IMPACT & PROCESS EVALUATION: CROSS-CUTTING COMMERCIAL & INSTITUTIONAL RETROFIT INCENTIVE PROGRAMS

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SUMMIT BLUE CONSULTING, LLC

FINAL REPORT

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E. EXECUTIVE SUMMARY

The Ontario Power Authority (OPA) has engaged an Evaluation Contractor, Summit Blue Canada Inc.(Summit Blue), to conduct the first year of a multi-year (2008 to 2010) evaluation for a suite of cross-cutting retrofit incentive programs aimed at the Commercial and Industrial (C&I) market. This report presents the approach and findings of the first year of the evaluation.

E.1 Overview of the Programs

Four Program Delivery Agents (PDAs) deliver existing retrofit programs for the C&I market. The C&I sector covers commercial office buildings, retail stores, hotels, agribusiness, municipal, academic, and the social and health care sectors. Some industrial projects have also been completed under the initiative. The suite of programs was designed to influence business retrofit decisions by providing customers with financial incentives to reduce the incremental costs of installing energy efficient equipment. These programs are delivered by four PDAs, which differ in terms of goals, geography and/or target customer group. Each program consists of projects that vary in scope and size (i.e., load reductions, floor space, number of measures, etc.) and the required complexity of project-level measurement & verification (M&V) processes. Eligible projects include upgraded lighting, heating, ventilation and air conditioning (HVAC), electric motors and transformers.

The PDAs and programs are:

1. Toronto Building Owners and Managers Association Conservation and Demand Management Program (BOMA CDM)

2. City of Toronto Better Buildings Partnership—Existing Buildings (BBP-EB)

3. Toronto Hydro Business Incentive Program (BIP)

4. Electricity Retrofit Incentives Program (ERIP) delivered by multiple local distribution companies (LDCs)

E.2 Approach to the Evaluation

The evaluation included an impact component and a process component. The impact evaluation consisted of the four tasks: 1) Verify energy and demand savings; 2) Review prescriptive input assumptions; 3) Report on M&V methods; and 4) Determine net to gross ratios and net savings. The process evaluation included the following tasks: 1) Assess program process efficiency; 2) Review incentive levels; and 3) Assess compliance with M&V requirements.

The Summit Blue team conducted primary research as part of this project—62 on-site visits to verify energy and demand savings, market research telephone surveys with a sample of 208 program participants, and in-depth interviews with program delivery staff for each of the four programs, project evaluators and other trade allies.

E.3 Findings

Table E-1 below shows the results for the gross and net savings determined from the impact evaluation.

Table E-1. Gross and Net Savings Results

Variable	Retrofit Incentive Program					TOTAL
	BBP-EB	BIP	BOMA CDM	ERIP – Commercial	ERIP-Multi-Family	
Program Reported Energy Savings (MWh)	46,234	n/a	22,859	n/a	n/a	n/a
Gross Verified Energy Savings (MWh)	38,342	5,479	22,140	86,369	10,862	163,192
Measure Quantity Installation Rate	94%	100%	98%	95%	92%	94%
Program Reported Demand Savings (kW)	2,000	890	5,607	20,732	12,282	41,511
Gross Verified Demand Savings (kW)	1,028	834	5,920	16,989	367	25,138
NTG Ratio (%)	58%	59%	62%	58%	41%	40%
Net MWh savings	22,238	3,233	13,727	50,094	4,453	93,745
Net kW savings	596	492	3,670	9,854	150	14,763

E.4 Conclusions

The key conclusions are:

- Customers are generally satisfied with the programs; this is a great beginning.
- Program results come primarily through lighting measures (89% of demand savings), which are coincident with summer peak and thus cost-effective.
- There were high demand realization rates for BOMA, BIP and ERIP non-MR custom projects, but BBP-EB achieved only a 51% realization rate.
- Savings for the ERIP prescriptive projects are based on generic PIA assumptions leading to inaccuracies.

- Several programs adhere to the IPMVP but, in many cases, protocols are not clearly defined or followed.

- Documentation of M&V for projects is either not completed or not available.

- Environmental concerns and rising energy bills are key motivators for customers to participate in the programs.

- There are product quality concerns, particularly about lighting measures.

- Marketing and outreach are not coordinated across programs, and most stakeholders believe that more customer education is needed.

- Data tracking systems are inconsistent, both in structure and data tracked.

E.5 Recommendations

Summit Blue recommends implementing a province-wide lighting program using a collaborative approach with the LDCs, other program delivery agents, and manufacturers. Lighting provided close to 90% of the savings in 2008, and there is a still lot of low-hanging fruit in the market, i.e., easily obtained. Osram-Sylvania estimates that there is at least 100 MW from lighting savings that easily can be achieved. Data on market share of installed commercial fluorescent lighting indicate that although the installed base of T12 lights dropped lower than that of T8s in 2006, there were still over ten million T12s installed across Canada in the commercial and industrial market in 2008. The lighting program approach could be used as a model for other measures such as motors and drives.

The custom projects could be delivered through a combined program design that applies the same procedures (M&V, costs, tracking, etc.) across the province. Lighting equipment incentives would be determined through the lighting program, and custom incentives would be based on using the recommended procedures in Section 3.3.2. M&V methods should be modified as discussed in the report (Section 4.2.2). Data tracking systems should be addressed for the program as a whole, including specifying what data to be tracked, field names with definitions, types of cost breakdowns, etc.

Recommendations for Prescriptive Input Assumptions

- **Coincident Peak Demand:** Program tracking estimates of peak demand, particularly for the ERIP MR component, should consider coincidence with peak load. Disaggregate demand savings for ultra high efficiency fans in future program cycles.

- **Annual Operating Hours:** Focus should be placed on establishing a better baseline for hours of operation across the lighting program. This is particularly important for the office lighting usage patterns. Certain building categories should be further divided to more accurately capture the magnitude of anticipated impacts for lighting.

- **Energy Savings:** Consider the impacts of HVAC interactive effects in the lighting measure PIAs. Incorporate winter usage patterns into the savings algorithms for dual exhaust ventilation systems in future program cycles.

- **Effective Useful Life (EUL):** The assumed EUL for high wattage metal halide lamps are overstated. Manufacturer specifications for a 400W CMH lamp generally are in the range of

20,000 hours. Given that the average operating characteristics for most of the building types are 5,000 hours per year, it is apparent that a 16-year EUL is overly optimistic. We recommend modifying this assumption to four years.

- **Incremental Costs:** Disaggregating measure incremental costs by the nature of replacement (e.g., New, Retrofit, Replace-On-Burnout, etc.) may improve the accuracy of cost effectiveness tests. Review and refine occupancy sensor cost assumptions to be consistent with the current market.

Table E-2. Recommendations for M&V Methods by Program

Program	Recommendations
BOMA CDM	• Require project evaluators to log end use parameters in cases where variations are expected, including chiller retrofits, VSD installations, and other complex custom installations. • Increase the M&V budgets in this Tier to allow a greater focus on metering activities. • Require clear documentation of the baseline equipment (nameplate, size, efficiency, operating hours, seasonal load variations, etc.). • Standardize the project application and invoice nomenclature. • Require detailed calculation spreadsheets to be submitted with project application.
ERIP	• Use a tiered approach to categorize projects by measure type and size (incentive thresholds). The projects with greater impact and higher uncertainty should follow an enhanced approach. Such projects should ideally follow a custom path where pre- and post-retrofit scenarios are carefully studied. Projects under the custom path above a certain threshold (e.g., $10,000 incentive) should require short-term pre- and post-metering/logging of operating parameters. • Improve the clarity of M&V guidelines. • Require photographs of installed technologies and applications, which yield useful evaluation information. • Incorporate/inform the LDCs of M&V activities as early as possible in the program Cycle.
BIP	• Standardize the documentation procedure across all projects. • Standardize the M&V process by establishing thresholds (incentive or project size) to enable a greater focus on projects with greater uncertainty. • Increase the level of M&V rigour on lighting projects.
BBP-EB	• Increase the level of rigour for projects greater than 50 kW with more focus on short term and seasonal metering of end use parameters, especially when the expected uncertainty is high (e.g., chiller retrofits with high end use variations, VFD installations, lighting retrofits is convention centers etc.) • Require customers to provide adequate documentation for any changes to the scope of work, and project evaluators should revise savings estimates and conduct additional M&V activities (if necessary) for accurate assessment of the project impacts.

The following are some general recommendations to improve the program process and help improve participation and savings results.

- Prepare a program logic model for the lighting and custom projects program in collaboration with program designers.
- Define what data is required to be tracked, including program status, measure details, savings estimates (initial, revised, approved, reported, verified, evaluated), energy savings (by month if possible), demand savings, incentives, total project costs, customer contact information, building information (# of floors, energy use, annual peak demand), market sector, etc.
- Ensure that M&V procedures are specified and that documentation is provided.
- Define what is to be included in cost breakdowns, e.g., marketing, M&V costs, administration, performance bonuses, etc.
- Revise OPA payment method to LDCs to make it easier for both LDCs and evaluators to track costs and payments.
- Simplify application forms and enable them to be filled out online.
- Increase education and outreach for end-users and coordinate across the province.
- Consider a redesign of incentives:
    - Offer a choice to customers to receive incentives based on either kWh or kW saved.
    - When designing incentives, first calculate the TRC to ensure cost-effectiveness, then set the incentive based on either the customer payback period (taking into account incremental measure costs) or the Utility Cost test.
    - Regularly (e.g., yearly) do a benefit-cost analysis for each type or class of measure in the program.
    - Review whether standard measures such as T8 lights and CFLs should be removed from the programs and more efficient measures such as Super T8s be added, as has been done in other jurisdictions.
    - Standardize incentives, or at least bring them closer into line, between programs.
    - When calculating incentives, take into account the low electric rates for C&I customers in the province and what kind of tariffs they are on, as these affect the customer's payback calculation.
    - In general, pay higher incentives for more reliable savings verified with on-site M&V.
    - Use existing market research and potential studies to identify technologies that have the most potential for quick implementation, can reduce peak demand on both winter and summer peak days, and are most in need of the incentives.
    - Target specific end uses in different sub-sectors within the C&I sector, e.g., Small and Medium Industry, Small Business, Large Office, Small Commercial, and Large Retail.
    - To keep program implementation simple and encourage more participation across the province, consider implementing two basic incentive structures: An Express Efficiency incentive scheme that would offer standard prescriptive incentives for common measures in different C&I sub-sectors; and a Standard Performance Contract program that would offer incentives based on actual kW and kWh savings at each site.

1 INTRODUCTION

The Ontario Power Authority (OPA) has engaged an Evaluation Contractor, Summit Blue Canada Inc.(Summit Blue), to conduct the first year of a multi-year (2008 to 2010) evaluation for a suite of cross-cutting retrofit incentive programs aimed at the Commercial and Institutional (C&I) market. The C&I sector covers commercial office buildings; retail stores; hotels; agribusiness; and municipal, academic, social and health care sectors. Some industrial projects have also been completed under the initiative. The suite of programs was designed to influence business retrofit decisions by providing customers with financial incentives to reduce the incremental costs of installing energy efficient equipment.

1.1 OPA's Existing C&I EE Programs

Four Program Delivery Agents (PDAs) deliver four existing retrofit programs for the C&I market. The C&I sector covers commercial office buildings, retail stores, hotels, agribusiness, municipal, academic, and the social and health care sectors. Some industrial projects have also been completed under the initiative. The suite of programs was designed to influence business retrofit decisions by providing customers with financial incentives to reduce the incremental costs of installing energy efficient equipment. These programs are delivered by four PDAs, which differ in terms of goals, geography and/or target customer group. Each program consists of projects that vary in scope and size (i.e., load reductions, floor space, number of measures, etc.) and the required complexity of project-level measurement & verification (M&V) processes. Eligible projects include upgraded lighting, heating, ventilation and air conditioning (HVAC), electric motors and transformers.

The PDAs and programs are:

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Three of the programs are aimed specifically at the Toronto area because the Toronto grid is more transmission- and distribution- constrained and has an aging infrastructure. Appendix A gives brief descriptions of each program and Table 1-1 shows the main characteristics for the four programs.

Table 1-1. Summary of Current Programs

Program	Toronto BOMA CDM Program	City of Toronto Better Buildings Partnership—Existing Buildings (BBP-EB)	Toronto Hydro Business Incentive Program (BIP)	Electricity Retrofit Incentive Program (ERIP):
Target Market	Large commercial buildings (25,000^{+} sq. ft or more), specifically large office buildings.	Existing City, Municipal, and Multifamily Residential Buildings.	Commercial buildings <25,000 sq. ft.	Province-wide (outside of the City of Toronto) industrial, commercial and agricultural customers.
Project Types	Custom	Custom	Custom	Custom and Prescriptive
Incentives	$400/kW of verified summer peak demand savings, or $0.05/kWh of verified energy savings. Up to 40% of capital cost of investment.	$400/kW of summer on-peak demand reduction, or $0.05/kWh of annual energy savings, on a per measure basis. Incentive payment limited to 40% of total eligible costs.	Tiered approach that increases incentives based on savings level. Average peak kW savings: < 100 kW: $150/kW; 100-350 kW: $250/kW; >350 kW: $350/kW	$150/kW saved: kW saved is the maximum of 100% summer kW, 80% winter kW and 50% of spring/fall kW. Incentive payment is up to 50% of incremental project cost. Incentives from all sources of funding must be <50% of total EE project cost.
Program Goal (by 2010)	150 MW	50 MW	20 MW	100 MW and 50 GWh

Source: Program tracking data, program descriptions, and Summit Blue analysis.
**Estimated 2007 savings for BOMA CDM from Ontario Power Authority, 2007 Final Conservation Results, February 2009.*
***Estimated 2007 savings for ERIP are based on personal communications with Bojana Zindovic of the OPA.*

Appendix A-1 contains individual program elements (i.e., additional program description, application process, program education, incentive levels, program timing, communications & program delivery, etc.). Appendix A-2 outlines individual program M&V methods. For a comprehensive list of eligible conservation measures and requirements for the programs, please refer to Appendix A-3.

1.2 Evaluation Goals and Objectives

The goals and objectives of the evaluation are to:

- Determine verified energy and demand savings with a high degree of confidence and precision (90% confidence with a precision of +/-10%);
- Report on the accuracy of the estimated energy / demand savings and project tracking systems and make recommendations for improvements;
- Estimate the net to gross ratios (free rider, spillover, persistence, etc.);

- Identify opportunities for program improvements as well as assess the effectiveness of the program design and delivery to market; and
- Address the strengths and weaknesses of the different program delivery models.

1.3 Overview of this Report

The next chapter discusses the impact evaluation, followed by the process evaluation and then the findings and conclusions.

2 IMPACT EVALUATION

This section describes the approach and findings from the impact evaluation tasks:

1. Verified energy and demand savings
2. Review of prescriptive input assumptions
3. Report on M&V methods
4. Net to gross ratios and net savings
5. Cost-effectiveness evaluation

Summit Blue undertook these tasks with the assistance of Nexant and Global Target Marketing, collectively the "Summit Blue Team".

2.1 Verified Energy & Demand Savings

This section presents the approach used to verifying energy and demand savings and the results obtained from that process.

2.1.1 Approach

The approach consists of the following steps:

1. Obtain data
2. Sampling
3. File review
4. On-site inspections
5. Engineering Calculations

Obtain Data: The impact evaluation task began with obtaining records of OPA-sponsored project implementations for the BOMA CDM, BIP, BBP-EB, and ERIP programs. There were two types of records available: program tracking and project specific. The program tracking records were electronic data sheets summarizing project specifics for each program, including customer name, site address, savings reported, geographic location, incentives paid, etc. Project-specific information was required to conduct a credible review of projects and was obtained from the OPA and the program implementers, and other third party M&V consultants. The quality of the records varied from project to project within each program. The greatest variation was found among custom projects as opposed to prescriptive projects. Some examples of significant variation include the existence and level of detail included in any equipment inventories and whether detailed savings calculations were included in the project file.

Sampling: The Summit Blue Team conducted a savings-weighted, random selection of projects from each of the four OPA programs for inspections and detailed analysis. The project population was developed by filtering the program tracking data to ensure that only projects completed in 2008 were included in the analysis (Qualifying Projects). A completed project was defined as one where incentives were paid and M&V processes were completed. All projects completed from January 1, 2008 through December 31, 2008 were pooled for sampling. The total size of the qualifying population, across all

programs, was 949 projects. At 90% confidence and 10% precision, assuming a coefficient of variation of 0.5 and adjusting for a finite population, the total portfolio sample size was 63 projects. The 63 samples were then distributed among the programs to maintain a minimum of 90% confidence and 30% precision at the program level. Table 2-1 below shows the distribution of the samples across the four programs.

Table 2-1. Sample Size by Program

Program	Eligible Projects	Sample Size
BBP-EB	59	7
BIP	27	6
BOMA CDM	54	7
ERIP	809	43
Total	949	63

The process to arrive at the sample sizes in Table 2-1, and then select individual projects, is detailed below:

1. **Calculate the portfolio sample size.** The overall, portfolio level sample size was computed by first calculating the infinite population sample size at 90% confidence and 10% precision levels. The following formula was used.

$$n = \frac{C_v^2 Z^2}{P^2} \qquad (1)$$

Where:

n = unadjusted, infinite population sample size.

Cv = Coefficient of variance = 0.5 (assumed)

P = Precision = 10%

Z = Z-Statistic based on 90% confidence = 1.645

Next, the results of this calculation were adjusted to account for the finite population of projects in the portfolio. The adjustment was made as follows.

$$n^* = \frac{n}{1 + n/N} \qquad (2)$$

Where:

n* = finite population adjusted sample size

n = infinite population sample size, from equation 1.

