate the noncompliance rate of external power supplies with respect to the MEPS, the numbers from Table 44 were used to estimate the impact of the introduction of this new regulation in the Nova Scotia market.

3.8.3 Unitary Savings Values

The table below presents the unitary savings values provided in Ecos' spreadsheet.

Table 45: Unitary Savings Values for Products Sold with an External Power Supply⁶²

Product Class	Annual Energy Savings (kWh/unit)
<1 watts	5.97
1-5 watts	0.01
5-10 watts	7.99
11-20 watts	0.51
21-50 watts	3.10
51-100 watts	4.51
> 100 watts	0.46

⁶⁰ Ecos. 2008 External Power Supply Market Analysis, October 26, 2012, p. 2.

⁶¹ *Ibid.*

⁶² Ecos. 2008 External Power Supply Market Analysis: Canadian EPS Market Spreadsheet, October 26, 2012.

3.8.4 At-meter Energy Savings

The Evaluator estimates that the introduced regulation on external power supplies generated 2.918 GWh in energy savings in Nova Scotia for 2014.

Table 46: Energy Savings Associated with the Introduction of the External Power Supplies Regulation in the Nova Scotia Market

Product Class	Shipments to Nova Scotia in 2014	Percentage of Total Shipments to Nova Scotia Affected by the Regulation in 2014 (%)	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
<1 watt	75,812	78	5.97	0.353
1-5 watts	961,215	63	0.01	0.006
5-10 watts	398,767	63	7.99	2.007
11-20 watts	166,244	75	0.51	0.064
21-50 watts	102,070	80	3.1	0.253
51-100 watts	80,186	63	4.51	0.228
> 100 watts	22,919	63	0.46	0.007
Total	1,807,212			2.918

3.8.5 At-meter Peak Demand Savings

Since the required information to calculate a diversity factor for each product class was not available, the Econoler team has not estimated the peak demand savings for this regulation.

3.9 Incandescent Lamps(75 W and 100 W)

3.9.1 Product Description

Incandescent lamps have been commonly used for lighting applications for over 100 years. The design and energy utilization has remained relatively unchanged. Incandescent lamps are very inefficient converters of energy to light; since most of the energy is emitted as heat. There are several product options that can meet consumer lighting requirements. However, prior to the late 2000s, their lighting characteristics and products costs did not provide consumers sufficient incentive to convert away from the high-energy consumption incandescent bulbs.

3.9.2 Regulation Description

Initially, Amendment 10 to the Regulations was developed to enable a phased-in introduction of lighting standards commencing on January 1, 2012. The regulation is intended to encourage the use of higher-efficiency lamps to help replace and phase out incandescent bulbs, which are a major end-

use of electricity for lighting. This amendment is expected to result in a 30% improvement in overall lighting efficiency in terms of electricity consumption.

In response to concerns raised, Amendment 12 was introduced, but delayed the phased introduction by two years to January 1, 2014. The rationale for this delay was to allow more time for communication about lighting choices to Canadians, to allow for further advances in technology and also to address environment and health concerns related to CFLs.

Amendment 12B dealt with three issues:

- › to provide Canadian customers with more lighting options, specifically a bulb which closely resembles and performs like a traditional incandescent bulb;
- › to reduce the regulatory compliance burden on the industry;
- › to support the government's regulatory policy of aligning with American standards, where feasible.

Energy impacts associated with the introduction of these standards will be gradual in nature for a number of reasons. One of those reasons is that the phase out of incandescent bulbs was designed in two stages: (1) effective January 1, 2014 was the elimination of 175 watt bulbs, (2) the 60 and 40 watt bulbs remained available on the market for the entire 2014 calendar year. Their discontinuation has been scheduled for December 31, 2014. The new regulation has introduced a level of lighting efficiency similar to that of a halogen incandescent bulb.

Table 47: Schedule of Light Bulbs Meeting New Standards⁶³

Traditional Incandescent Light Bulb	Light Bulbs Meeting the New Standards	Type of Light Bulb		Effective Date
Maximum Wattage	Maximum Wattage	Standard Spectrum (lumen range)	Modified Spectrum (lumen range)	Manufactured On or After
100 W	72 W	1,490 – 2,600	1,118 – 1,950	January 1, 2014
75 W	53 W	1,050 – 1,489	788 – 1,117	January 1, 2014
60 W	43 W	750 – 1,049	563 – 787	December 31, 2014
40 W	29 W	310 – 749	232 – 562	December 31, 2014

The lighting market offers Canadian customers three major types of products that respect the maximum wattage allowed by the new standard, namely the incandescent halogen, the CFL and the LED.

⁶³ "Amendment to Canada's Energy Efficiency Regulations for Lighting Products", Natural Resources Canada, January 2014, available at <<http://www.nrcan.gc.ca/energy/regulations-codes-standards/12342>>, (Last accessed February 16, 2015).

3.9.3 Market Size Estimate

Public data from Electro-Federation Canada was not available to estimate market size in 2014. Market size was moreover difficult to estimate since a phasing-out period was allowed. The ban was targeted at manufacturers and distributors, making it impossible to ship bulbs as of the effective dates. Retailers were permitted, however, to sell off inventories until exhausted.

Retailers reported in *The Globe and Mail* that they still had enough banned bulbs in stock to provide consumers continued access for a few months (Home Depot expected them to last until March 2014). It appears that the majority of these stocks have now been exhausted, although a casual survey of ten retailers conducted in December 2014 found 100-watt bulbs still available at two outlets.⁶⁴

As there was no publicly available light bulb sales data for the United States, Canada or the province of Nova Scotia, no energy impact estimate based on specific data can be derived. To our knowledge, no detailed analysis on the impact of this regulatory measure has been conducted since 2008, when NRCan commissioned ICF Consulting Canada Inc. to provide technical and analytical support to assist in establishing MEPS related to the proposed lighting standards. From there onwards, the methodology used to estimate savings was based on the ICF study results⁶⁵.

3.9.4 Portion of the Market Impacted by the Regulation

ICF analysis of baseline performance was based on product availability and assumed purchasing and utilization levels on a household or commercial establishment basis. The full analysis was not repeated when the standard was delayed or amended in 12B. However, as part of the Regulatory Impact Statement Process, the cost benefit analysis was adjusted to account for lower projected energy savings.

To quote, “The energy savings attributable to these amended standards will be less than the estimated savings of the current standards because the amendment permits a slightly less efficient bulb.... All products that meet the amended standards consume at least 28%⁶⁶ less energy than the traditional incandescent light bulbs available on market today.” The original standard prepared in 2008 by ICF was set at a 30% efficient level increase.

This estimate draws on the baseline work done in 2008 by ICF with modifications as per amendments and judgment by evaluation analysts. ICF reported that the average Canadian household had 26.4 light bulbs, of which 67.4 percent were incandescent. They also estimated the average operating times per bulb at three hours for residential bulbs, noting there are very few that operate more than six hours per day.

⁶⁴ Survey conducted by Gardner Pinfold Consultants Inc. (Princess Auto in Dartmouth and Chester Home Hardware had inventories of 100 watt bulbs in early December.)

⁶⁵ General Service Lighting Report, Prepared for Natural Resources Canada by ICF Consulting Canada Ltd, May 2008.

⁶⁶ Regulatory Impact Analysis Statement. executive summary, p 207, available at : <http://canadagazette.gc.ca/rp-pr/p2/2014/2014-01-15/pdf/g2-14802.pdf> (Last accessed February 16, 2015).

3.9.5 At-meter Energy Savings

The Evaluator suggests the impact on 2014 would be less than 4 percent. This is based on the following assessments:

- › ICF noted that 3.6 bulbs should be replaced, based on an average of 26.4 bulbs/Canadian household. To put things into perspective, approximately 13.6% of all installed bulbs per household are retired during the first stage of the standard
- › Overall, the unitary savings estimate of 28 percent per bulb displaced (see quote from ICF study in the previous section) and the retirement factor of 13.6 percent would equal to 3.8 percent in savings over the total energy consumption for light bulbs in the residential sector.