N = size of actual population

2. **Calculate the program level sample size.** In order to achieve a reasonable program level confidence and precision, the sampling algorithm was revised to achieve 90% confidence and 30% precision for each program. Striking a balance between budget costs and level of rigour, the 63 samples were reallocated to achieve the required confidence and precision while maintaining focus on the program streams with greater impact. Formulas 1 and 2 were employed, and the sample sizes shown in Table 2-1 were the result.
3. **Select projects for sampling.** A random, demand savings weighting process was used to select projects in each program. This process produced a prioritized list of projects by multiplying the program's estimate of demand savings for the project by a random number and sorting the list of projects by this new, demand savings weighted random number. Projects were selected for inclusion in the evaluation starting at the top of the list and working down in descending order until the desired sample size was reached. There were practical considerations that required some lower ranked projects to be substituted. For instance, travel times were too great for some projects to be cost effectively inspected, and others declined to participate in the evaluation. In addition, ERIP, the largest program, was stratified by program estimated demand savings, and samples distributed among the strata.
4. The project population was stratified into three groups, each representing one third of the total program kW savings. Projects with demand savings >235 kW were categorized as the large project stratum, projects with demand savings between 67 kW and 235 kW were in the medium project stratum, and projects with demand savings <67 kW were moved to a small projects stratum. The quantity of projects from each strata were determined such that, given the number of projects in each strata, the sample drawn from each would produce the same confidence and precision levels. The result was that 18 small, 15 medium, and 10 large projects were included in the analysis.

File Review: Initial and detailed file reviews were conducted of the project records. The purpose of the initial review was to gain a basic understanding of the projects and to determine if the Summit Blue Team would meter any of the measures. This information was used during the scheduling process so that the project contact could be told of the general on-site activities planned. After a project was scheduled for inspection, a detailed file review was performed to prepare a site inspection plan and, if applicable, a metering plan for the project. The decision to meter was based on the expected uncertainty in the equipment operating parameters and the overall size of the project. For example, a lighting retrofit in a large warehouse without occupancy sensors has a low overall uncertainty compared to a lighting retrofit in a convention/conference center or a chiller retrofit with a variable speed drive. In addition, previously metered data was used whenever possible after verifying the overall credibility of the information. Inspection plans included site specific questions and goals for the inspection as well as an overall approach to be followed by the on-site inspector, including a set of applicable checklists and equipment specification forms. The project measure and energy saving information in the project files varied considerably among projects, even within the same programs. Due to the varied and sometimes limited reporting of project measures, equipment inventories, and energy savings, at times it was difficult to assess the scope of projects, assumptions, and calculations made to determine energy savings.

On-site Inspections: On-site activities included collecting baseline and retrofit equipment information and operating parameters. Experienced engineers conducted the on-site inspections. Light logging (hours of operation) was conducted where it was determined to be practical and useful. In cases where good quality metered data was available from the program records, no additional data was collected. The site survey protocol included a sampling plan for each project at the measure level. Lighting retrofits were randomly inspected to capture the variance across space types. For example, in a residential facility, samples were drawn for in-suite retrofits, common areas and exterior retrofits (usage groups). In many cases the in-suite samples were further divided by unit size (1-bedroom, 2-bedroom, etc.). For multi-

location projects, samples were drawn at each site to capture a good portion of the savings in each usage group. For non-lighting measures, all retrofits were typically inspected without sampling. On-site inspections were significantly affected by the availability of equipment inventories, specifications, and whether or not equipment inventories included locations for both the baseline and retrofit conditions. The availability of that information varied from project to project. When such information was not available, the on-site inspectors attempted to assess it through interviews with site personnel and observations during the on-site inspection. The equipment inventories that were provided were often from the initial application. As some projects subsequently revised the inventory, the equipment inventories were not always up to date.

Calculations: The calculation approach involved first verifying energy and demand savings for the sample and then using a combination of sample and population information to estimate savings for the population.

- *Verified Energy and Demand Savings for the Sample*

  The Summit Blue Team used engineering analysis, informed by the best available baseline and retrofit information in the program records as well as the results of the on-site inspections, to determine savings for each project. The ratio of the evaluation determined savings to the program estimated savings for each project is the realization rate. Realization rates were calculated for each project included in the analysis. Savings-weighted averages of these realization rates produced the program and portfolio level realization rates.

  Characterizing baseline conditions presented a significant challenge. In many cases, the project records inadequately described the baseline, and clearly the baseline equipment was not in place during the site inspections. The inspectors did their best to characterize the baseline equipment and its operation during inspections. These efforts were necessarily largely dependent on the recollection of the site contact. In all cases, the Team used the best available information including project documents, information obtained during the on-site inspection and industry standards, adjusted to actual on-site conditions. The on-site inspections produced equipment counts (lighting fixtures, controls etc.) and operating parameters (equipment efficiency, lighting connected wattage, operating hours etc.) for retrofit equipment, which could often be used to inform the Summit Blue Team's estimate of the baseline equipment and its operation.

For each project in the sample, the Summit Blue Team first calculated the energy savings based on site-specific information collected by the inspectors. The demand savings were then calculated by developing equipment energy use load shapes. The load shapes were developed using site-specific equipment operating parameters (on/off times, reduced usage, partial load, etc.) to plot a 24-hour load profile for the summer, winter and shoulder periods. Using the hourly load profile the average peak demand savings were calculated for the summer peak period of June – September 11 AM – 5 PM on weekdays.[1]

In cases where on site data was not available or not credible (all residential and only few commercial), the verified annual energy savings were apportioned to the OPA-defined energy

[1] System Co-incident Peak Demand defined by OPA. 2009. "Commercial and Institutional Measures and Assumptions" and "Mass Market Measures and Assumptions."

periods[2] using pre-fixed factors defined in the OPA measures and assumptions lists. Average peak demand savings were then calculated for this period. Next, the CF2 factors in the M&V lists were applied to calculate system peak demand savings.

The resulting energy and demand savings were then compared with claimed savings estimates where possible (the ERIP MR, ERIP Other, and BIP program steams do not report annual energy savings). The ERIP program was broken out in to two program streams, ERIP Multi-family residential (ERIP MR) and ERIP C&I (ERIP Other), for analysis purposes.

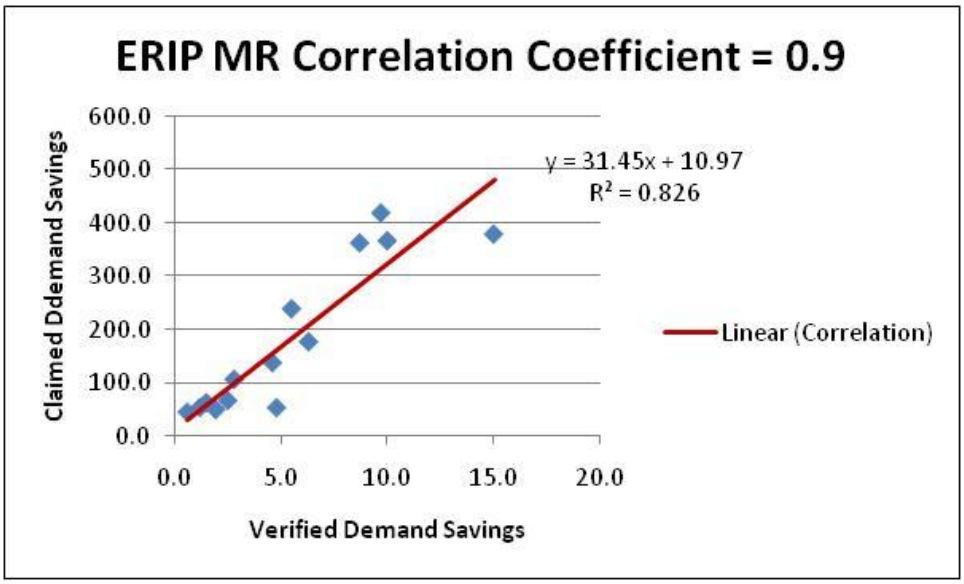
The results presented in this report are based on engineering analyses for 62 of the 63 inspected projects. One project was classified as an outlier. This outlier was excluded from the M&V sample for the ERIP program – the realization rate for this prescriptive commercial project was over 500%. This unusually high realization rate is attributable to discrepancies between the PIA baseline assumptions and the metered baseline data collected by the on-site team. The causes of the discrepancy were limited to this project, so it was classified as an outlier and excluded from the realization rate calculations to avoid skewing the results.

- *Extrapolating to the Population*

  The verification of energy and demand savings for the selected samples resulted in energy and demand realization rates for each program stream. The BOMA CDM and BBP-EB programs report energy and demand savings for all projects in the population. Since the sample is representative of the population, the calculated energy realization rate was used to extrapolate the savings for the population. As noted above, the ERIP MR, ERIP Other, and BIP program steams do not report annual energy savings. Since these streams do not report kWh savings, it was not possible to extrapolate from the sample to the population using the energy realization rate. The verified energy (kWh) savings were known for all projects in the sample. The verified demand savings were also known for all projects in the sample. In order to verify a good correlation between the sample and population, the Summit Blue Team developed a scatter plot to calculate a correlation coefficient and variance coefficient (R^2) between the verified and claimed demand savings for the sample. The scatter plots are shown on the following pages.

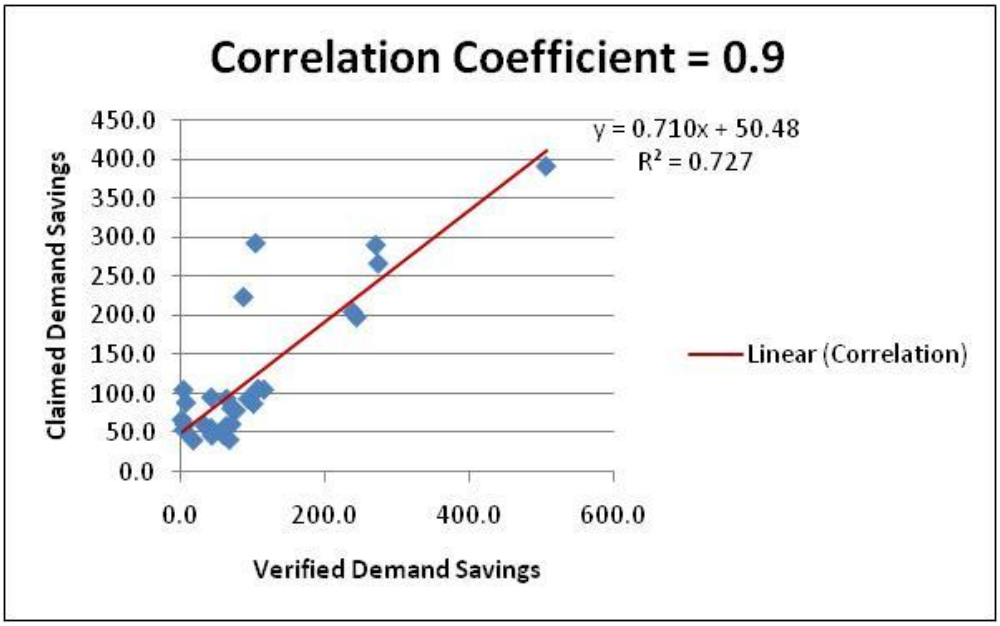
[2] Summer peak, summer off-peak, winter peak, winter off-peak, and shoulder.

Figure 2-1. Correlation Plot for ERIP MR Program Stream



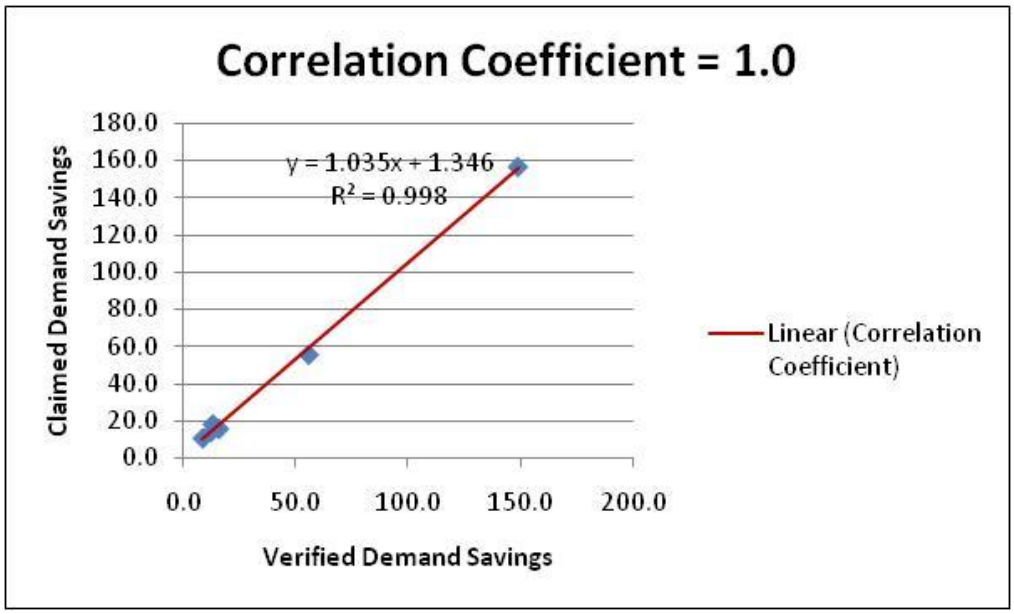
The ERIP Other program stream initially had a low correlation coefficient. The exclusion of the outlier increased the correlation coefficient and R^2 value thus increasing the confidence in extrapolating the savings from the sample to the population.

Figure 2-2. Correlation Plot for ERIP Other Program



The BIP program stream achieved the best correlation between the sample and the population with the lowest coefficient of variance of 0.1.

Figure 2-3. Correlation Plot for ERIP MR Program Stream



Based on the scatter plots, there was a strong correlation between verified and claimed demand savings for these streams. The verified demand savings in the sample were hence used to extrapolate the verified demand savings for the population. Since the verified energy savings for the sample were known, a linear proportionality equation was used to calculate the verified energy savings for the population.

The realization rate can be partially explained by non-installation of measures. To show the relative importance of this factor, the Summit Blue Team calculated an installation rate as the demand savings weighted ratio of measures installed to measures reported installed.

2.1.2 Results

The overall realization rate for the portfolio demand savings as 61%. As shown in Table 2-2, the realization rates varied significantly by program. The installation rates of 92% or more indicate that the realization rate is largely due to other factors, as discussed below.

Table 2-2. Results for On-Site Visits (n=63 Samples)

Variable	BBP-EB	BIP	BOMA CDM	ERIP-Commercial	ERIP – Multi-family Residential
Program Reported Energy Savings (MWh)	2,313	n/a	7,807	n/a	n/a
Gross Verified Energy Savings (MWh)	1,878	1,670	7,562	14,104	2,226
Program Reported Demand Savings (kW)	595	271	2,707	3,385	2,517
Gross Verified Demand Savings (kW)	306	254	2,858	2,774	75
Demand Realization Rate (%)	51%	94%	106%	82%	3%
Measure Quantity Installation Rate	94%	100%	98%	95%	92%

Table 2-3. Verified Savings Results for the Portfolio

Variable	BBP-EB	BIP	BOMA CDM	ERIP-Commercial	ERIP – Multi-family Residential	TOTAL
Program Reported Energy Savings (MWh)	46,234	n/a	22,859	n/a	n/a	n/a
Gross Verified Energy Savings (MWh)	38,342	5,479	22,140	86,369	10,862	163,192
Program Reported Demand Savings (kW)	2,000	890	5,607	20,732	12,282	41,511
Gross Verified Demand Savings (kW)	1,028	834	5,920	16,989	367	25,138
Demand Realization Rate (%)	51%	94%	106%	82%	3%	61%

The BBP-EB program stream achieved an energy realization rate of 83% and demand realization rate of 51%. All inspected samples achieved realization rates of less than 90%. However, four out of the seven projects achieved energy realization rates of less than 60%, and two of those have demand realization rates of less than 10%.

The low realization was attributable to the following factors:

- At least one of the projects had major differences between the inventory and what was observed on site. Although, the overall the measure quantity installation rate was 94% for the BBP-EB projects sampled, several discrepancies were observed in the baseline operating conditions and retrofit end use parameters by the on-site inspectors.
- Site inspectors observed that several facilities (samples) inspected under this program were diligent about turning off lights in unoccupied areas. A few of the facilities used emergency lights, where feasible, during unoccupied and low occupancy times, which occurred during the peak period. The reduced operating hours were not taken into account in the program savings. Three of the facilities had established a policy of running emergency lights whenever low light levels were sufficient. As a result, the operating hours during the peak period were significantly less than anticipated.

The energy and demand realization rates for the BOMA CDM program were over 95%. The Summit Blue Team observed only minor discrepancies in operating parameters.

About one- third of the ERIP Commercial projects achieved demand realization rates of less than 50% although the program has a measure quantity installation rate of 95%. Several of the projects with low realization rates were educational facilities and hospitality facilities with residential suites. It is common for the majority of lighting equipment in these spaces to not operate in the system peak window resulting in low realization rates.

Although the measure installation rate for the ERIP Multifamily Residential (MR) program stream was 92%, the demand realization rate was very low (3%). The claimed demand savings for the ERIP MR are based on the OPA measures and assumptions list. The reported savings are based on the connected wattage without regard to load shapes and coincidence with system peak. The majority of lighting equipment in residential suites does not operate during the system peak window. The verified demand savings were hence much lower than the program claimed savings. For example, in a multi-family housing complex, the Summit Blue Team observed that the program claimed savings for the living room lighting retrofits were calculated based on the connected wattage differential and an average daily usage of 8 hrs / day. The OPA Measures and Assumptions Lists assume an average daily usage of 2.7 hours per day, which is consistent with industry literature.

Demand Savings by Measure Type

Lighting measures dominate the population of projects installed under OPA programs. For the ERIP program, 97% of installed savings were attributable to lighting measures. For the BOMA CDM, BBP-EB and BIP programs, lighting measures contributed between 70% - 80% of the total savings achieved. The remainder was a combination of HVAC measures and motor retrofits.

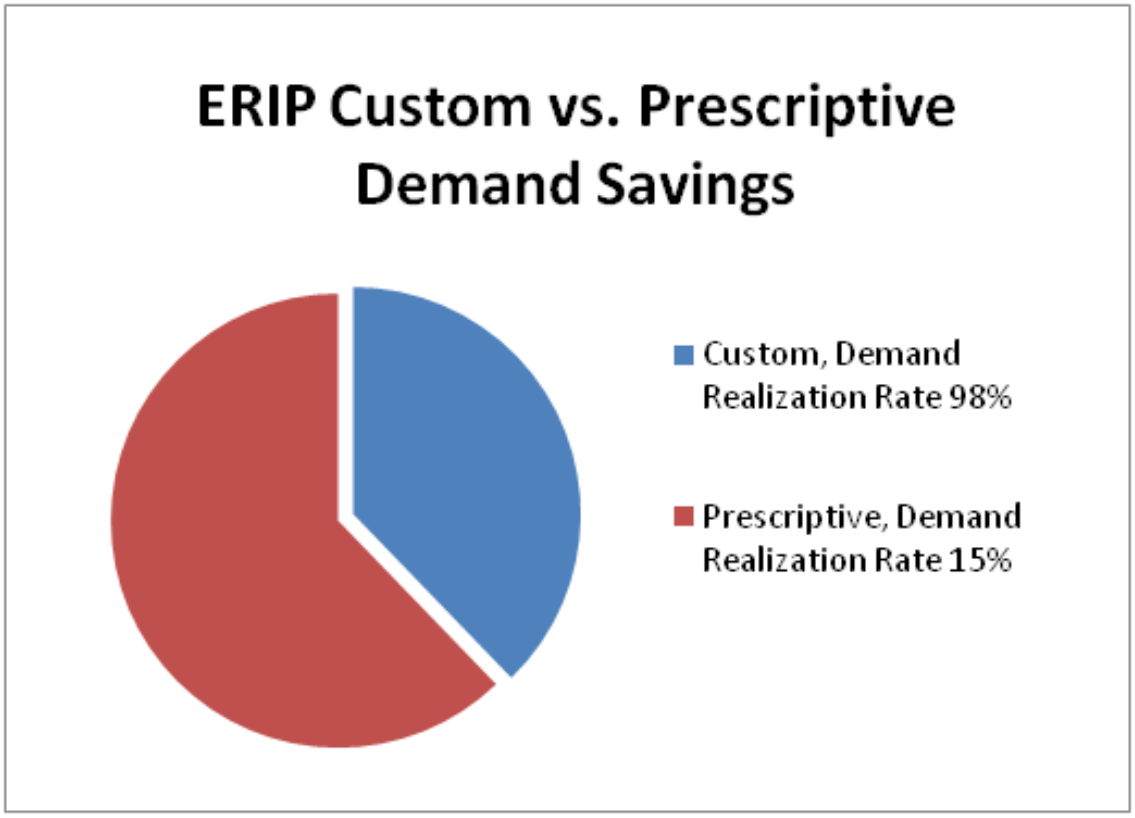
The demand realization rate for the ERIP lighting measures was 80%. The realization rate for the HVAC and other measures varied between 5% and 120%. The large variance was attributable to the complex nature of these measures. Operating parameters in several cases were incorrectly defined resulting in inaccuracies in the savings calculations.

For the BOMA CDM, BBP-EB and BIP programs, lighting measures achieved realization rates between 90% - 100%. The HVAC measure realization rates were 60% - 110%. The low realization rates for HVAC measures, for some projects, were attributable to discrepancies in operating parameters (load curves, operating hours).

Demand Savings – Prescriptive v/s Custom

Projects completed under the BOMA CDM, BBP-EB, and BIP programs follow a custom path unlike ERIP which has both custom and prescriptive projects. Figure 2-4 below shows the savings distribution for the ERIP program.

Figure 2-4. Savings Distribution for the ERIP Program



Custom projects represent 38% of ERIP's kW savings and prescriptive projects account for 62%. Custom projects achieved a realization rate of 98%, while the realization rate for prescriptive projects was 15%. Custom projects undergo a more rigorous savings calculation process where input assumptions and operating parameters are site specific, resulting in more accurate savings. Savings for the prescriptive projects are based on generic PIA assumptions leading to inaccuracies. Another contributing factor to the low realization rate for prescriptive projects was that the majority projects completed under the prescriptive path were residential or educational faculties where the overall energy use in the system peak window is low.

2.2 Prescriptive Input Assumptions

While custom measures have more variability between installations, are more complex, and are less frequently implemented, prescriptive measures possess characteristics for which energy and demand savings can more readily be generalized and benefit from economies of scale. As such, OPA's Cross-Cutting Programs rely on calculation of prescriptive savings primarily through prescriptive input assumptions (PIAs) unique to the technology installed. If these measure assumptions are inaccurate, they may have a broad range of influence on perceived program performance.

Through a thorough review of prescriptive input assumptions, Summit Blue has tightened the accuracy of calculated measure savings, demand reductions, and cost effectiveness, thereby ensuring that they are representative of installation conditions. Prescriptive input assumptions reviewed through this effort include:

- Efficient technology description
- Base technology description
- Winter & Summer On-Peak Demand (kW) Savings
- Annual (kWh) Savings
- Seasonal Energy Savings Patterns
- Equipment Useful Life (EUL)
- Incremental Cost
- Free-Ridership Estimates

Summit Blue used a prioritized approach in reviewing prescriptive input assumptions that ensured measures with the largest impact on program performance[3] were allocated the appropriate level of resources. As part of this effort, the project team requested and reviewed the appropriate program level implementation records and measure tracking reports.

Whenever possible, the Summit Blue Team leveraged supporting project documentation to become familiar with the quantitative values used to determine savings or incentive levels and to identify assumptions with the greatest level of uncertainty at the measure level. This allowed research staff to immediately focus research and data collection efforts on reducing uncertainties in key assumptions, bolstering or filling data gaps in technology performance variables, and verifying key factors.

Similarly, Summit Blue reviewed pre-/post- installation metering and monitoring findings to establish a representative baseline at the measure level. The results of this effort were then compared with the current measure assumptions, similar programs offering the same technologies, and existing baseline studies. Significant differences between the jurisdictions examined and Ontario (e.g., climate, codes & standards, etc.) that may have been responsible for variations in prescriptive input assumptions were identified accordingly.

Through this analysis, Summit Blue has provided recommendations to the input assumptions used in estimating energy savings. The project team hopes that the results of this effort will bolster the accuracy of current and future program planning efforts.

[3] Lighting projects accounted for more than 90% of the 2008 ERIP Program *ex-ante* savings estimates

2.2.1 Approach

Summit Blue's approach to reviewing the PIAs involved a prioritized evaluation of each measure level input assumption. The primary resource to benchmark input assumptions against was the OPA's documentation for estimating prescriptive measure savings, the Measures and Assumptions List.[4] This provided a base of performance metrics (e.g., program demographics, customer characteristics, etc.) to research in more detail.

In the event that the requested documentation lacked sufficient information to support Summit Blue's review effort (e.g., various space heating/cooling measures, water heating measures, and commercial cooking measures) Summit Blue used secondary literature for comparison purposes. Preference was given to references that specifically targeted the Canadian market, but when necessary, sources from the United States were used to fill in gaps not covered by more geographically convenient data. Special attention was given to weather sensitive prescriptive measures and the impact of this factor on similar study findings.

Although most measure categories included a fair amount of documentation on the savings algorithms used, many of the sources used to develop the input assumptions were unable to be verified. As an example, a majority of operating hour assumptions for lighting technologies were drawn from *"PG&E Work Papers, June 13, 2005."* Although specified, the documentation could not be provided by OPA staff.

Aside from the measure specific sources cited in OPA's 2009 Measures and Assumptions List, or given as citations in this report, resources used in this task included:

- Commercial and Institutional Building Energy Use Survey (CIBEUS)[5]
- Database for Energy Efficient Resources (DEER)[6]
- Buildings Energy Data Book (BEDB)[7]
- Commercial Buildings Energy Consumption Survey (CBECS)[8]

This chapter primarily addresses those OPA input assumptions that did not show reasonable agreement between with the industry recognized sources.

2.2.2 Measures

What follows is a detailed review of the calculation methodologies and resources used to develop prescriptive savings estimates for measures offered through ERIP's prescriptive track. As noted in the previous section, the depth of review was driven largely by each measure's contribution to program year savings. The technologies reviewed include:

1.) Lighting Measures and Applications

[4]Ontario Power Authority, *2009 OPA Measures & Assumptions List (Commercial and Institutional)*, Nov. 2008.

[5] Demand Policy and Analysis Division of the Office of Energy Efficiency, "Commercial and Institutional Building Energy Use Detailed Statistical Report," December 2002.
[6] California Public Utilities Commission, "Database for Energy Efficient Resources," 2008.
[7] U.S. Department of Energy, "2008 Buildings Energy Data Book," 2008.
[8] Energy Information Administration, "Commercial Buildings Energy Consumption Survey," 2003

2.) Domestic and Service Hot Water Improvements

3.) Premium Efficiency Motors Retrofits

4.) Agricultural Efficiency Technologies

Lighting Technologies

Historically, prescriptive lighting technologies have contributed towards a majority of *ex-ante* demand savings claimed through OPA's programs and nearly all of the demand savings attributed to the Electricity Retrofit Incentive Program. This section will address the assumptions and procedures used to develop prescriptive lighting savings estimates, including:

1.) Resources used to develop measure PIAs

2.) Review of measure PIA validity

3.) Recommended changes, if any, to measure PIAs used

Savings Algorithms

Demand savings for prescriptive lighting projects accounted for the inventory of fixtures installed, along with the demand impacts for lamp replacements. However, because not all fixtures contain the same number of lamps, the impact of a given fixture is equivalent to the product of the number of lamps housed and their respective impacts. Fixtures exhibiting the same usage patterns are generally aggregated into a common "usage group." An example of this would be high bay fixtures installed in a retail venue; generally all of the lights within the retail sections of the store will be of the same type and have identical operating characteristics driven by the store's open hours. These fixtures would be grouped into the same "usage group" and have identical impacts when estimating project savings.

Two consistent algorithms are used to estimate average peak demand savings (ΔP_{avg}) and annual energy savings for each lighting efficiency measure.

$$\Delta P_{avg}\ per\ fixture\ (kW) = \frac{Demand_{Base}(W) - Demand_{Eff}(W)}{1000\ W/kW} \times Diversity\ Factor$$

$$Annual\ Energy\ Savings\ (kWh) = \Delta \sum_{u}^{N} (kW_{fixture} \times Fixture_{u} \times Hours)$$

Where:

$kW_{fixture}$ = Lighting demand savings per fixture for usage group *u*

Diversity Factor = probability of a given load being on during the system peak

$Fixture_{u}$ = Quantity of affected fixtures for usage group *u*

$Hours$ = Annual operating hours for usage group *u*

Demand and energy savings for occupancy sensor measures (measure 12) were calculated through the following algorithm:

$$Annual\ Energy\ Savings\ (kWh) = \sum_{u}^{N} kW_{fixture} \times \left(1 - \%_{occupied}\right) \times Hours$$

Where:

$kW_{fixture}$ = Lighting demand savings per fixture for usage group *u*

$\%_{occupied}$ = Occupancy rate for usage group *u*

$Hours$ = Annual operating hours for usage group *u*

There are no demand savings attributed to occupancy sensor measures as it is assumed that the lighting fixtures are all operating during the system peak period. The Summit Blue team found no issues with the equations used estimate impacts.

Fixture Operating Characteristics

Due to the unique operating characteristics of each participant site, the annual operating hours of a given fixture are often the hardest prescriptive input variable to accurately predict. Table 2-4 details the input assumptions used in predicting the operating characteristics of OPA's prescriptive lighting technologies relative to other representative resources.

Table 2-4. Operating Assumptions for Various Commercial Buildings

	Annual Operating Hours				
Building Type	**OPA PIA**	**Express Efficiency[9]**	**DEER 2008[10]**	**CFL Metering Study[11]**	**CBECS[12]**
Grocery Store	5,800	5,824	4,964	-	5,564
Hotels/Motels	5,500	8,736	755	-	8,684
Large/Small Retail (Including Restaurants)	4,450	4,368	3,546	-	3,068
Hospital/Nursing Home	4,400	8,736	4,367	-	3,068
Large/Small Office	4,000	2,739	2,642	-	2,860
University (Gymnasium)	3,900	3,073	2,522	-	-
Sports Arena	2,880	-	-	-	-
Schools	2,150	2,305	2,445	-	2,600
Multi-Unit Residential Building (MURB)	3,150	-	-	796	-
MURB Apartment	2,100	-	-	796	-
MURB Corridor/Lobby	5,100	8,736	7,474	-	-
MURB Parking Garage	8,760	8,760	8,760	8,760	-

Summit Blue was unable to procure the OPA's input assumption references and, as a proxy, compared the input assumptions to a number of other representative evaluation study findings. The representative studies are cited in the subsequent sections, by measure category. These studies include, but are not limited to:

1.) The Database for Energy Efficient Resources (DEER), http://www.energy.ca.gov/deer/.

2.) Natural Resources Canada (NRCan) Lighting Guide, http://oee.nrcan.gc.ca/english/index.cfm.

3.) Buildings Energy Data Book, http://buildingsdatabook.eren.doe.gov/.

4.) U.S. Department of Energy (DOE), http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=12030.

[9] Quantum Consulting, *2003 Statewide Express Efficiency Program Measurement and Evaluation Study*, March 21, 2005.
[10] Database for Energy Efficient Resources, http://www.deeresources.com/deer2008exante/downloads/DEER2008UPDATE-EnergyAnalysisMethodsChangeSummaryV4.pdf.
[11] KEMA Inc., *CFL Metering Study*, February 25, 2005.
[12] Commercial Buildings Energy Consumption Survey (CBECS), http://www.eia.doe.gov/emeu/cbecs/.

5.) Illuminating Engineering Society of North America (IES), *An Analysis of the Energy and Cost Savings Potential of Occupancy Sensors for Commercial Lighting Systems*, 08/16/2000.

6.) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), *2004 ASHRAE Handbook: HVAC Systems and Equipment*, 2004.

7.) Hegberg, R.A, *Converting Constant-Speed Hydronic Pumping Systems to Variable-Speed Pumping*, ASHRAE Transactions, 1986.

8.) American Council for an Energy-Efficient Economy (ACEEE), *Impact of Proposed Increases to Motor Efficiency Performance Standards, Proposed Federal Motor Tax incentives, and Suggested New Directions Forward*, June 2007.

9.) KEMA Inc., *CFL Metering Study*, February 25, 2005[13].

10.)Quantum Consulting, *2003 Statewide Express Efficiency Program Measurement and Evaluation Study*, March 21, 2005.

Due to the variability between the OPA's PIAs and the secondary literature reviewed, Summit Blue recommends that future program cycles compile participant specific data to calibrate the operating hour input assumptions. In commercial office spaces, the OPA estimate of 4,000 hours per year is 30% above an average estimate of 2,750 provided by the other sources. Less of an issue, but still notable, is the OPA estimate of 5,100 hours per year for MURB Corridor/Lobby space. This is significantly below the 7,474 hours per year estimated by DEER or 8,736 hr/yr estimate from Express Efficiency Evaluation. Although the correction to the Multi-Unit Residential will have minimal impacts to overall estimates, the net impact from office buildings is more substantial.

It is also recommended that certain building categories be further divided to more accurately capture the magnitude of anticipated impacts. For example, according to the CBECS, average hours of operation for food service is 86 hours per week, whereas typical non-mall retail operations are only 56 hours per week. Combining these dramatically different sectors together, as ERIP does, may not provide the fidelity to accurately quantify measure savings. Another over-simplification can be seen in the annual operating hour assumptions for the "University" building type, which is defined as a "gymnasium". Experience has shown that that these institutions cannot be characterized by a single usage pattern. Similarly, the annual operating assumptions for guest houses (Hotel/Motels/Inns) and Multi-Unit Apartment Buildings (MUABs) are not clearly defined and typically depend on the location of the fixture. Given the breadth of space types and tasks performed within a typical university and residential complex, Summit Blue recommends disaggregating these building types into more representative usage areas.

HVAC Interaction

The method used by the OPA to estimate lighting savings has a simplification in that the total impact is not evaluated for potential HVAC interaction. HVAC interaction is load on building heating and cooling systems due to the presence of heat-emitting lights. The magnitude of HVAC interactive effects can vary based on a number of factors; the most influential of which are: HVAC efficiencies and fuel type, space use, and weatherization/infiltration.

[13] KEMA has been charged with conducting the *"2008 Residential Lighting Metering Study"* for the CPUC. This report is in progress and Summit Blue will forward the results of that evaluation to OPA staff.

Capturing the distribution of heating fuel type (gas vs. electric) can be an important benefit of customer surveys, which will directly improve the accuracy of calculating an HVAC interaction factor. HVAC efficiency can often be associated with mean building age. However, as time passes, more detailed analysis becomes important to ascertain impacts from equipment maintenance and upgrades. Other details, such as an above average regional preference for high efficiency HVAC equipment (i.e., geothermal heat pumps or evaporative cooling) can also come out in a more detailed survey.

Space use is relevant to the lighting-HVAC interaction in that it affects building set-points, construction, occupancy, type of lighting equipment installed, and a variety of other factors. For example, a refrigerated warehouse will have a significantly higher interaction than a large open office space.

Weatherization is relevant to HVAC interactive impacts because of the direct connection between infiltration and the magnitude of heating and cooling loads. The mean age of the building stock in a territory can often provide a reasonable estimate of weatherization levels.

OPA should consider the impacts of HVAC interactive effects in the lighting measure PIAs.