According to NRCan's Energy Use Data Handbook, the total energy consumption for lighting by the residential sector in Canada was 54.0 petajoules.⁶⁷ The 3.8 percent savings would result in a reduction of 2.052 petajoules in Canada. Since Nova Scotia households account for 2.9% of all households in Canada⁶⁸, the total energy savings in Nova Scotia would 0.0595 petajoules, which can be translated to 16.528 GWh.

ICF did not provide enough information to estimate energy savings in the commercial sector.

Table 48: Energy Savings Associated with the Introduction of Incandescent Bulbs Standards in the Nova Scotia Market

Product Class	Total Incremental Energy Savings at Meter for 2014 (GWh)
Incandescent bulbs (75 - 100W)	16.528

The Evaluator ensured that there was no overlap or double-counting with savings from the Instant Savings program which offers discounts for CFL products. For Instant Savings, the 2014 baseline is still based on the replacement of incandescent. CFLs were no longer part of the Instant Savings-rebated products as of the 2014 fall campaign. The baseline was therefore not reviewed during the 2014 evaluation. The analysis revealed, however, that the average power of the regular CFLs sold through Instant Savings was 14.6 watts and the average equivalent power of the incandescent lamps replaced corresponded to a value of 61.9 watts. The Evaluator thus assumed CFL lamps sold through Instant savings would not be affected by Amendment 12B and considered there was no overlap between ENSC programs and the savings attributable to C&S.

⁶⁷ Residential Secondary Energy Source and End Use, lighting sector in 2011, Energy Use Data Handbook 1990-2011, NRCan

⁶⁸ Household size, by province and territory ((Newfoundland and Labrador, Prince Edward Island, Nova Scotia) in 2011, Statistics Canada, available at : < <http://www.statcan.gc.ca/tables-tableaux/sum-som/I01/cst01/famil53a-eng.htm>>, (Last accessed February 17, 2015).

3.9.6 At-meter Peak Demand Savings

Peak demand savings are calculated using a demand-to-energy ratio of 0.158 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by Instant Savings in 2014, as developed by Navigant in the 2013-2015 DSM Plan.

Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 p.m. and 7 p.m. on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

As shown in the table below, the 100 percent diversity factor was considered because savings always occurred during the winter peak load.

Table 49: Peak Demand Savings Associated with the Introduction of Incandescent Bulbs Standards in the Nova Scotia Market

Product Class	Demand-to-Energy Ratio (MW)	Diversity Factor (%)	Total Peak Demand Savings at Meter for 2014 (MW)
Incandescent bulbs (75 - 100W)	0.158	100%	2.611

3.10 LED Street Lighting

3.10.1 Product Description

Light emitting diode (LED) streetlights provide a more energy-efficient means to meet the street lighting requirements of Nova Scotia's municipalities. Many lighting manufacturers applied considerable development efforts to LED sources, and as such the technology has been making great strides.⁶⁹

3.10.2 Regulation Description

In May of 2011, the province passed legislation requiring lighting on Nova Scotia roads and highways to be converted to LED lighting. At present, Nova Scotia is the first Canadian province to convert its existing street lighting. Most street lights in the province are owned by Nova Scotia Power, the remaining stock being owned by municipalities. Both Nova Scotia Power and municipalities have 10 years to complete the conversion (by December 31, 2022).

All lights are to be replaced as they require maintenance. The average life span of the most common street lights, high pressure sodium, is about five years, meaning that most of the existing stock would require replacement at some point well within the ten-year period.

⁶⁹ Energy Efficient Street Lighting Strategies for Nova Scotia Municipalities, DMD and Associates Ltd, 2009.

3.10.3 Market Size Estimate

In 2009, the Union of Nova Scotia Municipalities (UNSM) commissioned DMD & Associates Ltd.⁷⁰ to prepare “Energy Efficient Street Lighting Strategies for Nova Scotia Municipalities.” As part of this work, a complete inventory of all streetlights in the province was compiled by type—135,964 lights were reported in total. The inventory gave the energy conception range for an average month and the proportion of different categories. The results are presented in the table below.

Table 50: Existing Lighting Units Inventory in Nova Scotia, 2009

Type	Energy Consumption Range for an Average Month (kWh/month)	Proportion of Inventory	Proportion of Total Power Consumed
High pressure sodium	From 32 to 150	82%	73.5%
Mercury vapour	From 43 to 363	12%	16.0%
Metallic additive	From 50 to 360	2%	4.0%
Others :		4%	6.5%
> Incandescent	From 97 to 154	-	-
> Low pressure sodium	From 60 to 80	-	-
> Fluorescent	From 30 to 222	-	-

3.10.4 Portion of the Market Impacted by the Regulation

In its report, DMD & Associates Ltd. estimated that total street lighting consumption in 2009 was 88,886,988 kWh. This would work out to an average consumption per light unit of 653.8 kWh on an annual basis and an average power of 163 W per existing lighting unit on an annual basis totalling 4,000 operative hours.⁷¹

Nova Scotia Power reports that they have replaced 12,052 units⁷² in municipalities that currently rent streetlights from Nova Scotia Power, a figure coming directly from their project database. It is reported that Nova Scotia Power is replacing LED street lights on a daily basis, but current entry into database is lagging. At this time, 12,052 units is considered an underestimate of what has actually been replaced.

Deriving an actual estimate of energy savings generated to date would require information on which lights have been taken out of service, as there are varying degrees of efficiency. But information on replaced units was not available.

⁷⁰ Union of Nova Scotia Municipalities (UNSM), “Energy efficient street lighting strategies for Nova Scotia municipalities”, July 16, 2009, available at <http://www.sustainability-unsm.ca/climate-changeenergy-efficiency.html> (Last accessed January 28, 2015).

⁷¹ “Street and Area Lighting”, NSPI, available at <http://www.nspower.ca/en/home/about-us/electricity-rates-and-regulations/rates/street-and-area-lighting.aspx>, (Last accessed January 29, 2015).

⁷² This number came from the internal project database of NSPI.

3.10.5 Unitary Savings Values

The Evaluator presumes Nova Scotia Power replaced the least efficient units first (i.e., with a higher energy consumption than the average consumption of the existing lighting units in Nova Scotia). The total reduced energy requirement for those lights depends on which types were replaced. However, since the efficiency of the replaced units is unknown, the Evaluator used a conservative approach by applying the average consumption of 653.8 kWh per lamp for the 12,052 replaced units, totalling 7,891,041 kWh in energy consumption.

To estimate the total reduction in energy use resulting from LED replacements, the Evaluator conducted a literature review of study cases on LED street lighting in other jurisdictions.

Table 51: Literature Review of LED Street Lighting Study Cases

Baseline – Existing Fixture	Minimum Savings	Maximum Savings	Average Savings	Source
High pressure sodium 100 W	0%	41%	24%	Streetlights for local roads, National Lighting Product Information Program, February 2011 ⁷³
High pressure sodium 100 W	36%	68%	46%	Nova Scotia LED Roadway Lighting Pilot Installations, DMD & Associates Ltd, 2010 ⁷⁴
High pressure sodium 100 W – 400W	31%	51%	39%	GATEWAY Program, Kansas City, 2013 ⁷⁵
High pressure sodium 150 W	26%	57%	45%	GATEWAY Program, New York State, 2011 ⁷⁶
High pressure sodium 150 W	10%	40%	25%	GATEWAY Program, Philadelphia, 2011 ⁷⁷

⁷³ “Streetlights for local roads”, National Lighting, available at

<http://www.lrc.rpi.edu/programs/NLPIP/PDF/VIEW/SR_StreetlightsLocal.pdf, (Last accessed January 29, 2015).

⁷⁴ “Nova Scotia LED Roadway Lighting Pilot Installations”, DMD & Associates Ltd, 2010, available at

<http://www.lightsavers.ca/files/Nova_Scotia_LED_Roadway.pdf>, (Last accessed January 29, 2015).