Application Type vs. Incremental Costs

The application designation is important because it helps to define what type of cost estimate is needed by identifying the types of projects where the measure is expected to be applied. There are three generally accepted application codes that are used to identify how the measure is expected to be applied:

- Retrofit – replacing a working system with a new technology or installing a technology that was not there before;
- Replace-on-burnout – replacing a technology at the end of its useful life; and
- New construction – installing a technology in a new construction or major renovation project.

In general, new construction and replace-on-burnout applications are associated with incremental costs because a customer's analysis of efficiency alternatives is typically made when an equipment purchase must be made anyway. Note that labour costs are usually a wash in such cases; that is, there is often no incremental labour cost associated with installing the high-efficiency option. For example, the labour cost for installing a high-efficiency fluorescent fixture in a new office building is no greater than for installing a standard-efficiency fixture. Similarly, most decisions to install high-efficiency HVAC equipment are made when a customer's existing system has reached the end of its useful life; thus, the replace-on-burnout costs are calculated on an incremental basis. There can be variations on this, however, depending on the system requirements of the new equipment being installed. For example, replacing a failed 80% AFUE furnace with a condensing furnace (typically 90% AFUE and above) may require an upgraded flue design, and as such presents an incremental material and labour cost that are in addition to the incremental cost of the higher efficiency furnace.

The application and cost basis are defined for each measure, and many measures have more than one application code. As a general guide, retrofit applications typically mean that the cost basis is the full installed cost. In these cases, a customer is replacing a working system with a new technology or is installing a technology that was not there before, thus bearing the full cost of the installation. Examples include replacing incandescent exit signs in existing buildings with LED, replacing incandescent lamps before the end of their useful life with CFLs, and installing ceiling insulation in a home that did not have any insulation.

These are not hard and fast rules and, as noted, there are exceptions. For example, occupancy sensors have been designated as retrofit and new construction applications, yet their cost bases are considered to

be full installed in both cases since there is a cost to the installation beyond that of normal on/off switching in both applications. Similarly, installing a heat recovery system is considered to be a retrofit and new construction application, yet the cost basis is defined as full installed in both cases because it is an addition or option to a conventional system. Therefore, each measure needs to be examined individually with respect to application and cost basis.

Full installed costs typically encompass the measure equipment cost of the technology, not an incremental cost. For example, occupancy sensors are assumed to have a full installed cost basis and use the cost of the sensor (measure equipment cost) plus the labour to install the technology. There is no incremental cost in this case because the baseline is the absence of a sensor or an existing conventional on/off switch that is being displaced. The cost calculations follow the formulas for each cost basis designation as described in Table 2-5.

Table 2-5. Calculation of Costs According to Cost Basis

Cost Basis	Base Equipment Cost	Measure Equipment Cost	Incremental Cost	Labour Cost	Installed Cost
Incremental	a	b	b – a		
Installed		b		c	b + c

Due to the impact of measure application on incremental costs and the corresponding cost effectiveness calculations, Summit Blue recommends that future program cycles further disaggregate the nature of measure installations at participant sites.

Lighting Measures

Lighting technologies incented by the OPA ERIP program include:

1. Energy Star® Compact Fluorescent Lamps
2. High Performance T-8 Fixtures
3. T-8 Fixtures for Medium Bay Lighting
4. T-5 High Output Fixtures for High Bay Lighting
5. T-5 Fixtures
6. Metal Halide Ceramic (High Wattage)
7. Metal Halide Ceramic (Low Wattage)
8. Lower Wattage High Intensity Discharge (HID) Lighting
9. Halogen General Service Lamps
10. LED/Photoluminescent Exit Signs
11. Lamps with Infrared Coating
12. Occupancy Sensors

Compact Fluorescents

Incremental cost data is particularly difficult to pin down due to rapidly shifting market trends and the prevalence of a particular technology in a given region. One of the few representative resources that have attempted to capture current costs for a wide array of efficiency measures is the DEER. The most recent DEER update was done in 2008, and although this large collection of data was taken in California, cost multipliers are available to adjust the values to other regions of North America. Summit Blue uses DEER as reference point because it is recognized in the industry as one of the most comprehensive resources for residential, commercial, and industrial incremental measure costs used for Program design efforts.

The OPA PIA documentation provides an incremental materials cost estimate of $3.50CAN/lamp between a standard screw-in incandescent and comparable screw-in CFL. Although cost varies with lamp wattage, DEER 2008 provides an estimate that is roughly $2.20CAN,[14] or nearly 35% less than the OPA estimate. The incremental material cost estimate for a pin-base CFL lamp provided by the OPA is reasonable in comparison to the 2008 DEER database. However, the incremental cost estimate for a pin-base CFL should also include the cost of the actual fixture/housing; this is missing from the OPA assumptions list. The cost of the lighting fixture is important to include with pin-base incremental costs because, unlike a screw-in type CFL, a pin-base lamp does not have its own ballast but instead relies on an external one.

Another important detail in calculating the incremental cost difference associated with switching to pin-based CFLs is the labour cost of installing the required ballast and fixture. If the pin-base CFL option is chosen for a new construction project, the incremental labour cost is very low (nearly nothing). However, if the pin-base option is being installed as a retrofit, the cost of installation is incurred in full and is an order of magnitude greater than the materials costs. One added benefit to the OPA of seeing this type of upgrade is that it would be costly for a customer to down grade a pin-base fixture to an incandescent fixture. With a screw-in CFL, this would be as simple as unscrewing one lamp and installing another; however, as mentioned above, with a pin-base fixture, downgrading is not as simple. Assumptions for labour costs for this type of retrofit are not included in the PIA.

The exclusion of labour rates from incremental first costs is acceptable for screw-in lamps as it is common for maintenance staff to wait until a lamp has burned out prior to replacement. However, the five to ten fold increase in operating hours for a CFL relative to an incandescent bulb can lead to substantial maintenance savings over the life of the lamp. This extended life expectancy and avoided labour cost can actually lead to a negative incremental cost, e.g., replacing five incandescent lamps at $0.50 each with one CFL at $2 would result in a -$0.50 incremental cost, plus 4 bulb outages worth of avoided labour costs.

Ceramic Metal Halide

Location of Use

The PIAs for Ceramic Metal Halide lamps/fixtures list the same group of building types (except MURB) and operating schedules as CFLs. Aside from adding MURB parking garages and security lights back on the list, sports arenas and warehouses should also be added to the list of options open to CMH upgrades. Applications on the list but not generally suitable for CMH lighting would include: small retail, restaurant, office spaces, and school/classroom spaces.

[14] http://www.x-rates.com/, August, 2009.

Effective Useful Life (EUL)

Also of note, the effective useful life (EUL) for high wattage metal halide lamps was given as 16 years. Although EUL for CMH lamps has a wide range based on manufacture and lamp orientation (horizontal vs. vertical), a typical 400W CMH lamp can be expected to last 20,000[15] hours. Given that the annual operating hours for most of the building types stated in the PIA are around 5,000 hours per year, it is apparent that a 16 year EUL is overly optimistic and should be four years. Also, according to DEER 2008, the ballasts used with these luminaries generally only last 15 years. The EUL estimates given for low wattage metal halides (8,000 – 10,500 hrs) agrees well with other estimates found in the Natural Resources Canada Lighting Resource Guide[16] (6,000 hrs) and on manufacturer's websites (GE: 12,000 hrs).

Low Wattage HID

Technology Description

The wattage values stated in the Efficient and Base Equipment Description seems to have been switched. This appears to simply be an editing correction.

Halogen General Service Lamps

Incremental Demand Savings

Halogen lamps are the only lighting type in OPA's PIA that may need a more complete review of the incremental demand savings. The PIA states that "halogen general service lamps are approximately 50% more efficient [than standard incandescent lamps]…" This is much higher than savings estimates from other sources which range from increases in demand to reductions of 26% (see Table 2-6 below).

Table 2-6. Incremental Demand Savings from Halogen Light Sources

	Range of Efficacy (lm/W)		Savings Based
Source	**Incandescent**	**Halogen**	**On Average**
2006 Buildings Energy Data Book[17]	10-19	14-20	17%
U.S. Department of Energy[18]	10-17	12-22	26%
Natural Resources Canada Lighting Resources Guide[19]	10-35	18-24	-7%
Natural Resources Canada[20], 100W	16.5	18	9%

[15] General Electric, "General Electric (GE) Lighting," http://www.gelighting.com/na/.
[16] Natural Resources Canada, "Natural Resources Canada (NRCan) Lighting Guide," http://oee.nrcan.gc.ca/english/index.cfm.
[17] U.S. Department of Energy (DOE), "Buildings Energy Data Book," http://buildingsdatabook.eren.doe.gov/
[18] U.S. Department of Energy (DOE), "Types of Lighting," http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=12030
[19] Natural Resources Canada, "Natural Resources Canada (NRCan) Lighting Guide," http://oee.nrcan.gc.ca/english/index.cfm
[20] Ibid

Location of Use

Also, because of their high color rendering indexes and ability to provide highly focused beams, halogen lamps tend to be used in more task, spot, or accent lighting applications. As such, they are much more likely to be found in restaurants and retail applications than in parking garages or schools. Therefore, a review of applicable building types may also be warranted.

LED Exit Signs

Incremental Cost Estimate

Aside from the HVAC interactive impacts mentioned earlier, estimating energy savings from LED exit signs is straight forward and well-documented in the PIA. Of the assumptions reported for this category, only the incremental costs require further analysis. Like many of the other lighting measures, little or no distinction is made between a retrofit and a new installation cost. The lack of distinction between these two options can have a very significant impact on the total project cost for a measure like high efficiency exit signs and may likely be a key contributor to the wide range of costs cited in the PIA ($45.00CAN-$96.00CAN per sign). The DEER database lists the typical incremental cost between incandescent and LED exit signs at C$24.22CAN-$30.25CAN for a new installation. The same signage installed as a retrofit would incur the full installed cost of $91.00CAN and represents a swing of nearly 400% in incremental cost.

Occupancy Sensors

Incremental Cost

The cost data listed in the PIA for occupancy sensors and manual switches is likely too high. The stated cost for a manual switch is $50.00CAN-$100.00CAN, and the listed price for an occupancy sensor is $300.00CAN. Since no source is cited for these estimates, their direct validity could not be verified through this effort. However, a comparative analysis to the Database for Energy Efficient Resources[21] provided a measure cost of $51.70CAN for material and $48.4CAN for labour - roughly a third of OPA's PIA. The DEER estimate is consistent with the North Carolina Pollution Prevention and Environmental Assistance,[22] which estimates occupancy sensor material costs to be in the range of $33.00CAN-$143.00CAN. Neither of these sources addresses the subsequent costs of commissioning the lighting system. However, it is unlikely that this additional step justifies the large incremental cost discrepancies. Moving forward, Summit Blue recommends reviewing and refining occupancy sensor cost assumptions to be consistent with the current market.

Energy/Demand Savings

The values stated in OPA's input assumptions are generally consistent with an average of five sources:[23]

- North Carolina State Energy Office

[21] "Database for Energy Efficient Resources," http://www.deeresources.com/deer2008exante/downloads/DEER2008UPDATE-EnergyAnalysisMethodsChangeSummaryV4.pdf.
[22] "North Carolina Division of Pollution Prevention and Environmental Assistance," www.P2Pays.org.
[23] Illuminating Engineering Society of North America (IES), *An Analysis of the Energy and Cost Savings Potential of Occupancy Sensors for Commercial Lighting Systems*, 08/16/2000.

- California Energy Commission
- Cooper Controls Savings Estimates
- Watt Stopper Savings Estimates
- U.S. Environmental Protection Agency

The average occupancy rates listed below are based on a two step process. First, the high and low bounds from each source were averaged to find the mean value per location for a given source. Then the values for each location were averaged across the different sources to arrive at a final value for comparison purposes:

Table 2-7. Comparison of Occupancy Rates across Building Types

	Occupancy Rate		Savings Estimate	
Lighting Sensor Location	**OPA PIA**	**IES[24]**	**OPA PIA**	**IES[25]**
Private Office	60%	63%	~	37%
Open Office	60%	78%	High	22%
Classroom	57%	62%	~	38%
Conference	65%	54%	Low	46%
Restroom	60%	47%	Low	53%
Warehouse	-	35%	-	65%
Storage	-	41%	-	59%

Overall, the occupancy rate assumptions and savings estimates used by the OPA were fairly consistent. Moving forward, Summit Blue recommends more closely investigating sensor areas with large deviations in occupancy assumptions (e.g., open offices, conference rooms, restrooms) and their impact on overall Program savings.

Conclusions & Recommendations

In aggregate, the OPA's input assumptions for lighting technologies correlate well with similar studies. This has yielded gross demand savings estimates that have been deemed "representative" of the participant base installing these measures.

In an effort to continually improve the quality of input assumptions for future planning purposes, Summit Blue recommends investigating the following parameters in more detail:

- **Annual Operating Hours:** Because fixture operating characteristics do not directly impact demand reduction estimates, research into this topic area does not need to be addressed in the 2008 program analysis and impact evaluation. However, for future planning purposes and

[24] Ibid
[25] Ibid

estimating annual usage savings (kWh), it is recommended that focus be placed on establishing a better baseline for hours of operation across the lighting program. This is particularly important for the office lighting usage patterns.

- **Effective Useful Life (EUL):** As noted earlier, the assumed EUL for high wattage metal halide lamps are overstated. Manufacturer specifications for a 400W CMH lamp generally are in the range of 20,000 hours. Given that the average operating characteristics for most of the building types are 5,000 hours per year, it is apparent that a 16-year EUL is overly optimistic, and we recommend modifying this assumption to four years.
- **Incremental Costs**: Summit Blue has found that disaggregating measure incremental costs by the nature of replacement (e.g., New, Retrofit, Replace-On-Burnout, etc.) may improve the accuracy of cost effectiveness tests.
- **Method to Compute HVAC Interaction:** Certain DSM measures, such as commercial lighting retrofits, directly influence lighting energy consumption and indirectly influence HVAC energy consumption. That is, the lighting systems reduce building internal heat gain, thereby reducing cooling loads and increasing heating loads. Similar effects are produced by energy-efficient appliances, heat pump water heaters, and motors located in conditioned spaces. There are many complicated interactions between internal gains, shell heat gains, thermal mass effects, HVAC system efficiency, and HVAC system controls that influence HVAC energy consumption and demand. As a result of these influencing factors, Summit Blue is confident that hourly building energy simulation programs (e.g., DOE-2) are best suited for estimating interaction factors for various measure categories. A prototypical building may be developed and modeled to better understand the impact of retrofit measures on pre-existing HVAC system energy consumption.

Summit Blue's input assumption recommendations are further clarified in the following discussion.

The load shapes can also be found online at the following address:

http://www.deeresources.com/index.php?option=com_content&view=category&layout=blog&id=40&Itemid=55

The demand diversity factor is used to account for the fact that not all measures in all buildings are drawing full power at the same time. The demand diversity factor is defined as the ratio of the peak demand of a population of units to the sum of the non-coincident peak demands of all individual units. There are a number of methods used to estimate this factor – Summit Blue provides one *reasonable* method below:

$$Diversity\ Factor = kW_{population} \div (Units \times RLF \times kW/Unit)$$

Where:

$kW_{population}$ *= peak demand of a population of units*

Units = Number of units in population)

RLF = Rated Load Factor

kW/Unit = Unit Demand

Primary research into each of the four parameters is generally required to develop representative diversity factor estimates for lighting measures. This can be accomplished by examining the load shapes of a statistically significant sample of lighting retrofit projects.

As noted in the prescriptive input assumption review, Summit Blue recommends further disaggregating space types using the DEER Database taxonomy. The applications for metal halide, low wattage HID, and halogen general service lamps are shown below in Table 2-8.

Table 2-8. Applications for Metal Halide, Low Wattage HID and Halogen Lamps

Building Type	Space Use	Equivalent Full Load Hours DEER 2008
Assembly	Auditorium	2431
Education - Primary School	Exercising Centers and Gymnasium	2051
Education - Secondary School	Exercising Centers and Gymnasium	2366
Education - University	Comm/Ind Work (General, Low Bay)	3099
Education - University	Corridor	2972
Health/Medical - Nursing Home	Corridor	7884
Lodging – Hotel	Corridor	7884
Lodging – Motel	Corridor	7474
Manufacturing - Bio/Tech	Corridor	7008
Manufacturing - Light Industrial	Comm/Ind Work (General, High Bay)	3068
Manufacturing - Light Industrial	Storage (Unconditioned)	3376
Office – Large	Corridor	2641
Office – Large	Mechanical/Electrical Room	2692

Building Type	Space Use	Equivalent Full Load Hours DEER 2008
Office – Small	Corridor	2594
Office – Small	Mechanical/Electrical Room	2594
Retail - 3-Story Large	Storage (Conditioned)	2702
Retail - Single-Story Large	Retail Sales and Wholesale Showroom	3546
Retail - Single-Story Large	Storage (Conditioned)	2738
Retail - Single-Story Large	Auto Repair Workshop	3429
Retail - Single-Story Large	Retail Sales and Wholesale Showroom	3546
Retail - Small	Retail Sales and Wholesale Showroom	3378
Retail - Small	Storage (Conditioned)	2753
Storage - Conditioned	Storage (Conditioned)	3441
Storage - Unconditioned	Storage (Unconditioned)	3441
Grocery	Retail Sales, Grocery	4964
Grocery	Comm/Ind Work (Loading Dock)	4964
Grocery	Refrigerated (Food Preparation)	4380
Grocery	Refrigerated (Walk-in Freezer)	4380
Grocery	Refrigerated (Walk-in Cooler)	4380
Warehouse - Refrigerated	Refrigerated (Frozen Storage)	4818
Warehouse - Refrigerated	Refrigerated (Cooled Storage)	4818
Warehouse - Refrigerated	Comm/Ind Work (Loading Dock)	4818

Summit Blue recently completed the DEER 2008 Cost Update Study which entailed primary research into metal halide, low wattage HID and halogen general service lamps. Cost data was gathered from a variety of representative resources, including:

1.) Program data

2.) Retail observations

3.) Web research

4.) Interviews with installation contractors

5.) Interviews with manufacturers

This information can also be found online at
http://www.deeresources.com/deer0911planning/downloads/DEER2008_Costs_ValuesAndDocumentation_080530Rev1.zip

Domestic and Service Hot Water Improvements

Water heating technologies incented by the Electricity Retrofit Incentive Program include:

A. Pipe and Hot Water Tank Insulation

B. Drain Water Heat Recovery

C. Low Flow Spray Nozzles for Food Service

D. Solar Hot Water Collectors

E. Non-Electric Storage Tank

F. Non-Electric Tankless Water Heater

Of this list, PIA documentation could only be procured for the first three technologies – only two of which were associated with financial incentives. As such, only tank insulation and drain heat recovery were reviewed through this effort.

Pipe and Hot Water Tank Insulation

In the OPA PIA, the thermal conductivity of pipe and tank insulation is assumed to be 0.042 W/mK. Polyethylene foam is the most common for hot water pipes, whereas fiberglass is a much more common choice for domestic tank insulation. At 50C, polyethylene has a k-value of 0.036 W/mK.[26] Fiberglass insulation at 50C is similar with a k-value of 0.037 W/mK.[27] So although the OPA estimates are conservative based on the assumed thermal conductivity of insulation and the difference is too small to justify an immediate update, it is recommended that this change be included in future estimates.

All other temperature assumptions, dimensions, and methods used in finding the impact of DHW insulation for the OPA PIA appear reasonable.

[26] Industrial Insulation Sales, Inc., "Armacell polyethylene pipe insulation," www.industrialinsulation.com.
[27] Industrial Insulation Sales, Inc., "Owens Corning Fiberglas pipe insulation," www.industrialinsulation.com.

Recommendations for Pipe Insulation

Summit Blue recommends an EUL of 13 years for electric water heater pipe insulation and 11 years for gas water heater pipe insulation. Overall, it is assumed that the EULs of pipe insulation and water heaters are equivalent because water heater retrofits may compromise the quality of adjacent pipe insulation. These values are consistent with a number of different resources, including:

- A study done by GDS on Measure Life for Residential and Commercial/Industrial Lighting and HVAC Measures[28]
- Directive of MA NUP consultants - GDS report
- Vermont Efficiency Investment Corp. (VEIC) from GDS report
- Connecticut - from GDS report
- Efficiency Vermont Residential Master Technical Ref. User Man. No. 2005-37
- Vermont DPS screening of Efficiency Utility Core Programs
- CPUC Energy Efficiency Policy Manual, v.1 (2001)
- CALMAC 2000 workshop report
- Appliance Magazine

The DEER 2008 cost update found that the material cost for pipe insulation (R4) was approximately $0.88 per Ln. Ft. Pipe insulation for non-residential applications (1" Hot Water 120-200F, over 2" pipe) was generally more expensive with a material cost of $1.59 Ln. Ft.

A recent cost study completed for four utilities in the Pacific Northwest found that installed costs for R4 pipe insulation were approximately $1.40 per Ln. Ft.

Summit Blue recommends adjusting measure costs to be consistent with these findings.

Recommendations for Tank Insulation

Summit Blue recommends an EUL of 10 years. This estimate is based on ENERGY STAR lifetime assumptions and is consistent with the following resources:

- VEIC (from GDS report)
- CPUC Energy Efficiency Policy Manual, v.1 (2001)

The DEER 2008 cost update found that tank insulation generally incurred a material cost of $25.00. And a recent cost study completed for four utilities in the Pacific Northwest found that installed costs were approximately $85 (R-5) and $100 (R-11). Summit Blue recommends adjusting measure costs to be consistent with these findings.

[28] Measure Life Report, Residential and Commercial/Industrial Lighting and HVAC Measures,. *GDS* Associates, June 2007

Drain Water Heat Recovery

The OPA PIA for drain water waste heat recovery uses the simple and effective NTU method. The primary inputs for this calculation are the discharge temperature, the heat exchanger's effectiveness ratio, average temperature of the water entering from the city water main, and the efficiency of the primary water heater (boiler, tank, etc).

OPA's assumption regarding the waste water temperature is relatively conservative. The PIAs list a point of use water temperature of 50-55C for restaurants, and of 40.6C (105.8F) for hair salons. From this, the average discharge water temperature is estimated to be 32C (89.6F). In the absence of verification data, a temperature drop of 20C+ is considered to be relatively high for average food service loads. The U.S. Department of Energy[29] estimates the temperature of shower waste water to be 37°F. In the absence of primary research, Summit Blue finds this estimate to be *reasonable*.

OPA assumes the heat exchanger's effectiveness is 50%. Table 2-9 shows the effectiveness values for six different models (2 from each of 3 different manufacturers) that cover a range of designs and sizes[30]. The average of the six effectiveness values show is 45.4%.

Table 2-9. Effectiveness Values for Six Drain Water Heat Recovery Models[31]

MODEL:	GFX-40	GFX-60	Retherm 40	Retherm 60	PowerPipe-36	PowerPipe-60
C	3.7669	4.2096	3.4053	3.071	2.8869	4.7622
n	0.6452	0.6458	0.7028	0.5996	0.7219	0.6355
NTU	0.8874	0.9904	0.7051	0.8013	0.5727	1.1465
Effectiveness	47.02%	49.76%	41.35%	44.48%	36.42%	53.41%

In the absence of primary research, Summit Blue recommends that the EUL of waste water heater recovery systems is equivalent to that of the water heaters (11 years for gas water heaters, 13 years for electric water heaters, and 15 years for solar water heaters[32]).

The U.S. Department of Energy[33] estimates that the material prices for waste water heat recovery systems range from $300 to $500. Similarly, Natural Resources Canada[34] estimates full installed costs to range from $600 to $1,000. As such, Summit Blue accepts the 2009 Commercial and Institutional Measures and Assumptions estimate of waste water heat recovery system costs.

Premium Efficiency Motor Retrofits

This section addresses the prescriptive input assumptions associated with premium efficiency motors, including the assumed demand reduction, net annual savings, and life expectancy.

[29] http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13040
[30] Natural Resources Canada, "Drain Water Heat Recovery Characterization and Modeling," June 2007.
[31] Ibid
[32] KeySpan Energy, Cost Benefit Analysis Conducted for Solar Measures, 2005.
[33] http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13040
[34] http://www.watercycles.ca/docs/Natural-Resources-Canada.pdf

Savings Algorithms

The program includes motors up to 200 HP which meet NEMA premium nominal efficiencies. This prescriptive program includes new motors and retrofit of failing motors.

Energy savings for premium efficiency motors is calculated by the following equation:

$$Annual\ Energy\ Savings\ (kWh) = \sum_{u}^{N} [(DSF_i \times H_i)_{\text{no VFD}} + (0.5 \times DSF_i \times H_i)_{\text{with VFD}}]$$

Where:

DSF = Demand Savings Factors

H = Annul operating hours

The equation assumes a 50% savings from VFDs. This is not an unreasonable assumption and is based on publications by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).[35,36]

Demand Savings Factors are a function of motor size, number of poles and motor enclosures. DSF are assigned by PG&E working papers dated June 13, 2005 and assume a loading of 75%. No justification is given for 75% loading and this assumption may be high, many studies use average loading of 65%.

Annual operating hours are listed according to Facility Type, and motor use including Fans, Heating Pumps and Cooling Pumps.[37]

[35] American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), *2004 ASHRAE Handbook: HVAC Systems and Equipment*, 2004.
[36] Hegberg, R.A, *Converting Constant-Speed Hydronic Pumping Systems to Variable-Speed Pumping*, ASHRAE Transactions, 1986.
[37] Canadian Commission on Building and Fire Codes, *Performance Compliance for Buildings*, May, 1999.

Table 2-10. NEMA Recommended Demand Savings for High Efficiency Motors[38]

	Open Drip Proof			TEFC		
Poles	**2**	**4**	**6**	**2**	**4**	**6**
RPM	**3600**	**1800**	**1200**	**3600**	**1800**	**1200**
HP						
1	0.01	0.02	0.02	0.01	0.02	0.02
1.5	0.02	0.03	0.03	0.02	0.03	0.02
2	0.02	0.04	0.03	0.02	0.04	0.03
3	0.04	0.07	0.07	0.02	0.04	0.04
5	0.04	0.07	0.07	0.04	0.07	0.07
7.5	0.05	0.13	0.09	0.05	0.11	0.08
10	0.07	0.15	0.10	0.05	0.15	0.10
15	0.07	0.20	0.15	0.08	0.14	0.15
20	0.11	0.26	0.19	0.11	0.26	0.20
25	0.12	0.31	0.21	0.12	0.19	0.21
30	0.14	0.33	0.23	0.14	0.23	0.26
40	0.18	0.28	0.28	0.18	0.28	0.28
50	0.20	0.48	0.35	0.20	0.48	0.35
60	0.23	0.53	0.34	0.23	0.68	0.34
75	0.29	0.42	0.43	0.29	0.61	0.43
100	0.39	0.81	0.56	0.32	0.56	0.56
125	0.40	0.70	0.70	0.39	0.70	0.70
150	0.48	0.74	0.84	0.47	0.74	0.74
200	0.62	0.98	1.12	0.49	1.47	0.98

Other input assumptions include effective useful life and incremental cost of premium efficiency motors over standard efficiency motors.

[38] Schneider Electric, "NEMA Premium Motors Calculator," http://www.squared.com/us/squared/corporate_info.nsf/unid/8D5454AA2CDA4F6D852570520067E686/$file/nemamtrdatacal.htm

Motor EULs are assumed to be dependent on motor size and were drawn from a study conducted by the ACEEE.[39]

- 1-5 hp: 17 years
- 6-20 hp: 19 years
- 21-50 hp: 22 years
- 51-200 hp: 28 years

Incremental costs are a function of motor enclosures, number of poles, RPM and HP. With these inputs, incremental cost is charted based on US Department of Energy's MotorMaster+ International Software - the most recent international version of the software.

No Coincident Diversity Factor (CDF) is used in calculating energy savings, which is equivalent to a CDF value of 1.0. By not including CDF, the savings equation will consistently overstate savings, as any system with redundancy has a CDF of less than 1.

Conclusions & Recommendations

Moving forward, Summit Blue recommends the development of OPA-specific CDFs to more accurately characterize motor savings based on operating characteristics.

Agricultural Efficiency Technologies

Agricultural efficiency technologies incented by the Electricity Retrofit Incentive Program, and covered by this review, include:

A. Ventilation Exhaust Fans

B. Recirculation Ventilation Fans

C. Dual Natural Ventilation

D. Swine Creep Heat

E. Low Energy Livestock Waterers

Ventilation Exhaust Fans

The OPA demand reduction program incentivizes high efficiency ventilation exhaust fans and ultra high efficiency ventilation exhaust fans. Qualifying fans are 18"-53".

[39] American Council for an Energy-Efficient Economy (ACEEE), *Impact of Proposed Increases to Motor Efficiency Performance Standards, Proposed Federal Motor Tax incentives, and Suggested New Directions Forward*, June 2007.

Savings Algorithms

The algorithms used to estimate annual energy savings for each exhaust fan measure is provided below:

$$Annual\ Energy\ Savings\ (kWh) = Hours \times \sum_{u}^{N} [(kW_{fan\,u,b} - kW_{fan\,u}) \times Fan_u]$$

Where:

$kW_{fan\,u}$ = Demand per fan for usage group *u*

$kW_{fan\,u,b}$ = Baseline demand per fan for usage group *u*

Fan_u = Quantity of affected fans for usage group *u*

$Hours$ = Annual operating hours for usage group *u*

Annual Operating hours and demands are provided in Table 2-11.

Table 2-11. Hours and Demand for High Efficiency Fans[40]

Fan Size	Annual Operating Hours	Baseline (kW)	Demand (kW)
18",24"	2,804	0.375	0.321
36", 48", 50"-53"	1,342	0.852	0.75

While the Agribusiness Worksheet[41] and Incentives differentiate between high efficiency and ultra high efficiency fans, the savings calculations[42] do not. All savings are based on high efficiency fans which may significantly understate savings.

Conclusions & Recommendations

Currently, the savings for ultra high efficiency ventilation fans may be understated. Summit Blue recommends disaggregating demand savings for ultra high efficiency fans in future program cycles.

40 Agvior Inc., dm_assumptionsmeasurelist_Agviro2005AnnualEdit.pdf.
41 Ontario Power Authority, *Every Kilowatt Counts ERIP Agribusiness Worksheet*.
42 Ontario Power Authority, *Retrofit Incentive Programs M&V Methodologies for Various Programs*.

An alternative method for estimating the energy savings attributed to agricultural fan retrofits involves the use of the fan affinity laws. More specifically, the affinity laws state:

$$P_1 / P_2 = (q_1 / q_2)^3$$

Where:

q = volume flow capacity (CFM)

P = power (Watts)

The cubed relationship is representative of ideal situations and is generally adjusted to 2.5 to reflect system inefficiencies.

Recirculation Ventilation Fans

The program incentivizes recirculation ventilation fans. Recirculation ventilation fans high volume low speed (HVLS) are vertical ceiling mounted fans with a diameter of 8".

Savings Algorithms

The algorithms used to annual energy savings for each recirculation measure is provided below:

$$Annual\,Energy\,Savings\,(kWh) = Hours \times \sum_{u}^{N} [(kW_{fan\,u,b} - kW_{fan\,u}) \times cfm_u]$$

Where:

$kW_{fan\,u} = \frac{1000}{cfm/watt}$

$kW_{fan\,u,b} = \frac{1000}{cfm/watt}$

cfm_u = capacity of affected fans for usage group *u*

$Hours$ = Annual operating hours for usage group *u*

The following assumptions were used in the savings algorithm.

Annual Operating Hours are assumed to be 2,928.

Baseline fans operate at 17.6 CFM/Watt

HVLS fans operate at 200 CFM/Watt

Conclusions & Recommendations

Summit Blue finds the algorithms and assumptions to be accurate and does not recommend any modifications to the OPA's PIAs at this time.

Dual and Natural Ventilation

Natural and dual ventilation systems are included in the program. These incentives are paid per unit of ventilated area or animal. The application does not differentiate between dual and natural ventilation.[43]

For natural ventilation, no fans are used. Instead, facilities are modified to include passive systems such as chimneys and side wall openings. For dual ventilation, fans are used for ventilation during cold weather only and rely on passive ventilation the remainder of the year.

Savings Algorithms

The algorithms used to annual energy savings for each natural or dual ventilation system:

$$Annual\ Energy\ Savings\ (kWh) = \sum_{u}^{N} [(kW_{fan\,u,b} - kW_{fan\,u}) \times Hours \times B_u]$$

Where:

$kW_{fan\,u}$ = Demand per usage group *u*

$kW_{fan\,u,b}$ = Baseline demand for usage group *u*

B_u = Quantity of animals or greenhouse area in usage group *u*

$Hours$ = Annual operating hours for usage group *u*

Assumed hours and ventilation fan demand are listed in the OPA literature.

[43] Ontario Power Authority (OPA), *Every Kilowatt Counts ERIP Agribusiness Worksheet.*

Table 2-12. Hours and Demand for Dual Ventilation Fans[44]

Usage Group	Base Hours	Reduced Hours	Baseline Demand (kW)	Demand (kW)
Egg layers	8,760	0	0.4 W/ 1000 birds	0.4 W/ 1000 birds
Chicken Broilers	8,760	0	0.34 W/1000 birds	0.34 W/1000 birds
Turkeys	8,760	0	1.130 W/1000 birds	1.130 W/1000 birds
Swine (Breeding & Gestation)	8,760	0	0.017 W/swine	0.017 W/swine
Swine (Growing & Finishing)	8,760	0	0.005 W/swine	0.005 W/swine
Dairy (Year round housing)	8,760	0	0.035 W/cow	0.035 W/cow
Dairy (Winter housing only)	4,380	0	0.035 W/cow	0.035 W/cow
Greenhouse- vegetation	8,760	0	0.55 W/1000 m^2	0.55 W/1000 m^2
Greenhouse- Flowers	8,760	0	1.26 W/1000 m^2	1.26 W/1000 m^2

Conclusions & Recommendations

Currently, savings for dual exhaust ventilation systems are overstated. According to the OPA documentation, low energy hours are assumed to be zero in all cases, assuming that all systems are natural exhaust systems. However, dual system fans will be used during the winter months and are currently not accounted for in the savings algorithms. A range of estimates for winter operating characteristics can be found through secondary literature. More specifically, The Agviro Study[45] claims savings for dual systems are 80% of baseline, corresponding to 1,752 annual operating hours. Summit Blue recommends incorporating winter usage patterns into the savings algorithms for dual systems in future program cycles.

Swine Creep Heat

Creep heat measures covered by the program are:

- Heat mats less than 100W

[44] Ontario Power Authority, *Retrofit Incentive Programs M&V Methodologies for Various Programs*.
[45] Agviro Inc., *On-Farm Energy Audit Program*, January 2006.

- Diode switches for heat lamp control
- Dimmer switches or triac for heat lamp control
- High temperature cut out for heat lamp control

Due to the differing mechanisms for energy savings, a consistent savings algorithm was not used. Heat mats, controls and cut-outs each require a unique algorithm. All creep heat measures are compared to a baseline of one 175W heat lamp operating at 5,838 hours per year.

Savings Algorithms (Creep Heat Mats)

The algorithm used to calculate annual energy savings for each creep heat mat is provided below:

$$Energy\,Savings\,(kWh) = Hours\,(kW_{lamp} - kW_{mat})$$

Where:

Hours = Annual Operating hours = 5838 hours per year

kW_{lamp} = Demand of baseline lamp = 175 W

kW_{mat} = Demand of standard mat = 60 W

Double sized heat mats are treated as two mats and replace two baseline lamps.