⁷⁵ GATEWAY Program, Kansas City, 2013, “Final Report prepared in support of the U.S. DOE Solid-State Lighting Technology Demonstration”, available at < http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2013_gateway-msslc_kc.pdf>, (Last accessed January 29, 2015).

⁷⁶ GATEWAY Program, New York State, 2011

Final Report prepared in support of the U.S. DOE Solid-State Lighting Technology Demonstration, available at

<apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2011_gateway_fdr-drive.pdf>, (Last accessed January 29, 2015).

⁷⁷ GATEWAY Program, Philadelphia, 2011, available at

<http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/philadelphia_brief.pdf>, (Last accessed January 29, 2015).

Discrepancies were noted in the average savings even though a similar baseline was used (high pressure sodium) and most methodologies met the IESNA RP-8-00⁷⁸ criteria of the American National Standard Practice for Roadway Lighting. Differences that could explain those discrepancies have however been observed, among those the illuminance level between the existing roadway street lights and the new ones, and the efficiency of LED street lights. Furthermore, the specifications of the LED street lighting installed by Nova Scotia Power were unknown.

In light of these observations, a conservative approach was used—calculating the rounded average of energy savings from all study cases. The value obtained (35 percent) was used to estimate the energy and peak demand savings. Thus, a unitary energy saving of 229 kWh per street light unit and a displaced wattage per street light unit of 57 W were considered.

3.10.6 At-meter Energy Savings

The estimation of energy savings related to the installation of 12,052 units totalled 2.758 GWh, as shown in the table below.

Table 52: Energy Savings Associated with the Introduction of the LED Street Lightings in the Nova Scotia Market

Product Class	Number of Lighting Units Replaced in 2014	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
LED Street Lighting	12,052	229	2.758

3.10.7 At-meter Peak Demand Savings

The Econoler team estimates that 0.689 MW was saved at the meter in Nova Scotia in 2014 as a result of introducing LED street lightings. As shown in the table below, the diversity factor of 100 percent was considered because savings always occurred during the winter peak load.

Table 53: Demand Savings Associated with the Introduction of the LED Street Lightings in the Nova Scotia Market

Product Class	Number of Lighting units Replaced in 2014	Demand Savings (W/unit)	Diversity Factor (%)	Total Peak Demand Savings at Meter for 2014 (MW)
LED Street Lighting	12,052	57	100%	0.689

⁷⁸ IESNA, <http://www.ies.org/>

3.11 New Energy Code for Houses

3.11.1 Product Description

In November 2011, the Canadian Commission on Building and Fire Codes released the National Energy Code for Buildings (NECB). This enhanced the minimum requirements for the design and construction of energy-efficient buildings contained in the 1997 Model, National Energy Code for Buildings (MNECB). Generally, national building codes serve as guidance documents for provinces that can either develop their own or adopt national standards. The adoption of the NECB 2011 was progressively introduced in Canadian provinces. Ontario⁷⁹, British Columbia⁸⁰ and Nova Scotia⁸¹ have already implemented the 2011 NECB or an energy-equivalent standard for large buildings. These adoptions are the confirmation that the building sector has evolved towards a higher energy efficiency level. Nova Scotia's Building Code is based on the national model. In Nova Scotia, the NECB 2011 was enforced in December 31, 2014 so the impact of the code on energy consumption is not reviewed in this year's evaluation. However, new houses and small buildings are not covered by the NECB 2011⁸², but by the Revision 2012 of Part 9 of the National Building Code (NBC). In Nova Scotia, the 2012 Revision of the NBC (Part 9) was adopted in July 2013 and has been effective since December 31, 2013.⁸³ The following section evaluates the impact of this new regulation on the residential and small commercial market new houses.

3.11.2 Regulation Description

The 2010 edition of the National Building Code of Canada introduced a new section to Part 9 (Houses and Small Buildings) in 2012 called "Section 9.36. Energy Efficiency". This section was adopted to replace the former Part 10 of the Nova Scotia Building Code Regulations, which was originally adopted in 2009. In adopting the version found in the National Building Code for energy efficiency, Nova Scotia aligned with agreed-upon minimum national standards for energy efficiency in the design and construction of houses and small buildings (less than 600 square meters).⁸⁴ These requirements were extensively reviewed nationally and provincially with the participation of stakeholders from the energy conservation, construction and regulatory sectors. The Code aligns with energy conservation measures supported by the federal and provincial energy departments and agencies for programs such as EnerGuide for New Homes, Energy Star for New Homes and other similar programs.

⁷⁹ Government of Ontario - Ministry of Municipal Affairs and Housing, Ontario Building Code, "Are you ready? 2012 Requirements for New Construction", Web <<http://www.mah.gov.on.ca/Page9714.aspx>>.

⁸⁰ Government of British Columbia, Information Bulletin – Building and Safety Standards Branch, "New Energy Requirements, May 22, 2013.

⁸¹ Summary of Changes Nova Scotia Building Code Regulation July 2013, Web <<http://novascotia.ca/lae/buildingcode/docs/13-06-25-SummaryofChangesNovaScotiaBuildingCodeRegulation.pdf>>.

⁸² "National Energy Code of Canada for Buildings 2011", National Research Council Canada, available at < http://www.nrc-cnrc.gc.ca/eng/publications/codes_centre/2011_national_energy_code_buildings.html>, (Last accessed January 29, 2015).

⁸³ Nova Scotia, "Nova Scotia Building Code Regulations – Made Under Section 4 of the Building Code Act, 2013.

⁸⁴ "Summary of Changes Nova Scotia Building Code Regulation", July 2013. Available at: <<http://novascotia.ca/lae/buildingcode/docs/130625SummaryofChangesNovaScotiaBuildingCodeRegulation2.pdf>>

3.11.3 Market Share Estimate

The approach was to use data available from Statistics Canada pertaining to the value of building permits for both residential and small commercial facilities in the province. For 2014, data is available until the end of October. The table below summarizes the data available on building permits in Nova Scotia.

Table 54: Data on Nova Scotia's Building Permits for January to October 2014

End-use Sector	Total Value ⁸⁵ (000)	Estimated Total Surface Area (m ²)
Residential	\$647,426	385,167 ⁸⁶
Small Commercial	\$50,000 ⁸⁷	18,518 ⁸⁸

For 2014, small commercial constructions are considered negligible compared to residential constructions (4.6 percent of the estimated total surface area). The Evaluator assumed the energy consumption was also negligible.

Table 55: Number of Dwelling Units – Data on Nova Scotia's Residential Building Permits for 2014⁸⁹

	Singles Houses (detached, mobile homes)	Multiples (apartments)
Residential	1,674	1,803

Apartment or condominium buildings were not covered by the 2012 Revision of Part 9.36 of the NCB. This category has been removed from energy savings estimates.

3.11.4 Unitary Savings Values

NRCan carried out some analyses on HOT2000 simulations to establish the average energy performance level reached by the 2012 Revision of Part 9 of the NCB. As a result of these analyses, NRCan concluded that the average energy performance level corresponds to an EnerGuide rating of 78, based on version 10 of the HOT2000 software.⁹⁰

⁸⁵ Statistics Canada – Catalogue No. 64 001.

⁸⁶ For residential square metres, estimate assumed single dwellings were 1,800 square feet on average and multiples were 1,000 square feet on average – converted total square feet to square metre by dividing by 10.8.

⁸⁷ Small commercial sector may not correspond to building size applicable to code. Estimate serves as an indicator of scale of construction activity undertaken in the small commercial sector.

⁸⁸ Used the estimated \$50 million in small commercial and divided by \$250 construction costs per square foot, - this converted to \$2,700 per square metre which resulted in an estimate 18,518 square metres.

⁸⁹ Statistics Canada – Catalogue Table 026-0002 Building permits

⁹⁰ Government of Canada, National Model Construction Code Documents, "Energy Efficiency in Housing and Small Buildings – General Introduction", Web <<http://www.nationalcodes.nrc.gc.ca/eng/presentations/2012/introduction.html>>.

Despite a literature review, the Evaluator did not receive a detailed report of the current practices in new constructions used in the residential market before the 2012 Revision was enforced. ENSC did provide the Evaluator with a sample of 90 recently built houses (from 2010 to 2012) that participated in the Home Energy Assessment (HEA) program just a few years after their construction. It can be assumed that most of these houses were built based on the standards of the industry. Therefore, the assessment EnerGuide rating they obtained through their participation in HEA a few years later can be an indication of the baseline for standard residential houses built in Nova Scotia prior to the new regulation. The survey revealed an average EnerGuide rating of 77. Based on this analysis, the implementation of the new building regulations would result in an EnerGuide rating increase of 1.

To determine the energy savings value of an EnerGuide rating point, the Evaluator used the same methodology as the one used in the evaluation of ENSC New Homes Construction. In 2012, the Evaluator analysed building simulations and their respective electricity billing was used to calibrate the simulation results and estimate gross energy savings more realistically. In 2014, the New Home Construction evaluation calculated savings of 891 kWh per EnerGuide point.

In summary, the savings calculation per EnerGuide point for residential market is based on the equation below:

$$\begin{aligned}
 &\text{Gross Energy Savings for the Single Housing Market (kWh)} = \\
 &\text{Number of Single Houses} \times [ER_{\text{NBC-Revision 2012-Part 9}} - ER_{\text{Baseline}}] \times 891 \text{ (kWh)}
 \end{aligned}$$

Where *ER* corresponds to the EnerGuide Rating, all fuel types combined, $ER_{\text{NBC}}=78$ and $ER_{\text{Baseline}}=77$

Therefore, the energy savings per unit generated 891 kWh.

Despite a literature review of current practices in Nova Scotia's residential market, the Evaluator did not find any detailed information about the main heating source for new houses. According to a survey undertaken by ENSC in 2011, 33 percent of existing households in Nova Scotia used electricity as a main heating source for their home.⁹¹ The Evaluator finds this ratio does not reflect the residential market of new constructions.

Therefore, a cross-reference review was conducted from which a value of 91 percent was obtained for new houses built using electricity as their primary source for space heating. In fact, 91 percent of the houses from the ENSC sample of 90 recently built houses and 92 percent of the houses registered in New Home Construction in 2014 used electricity as their primary source for space heating. Moreover, the ENSC sample also resulted that 42 percent of the houses had an EnerGuide rating of 78 or more and for whom the regulation enforced in 2014 was already respected.

⁹¹ ENSC from 2011 socket study.

3.11.5 At-meter Energy Savings

The Evaluator estimates that the introduced regulation regarding residential market generated 0.779 GWh in energy savings in Nova Scotia for 2014.

Table 56: Energy Savings Associated with the Introduction of the Building Code Regulation in the Nova Scotia Market

Product Class	Number of Single Houses	Noncompliance Rate (%)	Percentage of Total Units to Nova Scotia with Electricity Used as Primary Space Heating (%)	Annual Energy Savings (kWh/unit)	Total Incremental Energy Savings at Meter for 2014 (GWh)
Single houses	1,674	58	91	891	0.787

3.11.6 At-meter Peak Demand Savings

Peak demand savings are calculated using an on-peak demand-to-energy ratio of 0.257 MW/GWh. This ratio was established based on a weighted-average ratio of modelled system-coincident peak demand savings and energy savings for a projected deployment of measures supported by New Home Construction in 2014, as developed by Navigant in the 2013-2015 DSM Plan. Navigant developed these ratios using a projected Nova Scotia system peak demand occurring in the months of December to February, between 5 PM and 7 PM on a non-holiday weekday. Navigant used local data in combination with existing technical literature to establish the ratios.

The Evaluator estimates that the introduced regulation generated 0.202 MW in energy savings in Nova Scotia for 2014.

Table 57: Peak Demands Savings Associated with the Introduction of the Building Code Regulation in the Nova Scotia Market

Product Class	Number of Single Houses	Noncompliance Rate (%)	Percentage of Total Units to Nova Scotia with Electricity Used as Primary Space Heating (%)	Annual Demand Savings (W/unit)	Total Peak Demand Savings at Meter for 2014 (MW)
Single houses	1,674	58	91	229	0.202

3.12 TOTAL SAVINGS AT GENERATOR

Energy savings for the program at the meter were calculated by taking into account all product categories, for which the necessary information on market size, noncompliance rates and unitary savings values was available. As for the savings calculations at the generator level, the Econoler team used a line loss factor of 1.100 for the residential sector and 1.064 for the commercial sector, as provided by Nova Scotia Power, to account for transmission and distribution losses. For product categories targeting both sectors, an average value of 1.082 was used.

The 2014 overall energy and peak demand savings for Codes and Standards have been estimated at 28.743 GWh and 4.720 MW at the meter respectively and at 31.433 GWh and 5.164 MW at the generator respectively.

The total savings obtained for Codes and Standards are presented in the table below.

Table 58: Overall Energy and Peak Demand Savings for Codes and Standards

Product Category	Electric Motors	General Service Incandescent Reflector Lamps	Dry-type transformers	Large Air Conditioners and Heat Pumps	Standby Power	External Power Supplies	Incandescent Lamps – 75W and 100W	Led Street Lighting	New Energy Code for Houses	Total
Energy Savings										
Number of Units	2,174	48,035	147	193	71,179	1 807,213	-	12,052	1,674	1 942,667
Total Energy Savings – at Meter (GWh)	0.645	1.229	0.633	0.313	2.933	2.918	16.528	2.758	0.787	28.743
Line Loss Factor	1.064	1.082	1.064	1.064	1.082	1.082	1.1	1.1	1.1	
Total Energy Savings – at Generator (GWh)	0.686	1.330	0.674	0.334	3.173	3.157	18.181	3.033	0.866	31.433
Peak Demand Savings										
Total Peak Demand Savings – at Meter (MW)	0.145	0.840	0.072	0.160	-	-	2.611	0.689	0.202	4.720
Line Loss Factor	1.064	1.082	1.082	1.064	1.082	1.082	1.1	1.100	1.100	
Total Peak Demand Savings – at Generator (MW)	0.154	0.909	0.078	0.170	-	-	2.873	0.758	0.223	5.164