Savings Algorithms (Diode Switch Controllers, Dimmers Switches and Triac Controllers)

Heat Lamp controllers allow for automatic or manual adjustment of heat lamps in swine furrowing applications. The algorithm used to calculate annual energy savings for each creep heat controller is provided below:

$$Energy\,Savings\,(kWh) = (Hours \times kW_{lamp}) - [\frac{2}{3}\,Hours\,(kW_{lamp} \times .5) + \frac{1}{3}\,Hours \times kW_{lamp}]$$

Where:

Hours = Annual Operating hours = 5838 hours per year

kW_{lamp} = Demand of baseline lamp = 175 W

Studies have shown that the lights are switched to 50% power during the 2nd and 3rd week of piglets' life.[46]

Savings Algorithms (High Temperature Cut-out)

High Temperature Cut-out controllers are thermostat based controllers for swine heat lamps. The thermostat turns the lamp off in the event that the temperature exceeds 60 degrees Celsius. The algorithm used to calculate annual energy savings for high temperature cut outs is provided below:

[46] Agviro Inc., *On-Farm Energy Audit Program*, January 2006.

$$Energy\,Savings\,(kWh) = (Hours - Hours_{co})\,kW_{lamp}$$

Where:

Hours = Summer Operating hours = 1,564 hours per year
$Hours_{co}$ = Summer Operating hours with cut out = 820 hours per year

kW_{lamp} = Demand of baseline lamp = 175 W

The algorithm assumes summer temperatures enable reduction in need for heat lamps from 1,466 hours per summer to 820 hours per summer.[47]

Conclusions & Recommendations

Summit Blue finds the savings calculations for Swine Creep Heat measures to be accurate and does not recommend any changes at this time.

Low Energy Livestock Waterers

Low Wattage water warmers completely insulated with 2" rigid insulation are also included through the Electricity Retrofit Incentive Program. These water heaters must be no larger than 300W.[48]

Savings Algorithms

The algorithms used to calculate annual energy savings for each livestock waterer is provided below:

$$Energy\,Savings\,(kWh) = Hours\,x\,(kW_{base} - KW_{ee})$$

Where

Hours = Annual Operating hours
kW_{base} = Demand of base water heaters (1,500 W)

kW_{ee} = Demand of energy efficient water heaters (300 W)

Conclusions & Recommendations

Summit Blue finds the savings calculations for Low Energy Livestock Waterers to be accurate and does not recommend any changes at this time.

[47] Agviro Inc., *dm_assumptionsmeasurelist_Agviro2005AnnualEdit.pdf.*
[48] Ontario Power Authority, Every Kilowatt Counts *ERIP Agribusiness Worksheet.*

2.3 M&V Methods

The Summit Blue Team conducted a review of the current M&V methods and processes used in OPA programs. M&V is used to establish that the measures have been installed and operating as expected. The goal of this task was to study M&V procedures to identify gaps and make recommendations for improvement. The appropriate level of rigour employed in the verification of project savings is a direct function of several factors including, but not limited to, the complexity of measures, project benefits versus cost (relative impact on the portfolio), interactive effects, uncertainty in the raw data and variance in the savings levels compared to the baseline. Clear definition of M&V methods with the optimum level of rigour is vital for reporting energy savings. The M&V methods used by OPA programs need to be rigourous, but cost effective.

2.3.1 Approach

The approach used was to interview program staff and other third party evaluators to understand the current M&V practices used in individual programs. The feedback from staff was compared to the observations from the impact evaluation of project samples. Recommendations were then refined by comparing program methods with the best practices of other jurisdictions.

The review of OPA's programs indicated that several programs adhere to the International Performance Measurement and Verification Protocols (IMPVP). In many cases, however, the IPMVP is either not clearly followed or the processes are not clearly defined. For example, several large projects with higher degrees of uncertainty are completed under the prescriptive path of IPMVP, which uses generic savings estimates. This leads to inaccuracies in the reported savings. In addition, in some cases, the M&V methods are not standardized for either the prescriptive or custom paths. While very large projects with the greatest impacts are evaluated at a higher level of rigour, there is less focus on projects that are slightly smaller and have a significant level of savings with high uncertainty. The latter projects may warrant a higher level of rigour.

2.3.2 Results

Each section below contains a table showing the key observations followed by conclusions and recommendations for each program. The observations and recommendations are derived from the interviews conducted with program staff and the engineering analyses conducted on the project samples. A total of eight interviews were completed with key LDC personnel for the ERIP program. For the BOMA CDM program, key program staff and third party program evaluators were interviewed. For the BIP and BBP-EB programs, interviews were completed with the program development managers. Several key points were studied including process efficiency, M&V compliance, costs, threshold definitions, and quality of data.

BOMA CDM

For the BOMA CDM program the Summit Blue Team interviewed the program development manager and the three independent project evaluators to understand the M&V procedures followed at the project level. Several points were studied including M&V compliance, costs, thresholds and levels of rigour employed for projects in different size groups. Table 2-13 shows the key observations.

Table 2-13. Key Observations on M&V Methods and Procedures for BOMA CDM

Issues	Observations
Process Efficiency	Program Evaluators suggest requiring the applicants to provide an electronic copy of the spreadsheets used to determine the energy savings with associated inputs and assumptions.
M&V Methodology	BOMA CDM M&V protocol was developed from the IPMVP. The M&V approach varies significantly between projects. In several cases inspections only consist of visual verification, with spot measurements in some cases. Short term metering is rarely conducted. IMPVP Option A is the one most widely used. In some circumstances Option B is followed.
M&V Compliance	M&V procedures vary significantly between projects and evaluators.
M&V Cost	A four tier approach is used to determine M&V method. - 1st tier M&V budget is not defined - 2nd tier M&V budget is $2,375. - 3rd and 4th tier budgets are $4,750.
Thresholds	First Tier: Less than $5,000 incentive amount (less than 12.5 kW or 100,000 kWh) - no M&V preformed, review performed by program staff. Second Tier: Between $5,000 and $10,000 incentive amount (12.5 - 25 kW or 100,000 - 200,000 kWh) - Pre-installation inspection, no metering. Third Tier: Between $10,000 and $20,000 incentive amount (25 - 50 kW or 200,000 - 400,000 kWh) - Pre and post installation inspections, no short term metering required, spot measurements may be performed if deemed necessary Fourth Tier: Over $20,000 incentive amount (over 50 kW or 400,000 kWh) - Pre and post installation inspections, spot measurements are done, and short term metering is conducted in some cases.
Accuracy and Level of Detail of Data Reporting	Reports with all data are prepared for OPA
Quality of On-Site Data Collection and Logging	Spot measurements are performed for projects over the 50 kW threshold. Short term metering is rarely done. Data collection activities vary significantly by project and evaluator. Records of data collected and logged are well maintained. For lighting retrofits, logging of operating hours is not done.

The M&V methods followed by the BOMA CDM program are based on the IPMVP and adhere to industry standards. However, there seems to be a lack of compliance in some cases. For example, projects over the 100 kW threshold are required to follow an enhanced M&V approach which involves ongoing metering. However, the Summit Blue Team noted that several sampled projects did not follow this protocol or the baseline determination was not clear. In these cases, only spot checks were performed on a limited number of control points. The program does not provide guidelines on when spot checks are sufficient and when short term or seasonal metering may have been more appropriate. Project evaluators

specified that short term or seasonal metering is generally not performed unless it is a special situation, such as requested by the applicant. The reasons cited include:

- It is not required by the program protocol;
- During the pre retrofit application stage applicants are eager to move on to the next step in project;
- It is deemed not cost effective by the project evaluator; and
- Chiller projects that are evaluated outside of the cooling season are difficult to meter.

The Summit Blue Team recommends program administrators require project evaluators to log end use parameters in cases where variations are expected, including chiller retrofits, VSD installations, and other complex custom installations.

A tiered approach is used by project evaluators to categorize projects by an incentive threshold. A tiered approach is an excellent way to control M&V costs. However, the Summit Blue Team noted that while short term metering is required for the Fourth Tier projects (refer to Table 2-13 for details), no additional funding is provided compared to the third tier where no short term metering is required. This has possibly contributed to the preference for spot metering over short term or seasonal metering. The allocated M&V costs for the Fourth Tier projects (approximately $4,750 for both due diligence verification and metering) are low. The projects in this Tier are large projects with significant impacts and greater variation in end use parameters. The Summit Blue Team recommends BOMA consider increasing the M&V budgets in this Tier to allow a greater focus on metering activities.

The Summit Blue Team and project evaluators noted that documentation received by project evaluators does not always include clean and credible information defining the specifications of the original energy consuming equipment and the specifications of equipment proposed for replacement. Project evaluators spend considerable time pursuing additional information from the applicant and this limits their ability on accurately assessing the baseline within the allocated budget. The Summit Blue Team recommends that the BOMA CDM program require clear documentation of the baseline equipment (nameplate, size, efficiency, operating hours, seasonal load variations, etc.).

The Summit Blue Team found that the retrofit measure information listed in the project application file was difficult to align with the contractor invoices. This complicated the evaluation process as it was not always clear whether or not changes had been made to the scope of the project. The Summit Blue Team recommends future program cycles to standardize the project application and invoice nomenclature.

The Summit Blue Team also experienced difficulty identifying the algorithms used to develop project level savings estimates. Similarly, the input assumptions for both the pre- and post-installation conditions were not always provided. In the interest of optimizing the accuracy and efficiency of M&V efforts, the Summit Blue Team recommends the program require detailed calculation spreadsheets to be submitted with project application.

ERIP

For the ERIP, the Summit Blue Team interviewed the eight largest LDCs to gain a better understanding of M&V rationale and rigour. Table 2-14 shows the key observations.

Table 2-14. Key Observations on M&V Methods and Procedures for ERIP

Key Issues	Observations
Process Efficiency	The program needs to improve the clarity of the M&V guidelines. LDCs should be incorporated into the M&V process at an earlier stage to make sure they are meeting expectations.
M&V Methodology	Prescriptive While all evaluators conduct post-installation site visits, only a quarter conduct pre-installation site visits as well. Due diligence includes verification of project documentation and nameplate verification Custom While all evaluators conduct post-installation site visits, only half conduct pre-installation site visits as well. M&V for custom projects is more detailed, but end-use metering is rarely performed.
M&V Compliance	Evaluators feel that the OPA is responsible for all M&V and that they are going above and beyond any "requirements"
M&V Cost	5-13% of incentive costs. Custom projects can cost nearly twice as much to verify as prescriptive projects.
Thresholds	Generally 90+% of projects verified are custom projects due to their unique nature. Threshold drivers are: size of project (kW), amount of incentive ($), and sometimes a random sample. Program should standardize methods and establish thresholds to identify level of rigour by project type and size. Greater focus is required on the mid level custom and large prescriptive projects where greater uncertainty is expected and relative impact on the program population is significant.
Accuracy and Level of Detail of Data Reporting	Comprehensive and accurate project applications.
Quality of On-Site Data Collection and Logging	For prescriptive projects spot measurements and logging are not conducted. Spot measurements and logging are conducted by only a few LDCs for custom projects. Both Prescriptive and Custom projects spend most of the verification resources confirming that applications are accurate and custom project calculations are reasonable. Site visits focus on collecting nameplate data, discussions of input assumptions, and inventory counts.

The Summit Blue Team found that the M&V methodologies used to confirm savings estimates varied across prescriptive and custom projects. Although all LDCs interviewed conducted post-installation site visits on a subset of prescriptive and custom projects, the evaluation rigour and quantity of information collected differed between the two project categories.

- *Prescriptive Projects:* At a minimum, all LDCs verified that project application data conformed to program requirements (e.g., measures installed, quantity incentivized, etc.). Operating characteristics were generally confirmed through participant interviews, and post-installation site visit activities included a visual inspection of measure inventory and installation quality. It should be noted that one of the LDCs adopted a much more comprehensive approach to verifying project savings which included end-use metering, spot measurements, and pre-/post-installation photographs. However, this information was not collected for auditing purposes. Instead, it was used to support the LDC's internal market research and identify opportunities for revenue growth. One other LDC conducted pre-installation site visits to support the completion of the project application process - not to verify baseline characteristics.
- *Custom Projects:* The verification approach adopted by the LDCs for custom projects was generally more rigourous and included, at a minimum, all of the verification components of prescriptive projects. Four of the eight LDCs interviewed conducted pre-installation site visits to confirm measure applicability and baseline characteristics. Similarly, all of the LDCs conducted in-depth post-installation site visits to ensure that savings estimates and input assumptions were representative of post-installation operating conditions. In addition, to verify the measure quantity and quality of installation for custom projects, the LDCs would also attempt to verify key performance influencing variables and potential interactive factors that could impact realized savings. And while only one LDC conducted end-use metering on a subset of prescriptive projects, two of the LDCs interviewed confirmed the use of end-use metering and spot measurements to support the verification of custom project savings.

The Summit Blue Team also observed notable differences in the criteria used to determine the distribution of M&V activities across prescriptive and custom projects.

  - *Prescriptive Projects:* In general, the factors that influenced verification efforts for prescriptive projects included project size (e.g., peak demand reduction), project incentive (e.g., $6,000 - $8,000), and oftentimes, a random distribution.
  - *Custom Projects:* Due to their unique nature, coupled with the limited number of applications relative to prescriptive projects, a majority of LDCs verified 90% of custom projects.

The Summit Blue Team recommends the ERIP use a tiered approach to categorize projects by measure type and size (incentive thresholds). The projects with greater impact and higher uncertainty should follow an enhanced approach. Such projects should ideally follow a custom path where pre- and post-retrofit scenarios are carefully studied. Projects under the custom path above a certain threshold (e.g., $10,000 incentive) should require short-term pre- and post-metering/logging of operating parameters.

The Summit Blue Team also investigated LDC M&V costs. Due to the sensitive nature of the information requested, care was taken to characterize costs as a function of project incentives paid.

- *Prescriptive Projects:* In general, acceptable cost thresholds expressed by the interviewed LDCs ranged from 5 – 13% of project incentives. Averaging the responses yielded an M&V cost of approximately 8%.
- *Custom Projects:* The LDCs unanimously agreed that because of the unique nature of custom projects, M&V costs were substantially higher than that of their prescriptive counterparts. One

LDC stated that cost of verifying custom project savings was twice that of prescriptive projects. Averaging the responses received yielded an M&V cost of 12%.

Throughout the interview process, the Summit Blue Team received consistent feedback regarding opportunities for improvement in the M&V process. The most notable comments included:

- *Improve the Clarity of M&V Guidelines:* Many of the LDCs were unclear of their responsibilities relative to measurement and verification.
- *Photographs of Installed Technologies and Applications Yield Useful Evaluation Information:* At least two of the LDCs interviewed felt that photographs of installed measures could provide information on installation quality, quantity, and performance metrics (e.g., nameplate data). Additionally, the LDCs believed that the photographs could be leveraged to gain a better understanding of measure installation conditions and participant contextual data.
- *Incorporate/Inform the LDCs of M&V Activities as Early as Possible in the Program Cycle:* Many of the interviewees felt it would be beneficial to incorporate, or at least notify, the LDCs of the M&V process at an earlier stage of the Program cycle. This effort would improve the quality and quantity of project information kept, and guide the information collected during the inspection efforts.

BIP

For the BIP, the Summit Blue Team interviewed the Toronto Hydro program manager to understand M&V methods and procedures. The program manager indicated that all M&V activities and due diligence task are completed in-house by the Toronto Hydro M&V engineer. Table 2-15 shows key observations.

Table 2-15. Key Observations on M&V Methods and Procedures for BIP

Key Issues	Observations
Process Efficiency	M&V is completed in-house by the M&V engineer. Logged data is not retained Program needs to standardize the documentation across projects. Currently, documentation is retained only on the projects with greater impact.
M&V Methodology	BIP M&V protocols are based on the IPMVP Typically IMPVP Options A and B are followed. M&V approach varies significantly between projects. In several cases baseline is not well established and post retrofit verification only includes visual verification and spot measurements in some cases. Short term metering is not conducted
M&V Compliance	M&V procedures vary significantly between projects
M&V Cost	Program does not track M&V costs. M&V is done in house by the M&V engineer
Thresholds	A tiered approach is used based on the engineer's judgment Program should standardize methods and establish clearly defined thresholds to identify level of rigour by project type and size
Accuracy and Level of Detail of Data Reporting	Baseline and retrofit inventories are well maintained in some cases, such as occupancy sensor installations. Most lighting retrofit projects maintain good documentation on equipment inventories and specifications.
Quality of On-Site Data Collection and Logging	Baseline M&V is conducted only for non standard measures and in such cases cut sheets are retained, load profiles are studied and seasonal variations are taken into consideration Spot measurements are conducted when appropriate but there is no short term metering activity. For lighting retrofits, logging of operating hours is not done, irrespective of project size and type

The Summit Blue Team observed that while detailed inventories are retained on large projects with non-standard measures (e.g., non-standard VFD installations, motor replacements, etc.), the majority of projects with standard measures lack adequate documentation on baseline and retrofit end use equipment. The Summit Blue Team recommends the BIP program standardize the documentation procedure across all projects.

The BIP M&V protocol is based on the IPMVP and does adhere to the standard. All large projects are required to follow either Options A or B of the IPMVP. The Summit Blue Team, however, noted several compliance issues.

- The M&V approach chosen varies widely from project to project.
- There is a lack of focus on short term and seasonal metering of end use parameters.
- The baseline and retrofit energy use, in most cases, is calculated using equipment nameplate information and stipulated operating hours.
- Spot measurements are conducted in some cases, but again this is not standard across all projects.