BIBLIOGRAPHY & REFERENCES

- Canadian Standards Association, *Minimum efficiency for dry-type transformers*,
http://www.hammondpowersolutions.com/upload_files/csa_c802%202-2006.pdf, January 23, 2007, p. 6.
- Caneta Research, *Commercial Refrigeration Study*, September 27, 2010, 20 p.
- Caneta Research, *Market, Benchmark and Technical Analysis for Large Air Conditioners and Heat Pumps for Future Regulation Amendment*, February 2008, 60 p.
- Ecos, *2008 External Power Supply Market Analysis*, October 26, 2012, 39 p.
- Ecos, *2008 External Power Supply Market Analysis: Canadian EPS Market Spreadsheet*, October 26, 2012.
- Ecos, *Market Analysis for Standby Power*, October 22, 2008, 87 p.
- Environment Canada. *Clean Air Regulatory Agenda: Backgrounder*,
<http://www.ec.gc.ca/default.asp?lang=En&n=56D4043B-1&news=295B1964-9737-4F80-B064-B3088D9910BE>,
October 28, 2011.
- International Energy Agency, *Standby Power Use and the IEA "1-watt Plan"*, April 2007, p. 1.
- Navigant Consulting, *Evaluation of Updating Regulations for Bulge Reflector Lamps and Elliptical Reflector Lamps*, March 31, 2007, 41 p.
- Navigant Consulting, *Market Analysis for Dry-type Transformers*, June 6, 2008, 43 p.
- Nielsen Engineering, *Harmonization of Minimum Efficiency Levels and Standards for Three Phase Induction Motors*, 2007, 28 p.
- Office of Energy Efficiency, *Dry-type transformers – Final Bulletin on Amending the Standard – October 2011*,
<http://oee.nrcan.gc.ca/regulations/bulletins/16910>, October 12, 2011.
- Office of Energy Efficiency, *Dry-type transformers – June 2010 – Bulletin on Amending the Standards Update*,
<http://oee.nrcan.gc.ca/regulations/bulletins/10086>, June 10, 2010.
- Office of Energy Efficiency, *Dry-type transformers – November 2006 – Bulletin on Amendment Final*,
<http://oee.nrcan.gc.ca/regulations/bulletins/13719>, June 30, 2009.
- Office of Energy Efficiency, *ecoENERGY Efficiency for Equipment Standards and Labelling*,
<http://oee.nrcan.gc.ca/corporate/13752>, October 26, 2011.
- Office of Energy Efficiency, *Electric motors – March 2009 – Bulletin on Proposed Regulations*,
<http://oee.nrcan.gc.ca/regulations/bulletins/13494>, April 20, 2009.
- Office of Energy Efficiency, *Electric motors – October 2011 – Final Bulletin on Amending the Standard – Bulletin on Amendment 11*, <http://oee.nrcan.gc.ca/regulations/bulletins/11972>, October 12, 2011.
- Office of Energy Efficiency, *Electric Motors – Updated Bulletin on Amending the Standards - June 2010 (as pre-published)*, <http://oee.nrcan.gc.ca/regulations/bulletins/17333>, January 20, 2011.
- Office of Energy Efficiency, *Energy Efficiency Act: Regulations Amending the Energy Efficiency Regulations*,
<http://canadagazette.gc.ca/rp-pr/p2/2011/2011-10-12/html/sor-dors182-eng.html>, October 12, 2011.

Office of Energy Efficiency, *External Power Supplies – Bulletin on Developing Standards – April 2009*, <http://oee.nrcan.gc.ca/regulations/bulletins/14907>, May 21, 2009.

Office of Energy Efficiency, *External Power Supplies – Final Bulletin on the Standard Update – October 2011*, <http://oee.nrcan.gc.ca/regulations/bulletins/1062>, October 13, 2011.

Office of Energy Efficiency, *General Service Incandescent Reflector Lamps – Final Bulletin on Amending the Standard*, <http://oee.nrcan.gc.ca/regulations/488>, October 25, 2011.

Office of Energy Efficiency, *General Service Incandescent Reflector Lamps – First Bulletin on Amending the Standards*, <http://oee.nrcan.gc.ca/regulations/bulletins/8877>, April 20, 2009.

Office of Energy Efficiency, *Large Air Conditioners and Heat Pumps – Bulletin Update – May 2005*, <http://oee.nrcan.gc.ca/regulations/12191>, April 17, 2009.

Office of Energy Efficiency, *Large Air Conditioners and Heat Pumps – Final Bulletin on Amending the Standard – October 2011*, <http://oee.nrcan.gc.ca/%20/1230>, October 12, 2011.

Office of Energy Efficiency, *Large Air Conditioners, Heat Pumps, and Condensing Units – Updated Bulletin on Amending the Standards – June 2010*, <http://oee.nrcan.gc.ca/regulations/bulletins/16827>, June 14, 2010.

Office of Energy Efficiency, *Proposed Amendment to Canada's Energy Efficiency Regulations – Incandescent Reflector Lamps*, <http://oee.nrcan.gc.ca/regulations/7601>, April 20, 2009.

Office of Energy Efficiency, *Publication of Regulations amending Canada's Energy Efficiency Regulations*, <http://oee.nrcan.gc.ca/regulations/14566>, October 24, 2011.

Office of Energy Efficiency, *Self-Contained, Commercial Refrigerators and Freezers – Bulletin Update – November 2006*, <http://oee.nrcan.gc.ca/regulations/2688>, April 20, 2009.

Office of Energy Efficiency, *Self-Contained, Commercial Refrigerators, Freezers and Refrigerator-Freezers – Final Bulletin on Amending the Standard*, <http://oee.nrcan.gc.ca/regulations/bulletins/12205>, October 12, 2011.

Office of Energy Efficiency, *Self-Contained, Commercial Refrigerators, Freezers and Refrigerator-Freezers – Updated Bulletin on Amending the Standards – June 2010*, <http://oee.nrcan.gc.ca/regulations/bulletins/10769>, June 24, 2010.

Office of Energy Efficiency, *Single Package Vertical Air Conditioners and Heat Pumps – Energy Efficiency Regulations*, <http://oee.nrcan.gc.ca/regulations/products/17983>, April 13, 2012.

Office of Energy Efficiency, *Single Package Vertical Air Conditioners and Heat Pumps – July 2009 – Bulletin on Developing Standards*, <http://oee.nrcan.gc.ca/regulations/bulletins/7111>, July 31, 2009.

Office of Energy Efficiency, *Single Package Vertical Air Conditioners and Heat Pumps – October 2011 – Final Bulletin on Developing the Standard Update*, <http://oee.nrcan.gc.ca/regulations/bulletins/4372>, October 12, 2011.

Office of Energy Efficiency, *Standby Power Consumption – October 2011 – Final Bulletin on Amending the Standard Update*, <http://oee.nrcan.gc.ca/regulations/bulletins/8495>, October 12, 2011.

Office of Energy Efficiency, *Standby Power – January 2009 – Bulletin on Developing Standards*, <http://oee.nrcan.gc.ca/regulations/bulletins/4411>, February 10, 2011.

Statistics Canada. *Canadian International Merchandise Trade Database. Merchandise imports and exports between “Canada” and “World”, by Harmonized System section, customs basis*, September 2012.

Statistics Canada. *Population and dwelling counts, for Canada, provinces and territories, 2011 and 2006 censuses*, November 4, 2012.

Canadian Commission on Building and Fire Codes, National Research Council

Adaptation Guidelines for the National Energy Code, 2011

DMD and Associates Ltd., Energy Efficient Street Lighting Strategies for Nova Scotia Municipalities, 2009

Electro Federation Canada, 2014. 2014 Consumer Electronics Market Trends and Forecast: An Insiders Look at the Future of the Canadian Consumer Electronics Market

Electro Federation Canada, 2014. Consumer Electronics Market in Canada High Level Summary Tabulations.

Electro Federation Canada, 2014. Dry Type Transformer Historical Sales Data Summary Tabulations.

Electro Federation Canada, 2014. Incandescent Bulb Historical Shipment Summary Tabulations.

Globe and Mail, January 12, 2014.

Government of Canada. 2015. Canada Gazette. (www.unsm.ca/led-streetlighting.html
<http://canadagazette.gc.ca/rp-pr/p2/2014/2014-01-15/pdf/g2-14802.pdf>)

Heating, Refrigeration and Air Conditioning Institute of Canada. 2014. Annual Unitary Sales Report Summary Tabulations.

ICF Consulting Canada Ltd., General Service Lighting, 2008

Life Savers Canada at the Canadian Urban, See: www.lifesavers.ca for more information.

NRCan see: <http://www.nrcan.gc.ca/energy/regulations-codes-standards/12342>

Regulatory Impact Analysis Statement Cost Benefit Statement. See: <http://canadagazette.gc.ca/rp-pr/p2/2014/2014-01-15/pdf/g2-14802.pdf>

Statistics Canada. 2015. Energy Use Data Handbooks.

Statistics Canada. 2015. Survey of household spending (SHS), household spending, by province and territory, annual (Various searches).

Statistics Canada. 2015. Canadian International Merchandise Trade Database (Various searches).

APPENDIX I

INTERVIEW GUIDE WITH NRCAN

PROGRAM NAME: CODES & STANDARDS

INTRODUCTION (2 minutes)

- Thank respondent
- Self-introduction by interviewer and colleague
- Introduction of ENSC study
Goal: The objective is to quantify the impact of 10 standards (introduced in 2012) on the Nova Scotia market in terms of energy savings.
- The interview should take less than 10 minutes.