The Summit Blue Team recommends THESL consider the following modifications to the M&V procedures:

- *Establish Clear Thresholds for M&V Activity.* The Summit Blue Team recommends the BIP program standardize the M&V process by establishing thresholds (incentive or project size) to enable a greater focus on projects with greater uncertainty.
- *Increase Lighting Project Attention to Detail.* The Summit Blue Team recommends the BIP program increase the level of M&V rigour on lighting projects. Lighting projects are evaluated using spot checks and operating hours are not logged for any project size or space type. Although it is not cost effective to log operating hours on all lighting projects, the level of rigour should be increased to reduce variance in expected versus achieved results (e.g., distinguish between lighting retrofits in a convention center, conference rooms, hallways, classrooms or offices).

BBP-EB

For the BBP-EB program, the Summit Blue Team interviewed the BBP-EB program development manager to gain a better understanding of M&V rationale and rigour. Table 2-16 shows the key observations.

Table 2-16 Key Observations on M&V Methods and Procedures for BBP-EB

Key Issues	Observations
Process Efficiency	Recently implemented a tiered approach for small and medium size projects (less than 50 kW). Program wants to create a catalog of energy use and schedule parameters for typical measures by building type.
M&V Methodology	M&V procedures are based on the IPMVP. Typically Options A and B are followed.
M&V Compliance	M&V procedures vary by project evaluator.
M&V Cost	The program has recently started using thresholds to allocate costs by project size. It is too early to break out costs by tier.
Thresholds	5% of projects less than 4 kW or 40,000 kWh receive a post-retrofit evaluation by a project evaluator 10% of projects between 4 kW or 40,001 kWh and 10 kW or 100,000 kWh get a post-retrofit evaluation by a project evaluator. 10% of projects between 10 kW or 100,001 kWh and 50 kW or 500,000 kWh undergo both pre and post-retrofit evaluation by a project evaluator. All projects larger than 50 kW or 500,000 kWh are evaluated using an enhanced M&V approach by a third party project evaluator.
Accuracy and Level of Detail of Data Reporting	Reports with equipment inventories for baseline and post retrofit equipment are documented. All spot measurements and short term logged data are documented.
Quality of On-Site Data Collection and Logging	Spot measurements are performed for enhanced M&V projects (over 50 kW threshold). The project evaluators decide what is measured and how it is measured, but M&V protocol is followed. Data collection varies by project.

The BBP-EB M&V protocol is based on the IPMVP and adheres to the standard. All large projects are required to follow either IMPVP Options A or B. However, the team noted several compliance issues.

- The M&V approach chosen varies widely between projects and project evaluators.
- There is a lack of focus on short term and seasonal metering of end use parameters.
- The baseline and retrofit energy use, in most cases, is calculated using equipment nameplate information and stipulated operating hours.
- Spot measurements are conducted for projects over 50 kW, but there seems to be a lack of standardization.

The Summit Blue Team recommends increasing the level of rigour for projects greater than 50 kW with more focus on short term and seasonal metering of end use parameters especially when the expected uncertainty is high (e.g., chiller retrofits with high end use variations, VFD installations, lighting retrofits is convention centers etc.).Since the BBP-EB program focuses on the public sector, there is less variation in the type of retrofits completed through program. Therefore, program staff want to create a catalog of energy use and operating parameters by measure for typical building types. While using standard input parameters by space type will be useful in maintaining a consistent approach between projects, project evaluators should study the variations in end use parameters on a case by case basis and meter key variables when the expected uncertainty is high.

The Summit Blue Team noted that comprehensive equipment inventories were retained by program staff and project evaluators for all project samples. In some cases, it was observed that changes to the scope of work (if any) were not properly documented. Project administrators should require customers to provide adequate documentation for any changes to the scope of work and project evaluators should revise savings estimates and conduct additional M&V activities (if necessary) for accurate assessment of the project impacts.

2.3.3 Protocols/Guidelines in Other Jurisdictions

A study done in 2007 for the CPUC[49] provides a snapshot of evaluation, measurement and verification (EM&V) protocols and guidelines across North America. The OPA programs are based on the IPMVP which is what is most commonly used in other jurisdictions. According to the author, "All respondents reported using at least one EM&V protocol or guideline document, and many reported using several, although some are not required to do so. The requirement of EM&V protocol or guideline documents did not appear to correspond to the type of program/portfolio evaluated, but rather more to the general evaluation philosophy, available funding and region's overall level of commitment to energy efficiency as indicated by the history of, scope of and funding provided for programs and related legislative activity. Most respondents indicated a belief in the need to accurately measure, verify and evaluate program results, but many felt limited by the amount of resources available to conduct EM&V." Table 2-17 below is an excerpt of the table from the report showing EM&V protocol and documents used and required in various jurisdictions across North America.[50]

[49] Source: Schiller, S. Survey Of Energy Efficiency Evaluation Measurement And Verification (EM&V) Guidelines And Protocols: An Initial Review of Practices and Gaps and Needs, May 2007

[50] Table based on survey responses and secondary source documents including a NEEP report on EM&V protocols in the Northeast US (NEEP 2006) and the 2006 National Action Plan for Energy Efficiency (US EPA 2006).

Table 2-17. EM&V Protocol/Guideline Documents Used and Required

Protocol/Guideline Document	% of Respondents Reporting Use	States Requiring Use
2002 International Performance Measurement and Verification Protocol (IPMVP)	58%	New York (for commercial performance program), Texas (note: the following states refer to IPMVP, but do not require it: Idaho, Montana, Oregon, Washington) Also required by the Ontario Emission Trading Code for EE set aside credits
2006 California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals	50%	California (IOUs for post-2005 energy-efficiency activities)
2004 California Evaluation Framework	46%	
2001 [California] Framework for Planning and Assessing Publicly Funded Energy Efficiency Programs	29%	
CADMAC Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs, including its Appendix J: Quality Assurance Guidelines for Statistical, Engineering, and Self-Report Methods for Estimating DSM Program Impacts Models (last revised in 1998)	25%	California (IOUs) – initially adopted by CPUC Decision 93-05-063, with subsequent revisions pursuant to Decisions 94-05-063, 94-10-059, 94-12-021, 95-12-054, 96-12-079, 98-03-063 and 99-06-052
Northwest Regional Technical Forum (RTF) documents	17%	
Technical Reference Manual (TRM) (prepared by Vermont Energy Investment Corporation)	17%	Vermont
1999 Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification of Energy-Efficiency Projects for Climate Change Mitigation (prepared by LBNL for US EPA)	13%	
2004 Protocols to Measure Resource Savings (New Jersey Clean Energy Program)	8%	New Jersey
ASHRAE Guideline 14	8%	
US DOE FEMP Guide V 2.2	8%	
WRI/WBCSD GHG Protocol for Project Accounting	8%	
2005 Program Savings Documentation (PSD) (prepared as part of C&LM plan filing)	4%	Connecticut
2006 US Dept of Energy EERE Guide for Managing General Program Evaluation Studies	4%	
2006 Protocols for Estimating the Load Impacts from DR Programs	4%	
1991 Impact Evaluation of Demand-Side Management Programs; Volume 1: A Guide to Current Practice	4%	

2.3.4 Best Practices for Future EM&V Cycles

The term "Best Practice" refers to the business practices that, when compared to other business practices, produce superior results. In the context of this report, best practices represent methods, procedures, and protocols that maximize the accuracy and statistical validity of evaluation findings. More specifically, the objective of this discussion is to define and characterize best practices in EM&V that can be generalized and have a high likelihood of transferability to other evaluations within, or across, different program categories.

The best practices identified in the subsequent sections have been compiled through in-depth interviews with program managers in other jurisdictions, a thorough review of secondary literature, a comparison of different program features and outcomes, and past evaluation experience. The specific resources reviewed in the development of these findings are provided below.

Table 2-18. Best Practice Studies and Relevant Literature Reviewed

Organization	Study Name	Year of Publication
State of California, Public Utilities Commission	Best Practices Benchmarking for Energy Efficiency Programs[51]	2009
Enbridge Gas Distribution	DSM Best Practices for Natural Gas Utilities: the Canadian Experience	2008
Consortium for Energy Efficiency	Energy Efficiency Program Evaluation: A Guide to the Guides	2008
Minnesota Office of Energy Security	Measurement and Verification Protocols for Large Custom CIP Projects - Version 1.0	2008
Northern California Power Agency	E, M &V Best Practices: Lessons Learned from California Municipal Utilities	2008
National Action Plan for Energy Efficiency Leadership Group	Model Energy Efficiency Program Impact Evaluation Guide: A Resource of the National Action Plan for Energy Efficiency	2007
State of California, Public Utilities Commission	California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals	2006
State of Wisconsin, Department of Administration, Division of Energy	Focus on Energy Public Benefits Evaluation, Business Programs: Best Practices Report	2003
American Council for an Energy-Efficient Economy	America's Best: Profiles of America's Leading Energy Efficiency Programs	2003

[51] http://www.eebestpractices.com/index.asp

And while each of the studies considered presented valuable insight into best practices within the field of EM&V, Summit Blue's approach to this review involved identifying recommendations with the following characteristics:

- Cross-cutting recommendations with a high level of representation across the different studies;
- Consistency of the recommendations relative to past evaluation experience and interviews with program managers in other jurisdictions; and
- Applicability to the programs evaluated by Summit Blue for the OPA.

What follows are Summit Blue's recommendations to enhance the quality and accuracy of future M&V activities in the BOMA CDM, ERIP, BIP, and BBP-EB program evaluation cycles. These recommendations are:

- Design/adjust programs to support an integrated data collection approach;
- Develop customized tracking systems/ensure the quality of M&V data collected;
- Prioritize/establish M&V activities;
- Apply the appropriate M&V to each project or measure;
- Establish regular/routine M&V schedules; and,
- Leverage EM&V findings to improve savings estimates.

Design/Adjust Programs to Support the Integrated Data Collection Approach

Accurate and reliable evaluations require accurate and complete datasets. The *Integrated Data Collection (IDC) Approach* will help realize the high levels of accuracy and completeness desired of the evaluation effort. The concept of IDC provides a data acquisition process that is designed into the program process flow, and occurs throughout the life of the program. The specific benefits of adopting the IDC approach include:

- *More Reliable Attribution Data* - The IDC approach directly addresses the important "recall" issues that typically arise when a time lag occurs between when a participant interacts with the program and when the program solicits data from those participants. Also, the response rate from participants tends to be higher because data collection occurs during program participation. As a result, data quality is improved because more actors who have been directly engaged with the program can be interviewed. This is especially valuable with smaller samples.

- *Real-Time Attribution Data Feed into Proactive Program Management* - IDC can be highly integrated into ongoing program processes, such as project applications or web-based tools, and yields near real time, actionable data to program staff. Data is continuously being gathered and can be reviewed at any point or frequency during the program operating cycle.

- *Longevity* – When data collection is integrated into program processes, it can be maintained over time with minimal staff effort or cost. This helps to ensure the longevity of the data collection effort.

- *Potential for Greater Depth of Data Set* - Many IDC evaluations involve obtaining a matched set of information. For example, multiple mid-market actors may respond to similar surveys

at several stages of a project. With information on the same project from all market actors, evaluators can do more with the data in terms of identifying inconsistencies, determining key influences, and addressing the true level of savings that are due to the program interventions. Many IDC plans employ a pre- and post-project survey approach which also adds depth to the data. In addition, because IDC surveys occur at or near the time the project occurs, the problem of reaching participants due to staff turnover are greatly reduced.

- *Cost Savings* - When IDC objectives are included in required program documents, such as applications, it results in a 100% response rate at no additional cost. When an IDC survey is conducted via telephone at the time of program intervention it avoids all of the challenging issues associated with phone surveys occurring some time after the project is complete, such as lost contacts due to employee turnover or recall issues that require a highly skilled interviewer spend time refreshing respondents on what was done under the program.

Summit Blue recommends working closely with the LDCs or implementation contractors at the earliest possible stage of program delivery to integrate evaluation-specific data collection into the implementation process. Developing datasets using the IDC approach has proven to be a very cost-effective means of producing the highly reliable evaluation datasets. It should be noted that the concept of an IDC approach dictates that the participation data set should have the following distinct features and requirements:

- The data is complete enough to accurately describe and quantify what measures and technologies were installed and what they replaced.

- The data includes additional explanatory variables needed to characterize how the measures are applied and what the utilization patterns are. In addition to knowing what was installed, it is necessary to know when and how it was used. For example, in order to characterize a lighting retrofit, it is necessary to understand the base technology, the retrofit specifications, operating characteristics, and HVAC interactions.

- The data should be collected and compiled as close to the time of measure implementation as possible to minimize "recall" issues including loss or misinterpreted data. This approach will also maximize a participant's willingness and ability to respond.

- Finally, the data should be collected as systematically as possible so as to assure the greatest consistency across the dataset.

This evaluation philosophy calls for the program implementers to collect basic types of data as part of the delivery of services that are necessary for evaluation while recognizing that certain data can only be collected after service delivery (e.g., installation observations). Properly defining the data needs pre- and post-installation are critical to the successful implementation of the IDC approach.

Most DSM programs fail to take EM&V data needs into account when the program delivery mechanisms are being established. However, with the appropriate framework and foresight, the OPA may preempt this common oversight by developing an evaluation plan for each program based on IDC principles, and assist the LDCs or implementation contractors in developing and fielding basic data collection methods to support the EM&V process. Experience has demonstrated that data collection does not need to be a daunting or onerous task. Often, it is simply a matter of selectively adding to or modifying the information systems that are used for program implementation purposes to ensure that specific data elements are collected and that survey/feedback mechanisms are put in place. However, it is imperative that these procedures be put in place as early as possible in the program implementation process.

As a general guide, the types of measure and system data that are needed for EM&V activities fall into five technical categories:

1. Quantity of measures installed
2. Capacity of measures installed (e.g., lamp wattage for lighting, tons for air conditioning)
3. Efficiencies of measures installed (e.g., SEER/EER for air conditioning)
4. Unique performance features of the measures installed (e.g., variable speed, low-emissivity, construction type)
5. Contextual variables such as building type and square footage, operating hours, and usage/occupancy profiles

Additional information that may be collected to support evaluation activities beyond EM&V includes:

- Data on customer response to program products/services and implementation processes;
- Satisfaction with program offerings;
- Net-to-gross factors such as free-ridership and spillover;
- Response to marketing and communications; and
- Recommendations for program adjustment.

Although measuring free-ridership and spillover can be challenging, there is usually critical information gained about program effectiveness through these analyses. Moreover, in some jurisdictions, net savings estimates are required by the regulatory commission. As such, it is important for the OPA to agree upfront on how results from these analyses will be used, particularly with respect to any performance rewards or penalties for program administrators.

The development of program evaluation plans that support the IDC approach by specifying the need, timing, and quantity of various data collection activities throughout the program implementation process will greatly improve the quality and accuracy of EM&V data collected. The exact type of EM&V data, and rationale for collecting that data, is further discussed in the following sections.

Develop Customized Tracking Systems / Ensure the Quality of M&V Data Collected

The development and use of customized systems for tracking program metrics and results is an industry wide best practice which will support the quality of information collected through the IDC approach. The tracking systems should consolidate program specific data in an organized manner while providing a reliable interface that allows for data access and reporting. The customized program tracking systems can provide a snapshot of information that needs to be collected along with preliminary reports will allow OPA program managers to identify delivery issues, and make mid-course corrections to those issues.

Program specific tracking systems should be developed using database normalization techniques that will minimize redundancy and improve the accuracy of information collected. Queries may be run to identify data outliers that can be further investigated prior to the evaluation process.

Prioritize/Establish M&V Activities

Summit Blue recognizes the budget implications program M&V activities. Given the limited resources available, it is important to prioritize these activities in a way that maximizes the useful information obtained by the M&V effort. Table 2-19, below, details the existing M&V expectations by OPA program:

Table 2-19. M&V Expectations by OPA Program

Program	M&V Procedures
BOMA CDM	A four tier approach is used to determine EM&V method: - 1st Tier: Less than $5,000 incentive amount (less than 12.5 kW or 100,000 kWh) - no M&V preformed, review performed by program staff. - 2nd Tier: Between $5,000 and $10,000 incentive amount (12.5 - 25 kW or 100,000 - 200,000 kWh) - Pre-installation inspection, no metering. - 3rd Tier: Between $10,000 and $20,000 incentive amount (25 - 50 kW or 200,000 - 400,000 kWh) - Pre and post installation inspections, no short term metering required, spot measurements may be performed if deemed necessary - 4th Tier: Over $20,000 incentive amount (over 50 kW or 400,000 kWh) - Pre and post installation inspections, spot measurements are done, and short term metering is conducted in some cases.
ERIP	-Prescriptive: Due diligence includes verification of project documentation and nameplate verification. -Custom: M&V methods are more rigorous but end-use metering is rarely performed.
BIP	A tiered approach is used based on the evaluating engineer's judgment.
BBP-EB	A four tier approach that establishes M&V thresholds by costs by project size: -1st Tier: 5% of projects less than 4 kW or 40,000 kWh receive a post-retrofit evaluation by a project evaluator. -2nd Tier: 10% of projects between 4 kW or 40,001 kWh and 10 kW or 100,000 kWh receive a post-retrofit evaluation by a project evaluator. -3rd Tier: 10% of projects between 10 kW or 100,001 kWh and 50 kW or 500,000 kWh undergo both pre- and post-retrofit evaluation by a project evaluator. -4th Tier: All projects larger than 50 kW or 500,000 kWh are evaluated using an enhanced M&V approach by a third party project evaluator.

Although the M&V thresholds and priorities are fairly well-defined for the BOMA CDM and BBP-EB programs, there is relatively little guidance offered for the ERIP and BIP programs. Interviews with individual LDCs found that many were unclear of their M&V responsibilities, while others felt that the M&V thresholds were not adequately enforced. These responses support Summit Blue's recommendation to further clarify and establish M&V thresholds for each program. In line with this effort, budget guidance and standard reporting metrics, by measure or program, should be developed to minimize the variability in savings estimates and documentation. These metrics should also rely on the specific measure performance parameters that are needed to reliably estimate savings. Ideally, the standardized reporting metrics will feed directly into a customized program tracking system.