According to Donald Dodge at ENSC, you are the person best suited to identify who we should speak with for more information about the 10 standards.

Do you have any questions before we begin?

DISCUSSION

Here is a list of the standards we would like to evaluate:

- a) Electric Induction Motors (CAN/CSA 390-10)
 - b) Incandescent Reflector Lamps from 40W up to 205W (CAN/CSA 862-09)
 - c) Incandescent Lamps 75 W and 100W (CAN/CSA C870-12)
 - d) Dry-type Transformers (CAN/CSA 802.2-06)
 - e) Self-contained Commercial Refrigerator, Freezers and Refrigerator-Freezers (HRAI Standard 1200-2008)
 - f) Commercial and Industrial Unitary Air Conditioners (CAN/CSA 746-2006)
 - g) Single Package Vertical Air Conditioners and Heat Pumps (SPVAC & SPVHP) (C746-06)
 - h) Stand-by Power Consumption (CAN/CSA 62301-07)
 - i) External Power Supplies (CSA 381.1-08)
 - j) LED Street Lights (CAN/CSA C653-13)
1. We have reviewed the original market analysis documents you sent in 2012 on which the standards were based. Are there additional relevant sources of information that became available this year? If so, would it be possible for you to share this information with us since we are also conducting secondary data research for this project?
 2. Once the standards are implemented, does NRCAN follow up on the compliance rate?

3. Do you conduct any research on the proportion of products that are impacted by your standard once implemented? If so, would it be possible to receive any new study that was conducted? If not, could you recommend reliable sources of such information?

CONCLUSION

Finally, in closing, do you have any comments or suggestions or are there any topics that we haven't discussed and that you would like to address?

This completes our interview. Thank you very much for your time. Your participation has truly been helpful. Thank you again and have a nice day.

APPENDIX II

INTERVIEW GUIDES FOR INDUSTRY ASSOCIATIONS

PROGRAM NAME: CODES & STANDARDS

INTRODUCTION

- › Thank respondent
- › Self-introduction by interviewer and colleague
- › Introduction of ENSC study

Goal: The objective is to quantify the impact of specific standards introduced in Canada in 2012 in terms of energy savings. More specifically, at this point in the evaluation process, we are trying to quantify the Nova Scotia market size for products that are impacted by the codes and standards for **[INSERT RELEVANT STANDARD FROM THE LIST BELOW]**.

- a) Electric Induction Motors (CAN/CSA 390-10)
- b) Incandescent Reflector Lamps from 40W up to 205W (CAN/CSA 862-09)
- c) Incandescent Lamps 75 W and 100W (CAN/CSA C870-12)
- d) Dry-type Transformers (CAN/CSA 802.2-06)
- e) Self-contained Commercial Refrigerator, Freezers and Refrigerator-Freezers (HRAI Standard 1200-2008)
- f) Commercial and Industrial Unitary Air Conditioners (CAN/CSA 746-2006)
- g) Single Package Vertical Air Conditioners and Heat Pumps (SPVAC & SPVHP) (C746-06)
- h) Stand-by Power Consumption (CAN/CSA 62301-07)
- i) External Power Supplies (CSA 381.1-08)
- j) LED Street Lights (CAN/CSA C653-13)

- › The interview should take less than 15 minutes.

SECTION A

As mentioned, with your assistance, we are looking to quantify the Nova Scotia market size of **[STANDARD/PRODUCT]** impacted by the **[SPECIFY CSA]** for the year 2014, based on the information available to date. More specifically, we are interested in the number of units sold by product sub-category within **[STANDARD/PRODUCT]**.

1. Do you have any information regarding sales for the Nova Scotia market in 2014 (current and projected)?
2. **[IF NO]** Would you be more comfortable providing market size of **[STANDARD/PRODUCT]** for the Canadian market as a whole for the year 2014? **[IF NO, SKIP TO SECTION B-CONCLUSION]**

3. **[IF YES TO QA1 OR QA2]** Are you agreeable to sharing this information in the context of our study? **[IF NO, SKIP TO SECTION B-CONCLUSION]**
4. **[IF YES TO QA3]** I would like to ask a few specific questions regarding these forecasts.

NOVA SCOTIA MARKET [ASK QA5 TO QA12 IF YES IN QA1]

5. To provide us with a benchmark, how many **[STANDARD/PRODUCT]** were sold in Nova Scotia in 2013? **[RECORD IN RELEVANT TABLE A]**
6. And how many do you anticipate will be sold in 2014? **[RECORD IN RELEVANT TABLE A]**
7. **[FOR STANDARDS WITH SUB CATEGORIES OF PRODUCTS ONLY]** More specifically, we are looking to identify the number of units sold in Nova Scotia in 2013 for each of the following product categories. **[RECORD IN RELEVANT TABLE A]**
8. **[FOR STANDARDS WITH SUB CATEGORIES OF PRODUCTS ONLY]** Do you anticipate that the market size for each of these product categories will increase, decrease, or stay about the same for 2014? If you believe it will change, how many units do you think will be sold for each product category? **[RECORD IN RELEVANT TABLE A]**
9. **[IF CHANGE ANTICIPATED IN QA6 OR QA8]** In your opinion, what explains the projected **[INCREASE/ DECREASE]** in market size for 2014?
10. Are you in a position to comment on the compliance of **[STANDARD/PRODUCT]** sold in Nova Scotia with the codes and standards implemented in 2012 by the Canadian Office of Energy Efficiency? **[IF NO, SKIP TO SECTION B-CONCLUSION]**
11. **[IF YES]** Let's assume for a moment that the Canadian Office of Energy Efficiency had not implemented the codes and standards for **[STANDARD/PRODUCT]** in 2012. Given that through research and development and market demand, product efficiency naturally improves over time, what proportion of **[STANDARD/PRODUCT]** do you estimate would be compliant today even without a standard in place?
12. Would this proportion vary based on the categories of **[STANDARD/PRODUCT]**? How so? **[RECORD IN RELEVANT TABLE B]**

CANADIAN MARKET [ASK QA13 TO QA21 IF NO IN Q1]

13. To provide us with a benchmark, how many **[STANDARD/PRODUCT]** were sold Canada in 2013? **[RECORD IN RELEVANT TABLE C]**
14. And how many do you anticipate will be sold in 2014? **[RECORD IN RELEVANT TABLE C]**
15. **[FOR STANDARDS WITH SUB CATEGORIES OF PRODUCTS ONLY]** More specifically, we are looking to identify the number of units sold in Canada in 2013 for each of the following product categories. **[RECORD IN RELEVANT TABLE C]**

16. **[FOR STANDARDS WITH SUB CATEGORIES OF PRODUCTS ONLY]** Do you anticipate that the market size for each of these product categories will increase, decrease, or stay about the same for 2014? If you believe it will change, how many units do you think will be sold for each product category? **[RECORD IN RELEVANT TABLE C]**
17. **[IF CHANGE ANTICIPATED IN QA14 OR QA16]** In your opinion, what explains the **[INCREASE/DECREASE]** in market size for 2014?
18. Based on your estimations, what percentage of the number of **[STANDARD/PRODUCT]** in Canada will be sold in the Province of Nova Scotia in 2014?
19. Are you in a position to comment on the compliance of **[STANDARD/PRODUCT]** sold in Canada with the codes and standards implemented in 2012 by the Canadian Office of Energy Efficiency? **[IF NO, SKIP TO SECTION B-CONCLUSION]**
20. **[IF YES]** Let's assume for a moment that the Canadian Office of Energy Efficiency had not implemented the codes and standards for **[STANDARD/PRODUCT]** in 2012. Given that through research and development and market demand, product efficiency naturally improves over time, what proportion of **[STANDARD/PRODUCT]** do you think would be compliant today even without a standard in place?
21. Would this proportion vary based on the categories of **[STANDARD/PRODUCT]**? How so? **[RECORD IN RELEVANT TABLE D]**

SECTION B - CONCLUSION

- B1. Does your organization publish any report with the type of information we are looking for, as discussed today? If so, would we be able to receive or purchase a copy?
- B2. To your knowledge, what other sources of information may provide us with Canadian market data regarding **[INSERT STANDARD/PRODUCT]**?
- B3. Finally, in closing, do you have any comments or suggestions or are there any topics that we haven't discussed and that you would like to address?

This completes our interview. Thank you very much for your time. Your participation has truly been helpful

ELECTRIC INDUCTION MOTORS 1 TO 500 HP (CAN/CSA 390-10)

TABLE A: NOVA SCOTIA MARKET SIZE

Electric Motors 1 to 500 HP	Q7.Number of units sold in Nova Scotia in 2013 (actual)	Q8. Number of units sold in Nova Scotia in 2014 (projected)
Electric motors of 1 to 5 HP		
Electric motors of 16 to 25 HP		
Electric motors of 26 to 100 HP		
Electric motors of 101 to 200 HP		
Electric motors of 201 to 500 HP		
Total electric motors of 1 to 500 HP	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

Electric motors	Expected compliance rate for 2014
Electric motors of 1 to 5 HP	
Electric motors of 16 to 25 HP	
Electric motors of 26 to 100 HP	
Electric motors of 101 to 200 HP	
Electric motors of 201 to 500 HP	
Total electric motors of 1 to 500 HP	

TABLE C: CANADA MARKET SIZE

Electric motors	Q15.Number of units sold in Canada in 2013 (actual)	Q16. Number of units sold in Canada in 2014 (projected)
Electric motors of 1 to 5 HP		
Electric motors of 16 to 25 HP		
Electric motors of 26 to 100 HP		
Electric motors of 101 to 200 HP		
Electric motors of 201 to 500 HP		
Total electric motors of 1 to 500 HP	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

Electric motors	Expected compliance rate for 2014
Electric motors of 1 to 5 HP	
Electric motors of 16 to 25 HP	
Electric motors of 26 to 100 HP	
Electric motors of 101 to 200 HP	
Electric motors of 201 to 500 HP	
Total electric motors of 1 to 500 HP	

INCANDESCENT REFLECTOR LAMPS FROM 40W TO 205W (CAN/CSA 862-09)

TABLE A: NOVA SCOTIA MARKET SIZE

Incandescent reflector lamps from 40W to 205W	Q7. Number of units sold in Nova Scotia in 2013 (actual)	Q8. Number of units sold in Nova Scotia in 2014 (projected)
60-85 W BR - residential		
86-155 W BR - residential		
75 W ER30 - residential		
120 W ER40 - residential		
60-85 W BR - commercial		
86-155 W BR - commercial		
75 W ER30 - commercial		
120 W ER40 - commercial		
Total (BR and ER lamps 60 W to 155 W)	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

Incandescent reflector lamps from 40W to 205W	Expected compliance rate for 2014
60-85 W BR - residential	
86-155 W BR - residential	
75 W ER30 - residential	
120 W ER40 - residential	
60-85 W BR - commercial	
86-155 W BR - commercial	
75 W ER30 - commercial	
120 W ER40 - commercial	
Total (BR and ER lamps 60 W to 155 W)	

TABLE C: CANADA MARKET SIZE

Incandescent reflector lamps from 40W to 205W	Q15. Number of units sold in Canada in 2013 (actual)	Q6. Number of units sold in Canada in 2014 (projected)
60-85 W BR - residential		
86-155 W BR - residential		
75 W ER30 - residential		
120 W ER40 - residential		
60-85 W BR - commercial		
86-155 W BR - commercial		
75 W ER30 - commercial		
120 W ER40 - commercial		
Total (BR and ER lamps 60 W to 155 W)	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

Incandescent reflector lamps from 40W to 205W	Expected compliance rate for 2014
60-85 W BR - residential	
86-155 W BR - residential	
75 W ER30 - residential	
120 W ER40 - residential	
60-85 W BR - commercial	
86-155 W BR - commercial	
75 W ER30 - commercial	
120 W ER40 - commercial	
Total (BR and ER lamps 60 W to 155 W)	

INCANDESCENT LAMPS 75W and 100W (CAN/CSA C870-12)

TABLE A: NOVA SCOTIA MARKET SIZE

Incandescent lamps 75W and 100W	Number of units sold in Nova Scotia in 2013 (actual)	Number of units sold in Nova Scotia in 2014 (projected)
Incandescent lamps 75W	Q5.	Q6.
Incandescent lamps 100W	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

Incandescent lamps 75W and 100W	Expected compliance rate for 2014
Incandescent lamps 75W	
Incandescent lamps 100W	

TABLE C: CANADA MARKET SIZE

Incandescent lamps 75W and 100W	Number of units sold in Canada in 2013 (actual)	Number of units sold in Canada in 2014 (projected)
Incandescent lamps 75W	Q13.	Q14.
Incandescent lamps 100W	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

Incandescent lamps 75W and 100W	Expected compliance rate for 2014
Incandescent lamps 75W	
Incandescent lamps 100W	

DRY-TYPE TRANSFORMERS (CAN/CSA 802.2-06)

TABLE A: NOVA SCOTIA MARKET SIZE		
Dry-type transformers	Q7. Number of units sold in Nova Scotia in 2013 (actual)	Q8. Number of units sold in Nova Scotia in 2014 (projected)
Three-phase dry-type transformers of 15 to 750 kVA		
Three-phase dry-type transformers of 1000 kVA		
Three-phase dry-type transformers of 1500 kVA		
Three-phase dry-type transformers of 2000 kVA		
Three-phase dry-type transformers of 2500 to 7500 kVA		
Total (Three-phase dry-type transformers of 15 to 7500 kVA)	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)	
Dry-type transformers	Expected compliance rate for 2014
Three-phase dry-type transformers of 15 to 750 kVA	
Three-phase dry-type transformers of 1000 kVA	
Three-phase dry-type transformers of 1500 kVA	
Three-phase dry-type transformers of 2000 kVA	
Three-phase dry-type transformers of 2500 to 7500 kVA	
Total (Three-phase dry-type transformers of 15 to 7500 kVA)	

TABLE C: CANADA MARKET SIZE		
	Q15. Number of units sold in Canada in 2013 (actual)	Q16. Number of units sold in Canada in 2014 (projected)
Three-phase dry-type transformers of 15 to 750 kVA		
Three-phase dry-type transformers of 1000 kVA		
Three-phase dry-type transformers of 1500 kVA		
Three-phase dry-type transformers of 2000 kVA		
Three-phase dry-type transformers of 2500 to 7500 kVA		
Total (Three-phase dry-type transformers of 15 to 7500 kVA)	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)	
	Expected compliance rate for 2014
Three-phase dry-type transformers of 15 to 750 kVA	
Three-phase dry-type transformers of 1000 kVA	
Three-phase dry-type transformers of 1500 kVA	
Three-phase dry-type transformers of 2000 kVA	
Three-phase dry-type transformers of 2500 to 7500 kVA	
Total (Three-phase dry-type transformers of 15 to 7500 kVA)	

SELF-CONTAINED COMMERCIAL REFRIGERATORS, FREEZERS AND REFRIGERATOR-FREEZERS (HRAI Standard 1200-2008)

TABLE A: NOVA SCOTIA MARKET SIZE

Self-contained commercial refrigerator, freezers and refrigerator-freezers	Q7.Number of units sold in Nova Scotia in 2013 (actual)	Q8. Number of units sold in Nova Scotia in 2014 (projected)
Self-contained commercial refrigerators		
Self-contained commercial freezers		
Self-contained commercial refrigerator-freezers		
Total (Self-contained commercial refrigerators, freezers and refrigerator-freezers)	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

Self-contained commercial refrigerator, freezers and refrigerator-freezers	Expected compliance rate for 2014
Self-contained commercial refrigerators	
Self-contained commercial freezers	
Self-contained commercial refrigerator-freezers	
Total (Self-contained commercial refrigerators, freezers and refrigerator-freezers)	

TABLE C: CANADA MARKET SIZE

Self-contained commercial refrigerator, freezers and refrigerator-freezers	Q15.Number of units sold in Canada in 2013 (actual)	Q16. Number of units sold in Canada in 2014 (projected)
Self-contained commercial refrigerators		
Self-contained commercial freezers		
Self-contained commercial refrigerator-freezers		
Total (Self-contained commercial refrigerators, freezers and refrigerator-freezers)	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

Self-contained commercial refrigerator, freezers and refrigerator-freezers	Expected compliance rate for 2014
Self-contained commercial refrigerators	
Self-contained commercial freezers	
Self-contained commercial refrigerator-freezers	
Total (Self-contained commercial refrigerators, freezers and refrigerator-freezers)	

COMMERCIAL AND INDUSTRIAL UNITARY AIR CONDITIONERS (CAN/CSA 746-2006)

TABLE A: NOVA SCOTIA MARKET SIZE

Commercial and industrial unitary air conditioners	Number of units sold in Nova Scotia in 2013 (actual)	Number of units sold in Nova Scotia in 2014 (projected)
Medium air conditioners (between 19.0 kW and 39.6 kW (between 65 kBtu/h and 135 kBtu/h))	Q5.	Q6.
Large air conditioners (between 39.6 kW and 70.3 kW (between 135 kBtu/h and 240 kBtu/h))	Q5.	Q6.
Very large air conditioners (between 70.3 kW and 223 kW (between 240 kBtu/h and 760 kBtu/h))	Q5.	Q6.
Medium and Large heat pumps (with capacity equal to or greater than 65 kBtu/h (19.0 kW))	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

Commercial and industrial unitary air conditioners	Expected compliance rate for 2014
Medium air conditioners (between 19.0 kW and 39.6 kW (between 65 kBtu/h and 135 kBtu/h))	
Large air conditioners (between 39.6 kW and 70.3 kW (between 135 kBtu/h and 240 kBtu/h))	
Very large air conditioners (between 70.3 kW and 223 kW (between 240 kBtu/h and 760 kBtu/h))	
Medium and Large heat pumps (with capacity equal to or greater than 65 kBtu/h (19.0 kW))	

TABLE C: CANADA MARKET SIZE

Commercial and industrial unitary air conditioners	Number of units sold in Canada in 2013 (actual)	Number of units sold in Canada in 2014 (projected)
Medium air conditioners (between 19.0 kW and 39.6 kW (between 65 kBtu/h and 135 kBtu/h))	Q13.	Q14.
Large air conditioners (between 39.6 kW and 70.3 kW (between 135 kBtu/h and 240 kBtu/h))	Q13.	Q14.
Very large air conditioners (between 70.3 kW and 223 kW (between 240 kBtu/h and 760 kBtu/h))	Q13.	Q14.
Medium and Large heat pumps (with capacity equal to or greater than 65 kBtu/h (19.0 kW))	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

Commercial and industrial unitary air conditioners	Expected compliance rate for 2014
Medium air conditioners (between 19.0 kW and 39.6 kW (between 65 kBtu/h and 135 kBtu/h))	
Large air conditioners (between 39.6 kW and 70.3 kW (between 135 kBtu/h and 240 kBtu/h))	
Very large air conditioners (between 70.3 kW and 223 kW (between 240 kBtu/h and 760 kBtu/h))	
Medium and Large heat pumps (with capacity equal to or greater than 65 kBtu/h (19.0 kW))	

SINGLE PACKAGE VERTICAL AIR CONDITIONERS AND HEAT PUMPS (SPVAC & SPVHP) (C746-06)

TABLE A: NOVA SCOTIA MARKET SIZE

Single package vertical air conditioners and heat pumps	Number of units sold in Nova Scotia in 2013 (actual)	Number of units sold in Nova Scotia in 2014 (projected)
Single package vertical air conditioner	Q5.	Q6.
Single package vertical heat pump	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

Single package vertical air conditioners and heat pumps	Expected compliance rate for 2014
Single package vertical air conditioner	
Single package vertical heat pump	

TABLE C: CANADA MARKET SIZE

Single package vertical air conditioners and heat pumps	Number of units sold in Canada in 2013 (actual)	Number of units sold in Canada in 2014 (projected)
Single package vertical air conditioner	Q13.	Q14.
Single package vertical heat pump	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

Single package vertical air conditioners and heat pumps	Expected compliance rate for 2014
Single package vertical air conditioner	
Single package vertical heat pump	

STAND-BY POWER CONSUMPTION (CAN/CSA 62301-07)

TABLE A: NOVA SCOTIA MARKET SIZE

Stand-by power consumption	Number of units sold in Nova Scotia in 2013 (actual)	Number of units sold in Nova Scotia in 2014 (projected)
Integrated stereo	Q5.	Q6.
Portable audio	Q5.	Q6.
Televisions	Q5.	Q6.
Non-recording video players	Q5.	Q6.
Recording video players	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

Stand-by power consumption	Expected compliance rate for 2014
Integrated stereo	
Portable audio	
Televisions	
Non-recording video players	
Recording video players	

TABLE C: CANADA MARKET SIZE

Stand-by power consumption	Number of units sold in Canada in 2013 (actual)	Number of units sold in Canada in 2014 (projected)
Integrated stereo	Q13.	Q14.
Portable audio	Q13.	Q14.
Televisions	Q13.	Q14.
Non-recording video players	Q13.	Q14.
Recording video players	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

Stand-by power consumption	Expected compliance rate for 2014
Integrated stereo	
Portable audio	
Televisions	
Non-recording video players	
Recording video players	

EXTERNAL POWER SUPPLY (CSA 381.1-08)

TABLE A: NOVA SCOTIA MARKET SIZE

External power supply	Q7. Number of units sold in Nova Scotia in 2013 (actual)	Q8. Number of units sold in Nova Scotia in 2014 (projected)
Class less than 1 W		
Class 1 to 5W		
Class 6 to 10W		
Class 11 to 20W		
Class 21 to 50W		
Class 51 to 100W		
Class more than 100W		
Total external power supply	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

External power supplies	Expected compliance rate for 2014
Class less than 1 W	
Class 1 to 5W	
Class 6 to 10W	
Class 11 to 20W	
Class 21 to 50W	
Class 51 to 100W	
Class more than 100W	
Total external power supply	

TABLE C: CANADA MARKET SIZE

External power supplies	Q15.Number of units sold in Canada in 2013 (actual)	Q16. Number of units sold in Canada in 2014 (projected)
Class less than 1 W		
Class 1 to 5W		
Class 6 to 10W		
Class 11 to 20W		
Class 21 to 50W		
Class 51 to 100W		
Class more than 100W		
Total external power supply	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)

External power supplies	Expected compliance rate for 2014
Class less than 1 W	
Class 1 to 5W	
Class 6 to 10W	
Class 11 to 20W	
Class 21 to 50W	
Class 51 to 100W	
Class more than 100W	
Total external power supply	

LED STREET LIGHTS (CAN/CSA C653-13)

TABLE A: NOVA SCOTIA MARKET SIZE

LED street lights	Q7.Number of units sold in Nova Scotia in 2013 (actual)	Q8. Number of units sold in Nova Scotia in 2014 (projected)
?		
?		
?	Q5.	Q6.

TABLE B: EXPECTED COMPLIANCE RATE IN NOVA SCOTIA (2014)

LED street lights	Expected compliance rate for 2014
?	
?	
?	

TABLE C: CANADA MARKET SIZE

LED street lights	Q15.Number of units sold in Canada in 2013 (actual)	Q16. Number of units sold in Canada in 2014 (projected)
?		
?		
?	Q13.	Q14.

TABLE D: EXPECTED COMPLIANCE RATE IN CANADA (2014)	
LED street lights	Expected compliance rate for 2014
?	
?	
?	



ECONOLER