The accuracy of EM&V findings is limited by the availability and quality of relevant participant measure data. Past evaluation experience has demonstrated that there are numerous challenges to collecting supporting evaluation data from various participants due to:

- Lack of available project documentation and supporting savings methodologies, and
- Lack of participant support for the impact evaluation process.

In order to leverage the reporting/application requirements to their full potential, Summit Blue recommends future evaluation efforts to closely monitor the quality of project level documentation provided to support the impact evaluation effort, along with the calculation of project level realization rates.

Apply the Appropriate M&V Activity to Each Project or Measure

The greatest accuracy and precision is achieved in an impact evaluation when it is based on an appropriate level of direct field observation, monitoring, and measurement. There are a variety of data collection methods available to the researcher including on-site observations, spot measurements, run-time hour monitoring, and end-use interval metering:

- **Spot Measurements** – Spot measurements are the first and simplest level of on-site performance measurement and include one-time instantaneous measurements of technology, system, or environmental factors including temperature, volts, amperes, true power, power factor, light levels, and other variables. As a general guide, these measures are used to quantify single operating parameters that do not vary significantly over time or are intended to provide a snap-shot in time. They are not intended to capture seasonal or longer term effects. Another way of looking at this approach is that it is useful in assessing the savings of constant performance measures.

- **Run-Time Hour Data Logging** – Run-time hour monitoring represents the second level of performance measurement and is used to record run-time profiles over a given time period or operating hour totals. Run-time hour monitoring is particularly useful for estimating long –term energy consumption from short-term measurements, particularly for technologies which exhibit constant performance characteristics. For example, this method is used extensively for assessing the operating hours of lighting systems and constant load motor systems. Monitoring is conducted with small, portable, simple-to-use monitors that typically hold two weeks to one month's worth of data.

- **Interval Metering** – Interval metering is the most sophisticated level of on-site performance measurement and involves real-time monitoring of the energy use of specific end-uses over a specified time period. This may involve recording true energy use or "proxy" values such as voltage and amperes from which energy used is computed. Interval metering is often used to measure pre- and post-installation performance to obtain an accurate data on measure performance. Typically, this strategy is not deployed over long enough time periods to gauge seasonal effects, so the results of the measurements must be integrated into an analysis model to compute annual and seasonal impacts.

However, on-site data collection is expensive and time consuming, and it is clear that not everything can be measured or monitored. Thus, it is imperative that limited EM&V resources be focused in those areas where knowledge is most limited, data gaps are the greatest, and uncertainty is the highest.

Marshall Keneipp of Summit Blue co-authored an authoritative text on conducting on-site performance measurement.[52] This text presents a best practices approach to assigning field data collection resources to DSM measure assessment by measure/technology performance characteristics. For monitoring purposes, measures within the EM&V sampling frame may be classified as either *constant performance* or *variable performance*:

- **"If *both*** the efficiency ***and*** the output of the technology were constant, the measure is deemed ***constant performance***."

- **"If *either*** the efficiency ***or*** the output of the technology was variable, the measure is deemed ***variable performance***."

A useful construct for thinking about this topic is the IPMVP. This protocol is consistent with the M&V procedures currently adopted by the BOMA CDM, ERIP, BIP, and BBP-EB programs and was most readily recognized during interviews with the OPA program and market actors. Table 2-20 presents a listing of the IPMVP protocols, the nature of the performance characteristics of the measures to which M&V options were applied, and an overview of the data requirements to support each option.

Table 2-20. IPMVP Options and Data Requirements

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations using spot or short-term measurements, and/or historical data.	Constant performance	• Verified installation • Nameplate or stipulated performance parameters • Spot measurements • Run-time hour measurements
Option B: Engineering calculations using metered data.	Constant or variable performance	• Verified installation • Nameplate or stipulated performance parameters • End-use metered data
Option C: Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate regression analysis.	Variable performance	• Verified installation • Utility metered or end-use metered data • Engineering estimate of savings input to SAE model
Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.	Variable performance	• Verified installation • Spot measurements, run-time hour monitoring, and/or end-use metering to prepare inputs to models • Utility billing records, end-use metering, or other indices to calibrate models

[52] EPRI, *End-Use Performance Monitoring Handbook*, 1996.

Going forward, Summit Blue recommends adopting the appropriate IPMVP data collection and evaluation method based on the performance characteristics of the measures verified. Table 2-21 provides an example of how this best practice approach may be applied to different measures incented through OPA's programs:

Table 2-21. Assignment of M&V Protocols to Program Measures

Measure Category	IPMVP Option				Comments
	A	B	C	D	
High-Efficiency Lighting Equipment	✓				Constant performance, low uncertainty in performance parameters
Lighting Controls (Occupancy Sensors)	✓				
Lighting controls (Daylighting)		✓		✓	Can be analyzed with either end-use metered data set or simulation model
Energy Management System			✓		
High-Efficiency HVAC Equipment		✓	✓	✓	Pre-/post-installation metering can be used alone or to prepare inputs to simulation models
High-Efficiency Motors	✓				
Variable Speed Drives		✓			
Building Envelope Measures			✓	✓	

Similarly, there are a variety of analytic methods including hourly building energy simulation models, algorithm-based models, and regression modeling tools, and it is important to apply the appropriate tool to the analysis at hand. Engineering methods are an important part of this tool kit and can provide accurate and reliable results provided that the data sources are good quality and that the baseline models are calibrated to know consumption and demand indices. It is important to note that end-use metering in and of itself is not an analytic method, but rather a data collection method. End-use metered data is used to develop inputs to engineering models or as a primary dataset for regression modeling techniques. The data collected through the EM&V process can further be used for important evaluation research, including:

- Estimating the *load shapes* for the DSM measures installed through the programs, including the coincidence of each DSM measure with peak demand periods.
- Estimating the *long-term persistence* of the program's impacts. This is necessary for the benefit/cost analysis over the life of the measures installed. Less than 100% of the measures' impacts will generally persist over time due to customer removal, tenant or occupant changeover, and other changes.
- Estimating *snapback* effects, which occurs when customers "take back" some of their energy savings in increased service. For example, customers may use their more efficient lighting systems for longer periods than they used their inefficient systems since the new system costs less to operate.

Establish Regular/Routine M&V Schedules

Summit Blue recommends establishing routine M&V schedules (e.g., annually). Evaluating DSM programs and input assumptions on a regular basis is an important best practice as it ensures that all of the programs and their input assumptions are captured over time, avoids duplication of effort by ensuring that programs and input assumptions are not evaluated before such evaluation is necessary, and guarantees that evaluations only take place when there is appropriate data to produce meaningful evaluation results. This recommendation is complimentary to the IDC approach.

Leverage EM&V Findings to Improve Savings Estimates

Because savings from custom measures are intrinsically difficult to estimate, it is important to use ex-post measurements of savings to develop realization rates by end use, measure type, or other key segments, so that program implementers can make appropriate adjustments to their savings calculations. Ex-post results should be well-documented to clearly indicate which specific engineering parameters or operating assumptions were revised for each project so that systematic biases can be identified and corrected. As part of this best practice, the EM&V findings should also be used to calibrate or benchmark prescriptive input assumptions where applicable. This will improve the performance of these programs in future life cycles and ensure that the applicable cost-effectiveness test outputs are accurate.

Best Practice Conclusions

The EM&V best practices characterized in this section should be carefully considered within the context of the individual programs and regulatory cost-effectiveness requirements. And while individual EM&V budgets will ultimately drive the methods adopted, the best practices have been purposely developed to accommodate a broad range of program applications and budget constraints unique to OPA's programs.

On a final note, Summit Blue recognizes that M&V is essential to the successful implementation of DSM programs. Evaluation findings are needed for continual improvement of program design and delivery and can be used to calibrate input assumptions unique to the program service territory. It is Summit Blue's intent that the best practices identified above may be implemented by the OPA to maximize the efficiency and effectiveness of future evaluation cycles.

2.4 Net to Gross Ratio

This section describes the approach to and results of estimating the net to gross ratio.

2.4.1 Approach

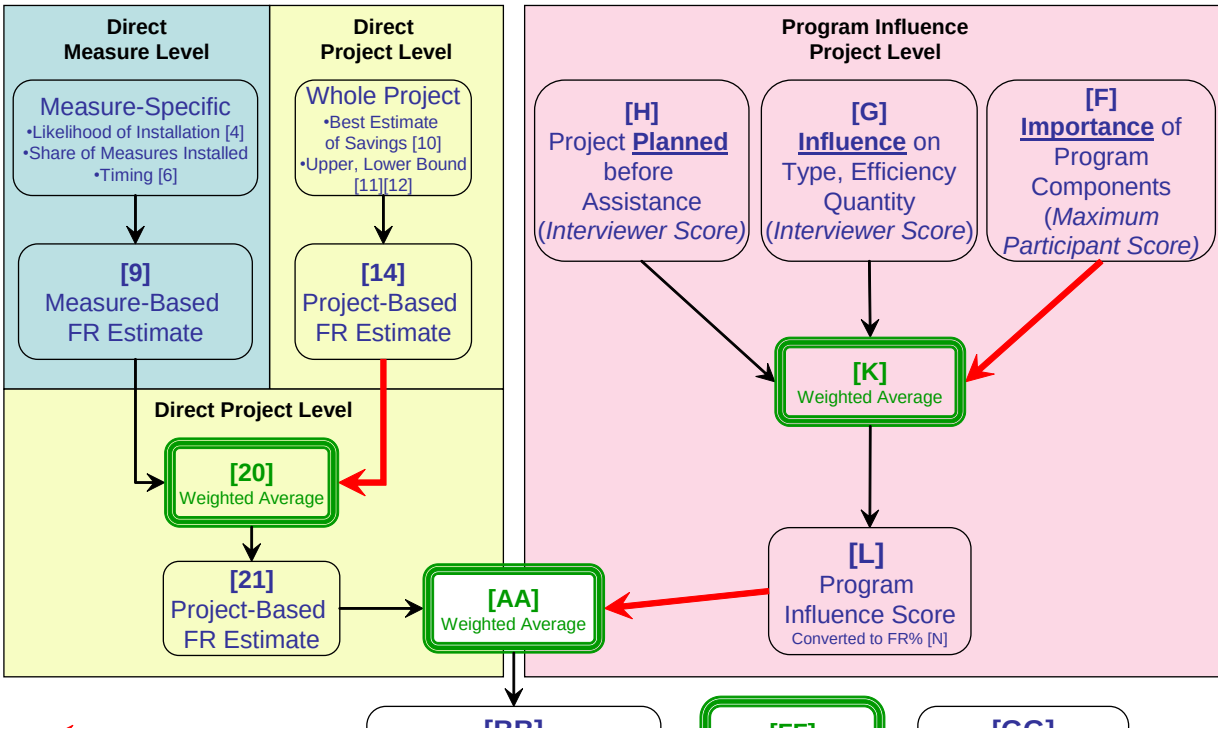
The net to gross ratios for each program were determined by conducting a telephone survey of a sample of participants to assess the influence of the program on customer decisions to take energy efficiency actions. The survey included a battery of questions designed to address both measure-level (direct free ridership) and indirect influence of the programs, as well as spillover, where participants implemented measures that were not incented by the program.

Free ridership and spillover were estimated using data from surveys with participants and interviews with key stakeholders. This approach is based primarily on participant self-reported information from the telephone survey. To address the possibility of respondent bias, the interviews approached each topic from a variety of directions. The interviewer had the discretion to probe for supporting information and the analysis process checks for consistency across answers. Interviewees were promised confidentiality

and assured that their answers will not affect the incentives or support they have received from the program.

Figure 2-5 presents an overview of the survey and analysis approach. Key points in the diagram are labeled with numbers and letters in square brackets, which we will refer to below. Free ridership was discussed with each respondent in both **direct questions** aimed at obtaining respondent estimates of the appropriate (full or partial) free ridership rate to apply to them (represented by the large box on the left side of the diagram), and in **supporting or influencing questions** used to verify whether direct responses are consistent with participants' views of the program's influence on their equipment investment decisions (represented by the large box on the right side of the diagram). The direct questions were asked at the measure level [4] and [6] and at the whole project level [10]. They were then combined into a single, project-level direct free ridership score at [21]. Direct and program influence scores are combined into the final project-level free ridership score at [BB]. That project-level score is weighted by program-reported savings and sample weights [FF] to calculate the final savings-weighted free ridership percentage [GG]. Free ridership results were first calculated on the measure level. The measure-level gross and net savings are summed up across all customers and then net savings were divided by gross savings produces the final savings-weighted, program-wide free ridership result. (Sample weights are applied during the summing step.)

Figure 2-5. Free Ridership Analysis Overview



Source: Custom Projects Attribution Study Prepared for Union Gas Limited and Enbridge Gas Distribution, Summit Blue Canada, July 27, 2008.

Table 2-22 shows some example questions for free ridership (direct and indirect) and spillover.

Table 2-22. Examples of Net to gross Survey Questions

Question Ares	Example Question
Measure-level	If you had not received assistance you received from [PROGRAM SPONSOR] , would you have replaced your existing *[MEASURE CATEGORY]* in the foreseeable future? When would you likely have made these investments if you had not received assistance from [PROGRAM SPONSOR]? *[If clarification needed:]* (Within how many months or years of when you participated in the program?) Overall, across all equipment, that is the entire project, how much of these extra energy savings would have been achieved anyway, even if you had not received the rebate from [PROGRAM SPONSOR]. Please provide a lower and upper bound, and then your best estimate. {
Indirect influence	On a scale of 1 to 5, where 1 = "not at all important" and 5 = "very important"…Please indicate how important each of the following aspects of your experience with THE [INSERT PROGRAM] were in your decision to install energy efficient equipment at your facility? How did you become aware of the Electric Retrofit Incentive Program? FOR EACH SPONTANEOUS MENTION ASK: On a scale of 1 to 5 where 1 is not at all influential and 5 is extremely influential, how influential was (INSERT FROM PREVIOUS QUESTION) in your decision to participate in the [INSERT PROGRAM?
Spillover	Did in fact the assistance received from the [PROGRAM] influence the company/ organization to install any additional energy efficient equipment or implement any process improvements at other buildings or facilities in the Province of Ontario that did not get reported under the program? Did the rebate from [PROGRAM SPONSOR] in any way influence you to install additional energy efficient equipment at this site that did not get reported to the program (i.e., equipment that would not have been installed without the influence of the program)? Did the assistance you received from [PROGRAM SPONSOR] in any way influence you to install any additional energy efficient equipment ***at other buildings or facilities in the Province of Ontario*** beyond what you would have done otherwise?

The sample frame for the survey of participants was the customer database lists of participants in each of the programs: The sampling unit for the survey was the individual site or location. Questions to respondents about measures and program incentives were measure specific. Program participants installing more than one measure were asked about a maximum of two measures. In this context, a decision-maker who had responsibility for multiple sites/locations could provide information during the survey about multiple sites/locations. A modular survey was developed with common questions for all of the programs (BOMA CDM, BIP, ERIP and BBP-EB). Content areas covered the research objectives inclusive of energy saving measures implemented, influences to program participation, free ridership and spillover. The survey was administered by telephone during June 2009. On average, each interview was approximately 22 minutes. A census approach was taken and multiple attempts were made to contact all program participants where contact information was available. In total, interviews covering 208 locations

and 246 measures were completed. Details of the telephone survey are presented in Table 2-23. The significance level was 6% precision at 90% confidence.

Table 2-23. Summary of Telephone Survey of Participants

	BOMA CDM	BIP	ERIP	BBP-EB	TOTAL
Gross Sample (Sites)	108	98	326	34	566
Net Sample[53*] (Sites)	98	95	282	34	509
Completions (Sites)	37	39	110	22	208
Completion (Measures)	40	39	135	32	246
Completion Rate (Sites)	38%	41%	39%	65%	41%

Source: Summit Blue research

The Summit Blue team used the survey data to analyze free riders by program using SPSS software (as described in Section 2.4.1). The Summit Blue team looked for spillover from customers who are not "pure free riders". Pure free riders are participants who would have installed the same amount of energy efficiency measures and at the same level and the same time, even if there had been no program. The NTG algorithm is (1 – Free Riders Rate + Spillover Rate). Sample results are then applied to each program to determine net program savings. As with gross savings, ERIP results were determined for Multi-Residential separately.

2.4.2 Results

This section provides the results of the net to gross analysis, describing the estimates of free riders, spillover, and final net savings foe demand and energy.

2.4.3 Free Riders

The table below presents the results for the free ridership analysis for each program based on applying the NTG algorithm as described in Section 2.4.1. Free ridership is 42% across all programs and ranges from a low of 38% for BOMA CDM to a high of 59% for ERIP projects implemented in the multi-residential sector. These results are similar to what is found in other jurisdictions and for Ontario gas C&I customers.[54]

[53] Excludes not in service, wrong number, and fax /modem.
[54] Summit Blue Canada, *Custom Projectd Attribution Study*, prepared for Union Gas Ltd and Enbridge Gas Distribution, July 2008.

Table 2-24. Free Ridership Rates by Program and Portfolio

Program	BBP-EB	BIP	BOMA CDM	ERIP		TOTAL
				Commercial	Multi-Family	
Free Ridership (%)	42%	41%	38%	42%	59%	40%

Market research findings described below provide support for the results of the application of the free ridership algorithm. Although there is evidence that the program had some influence for a number of participants (see Figure 2-6), Table 2-25 shows that about half were considering implementing energy efficient measures before they became aware of the program. Almost 40% said that the program was neither extremely nor even very important in the decision to implement measures, one-third would have implement the measures within a year, and about 30% would have implemented measures of the same or similar efficiency.

Figure 2-6. Percent of Respondents Saying the Program was Extremely Significant vs. Other Factors in Decision to Implement Measures

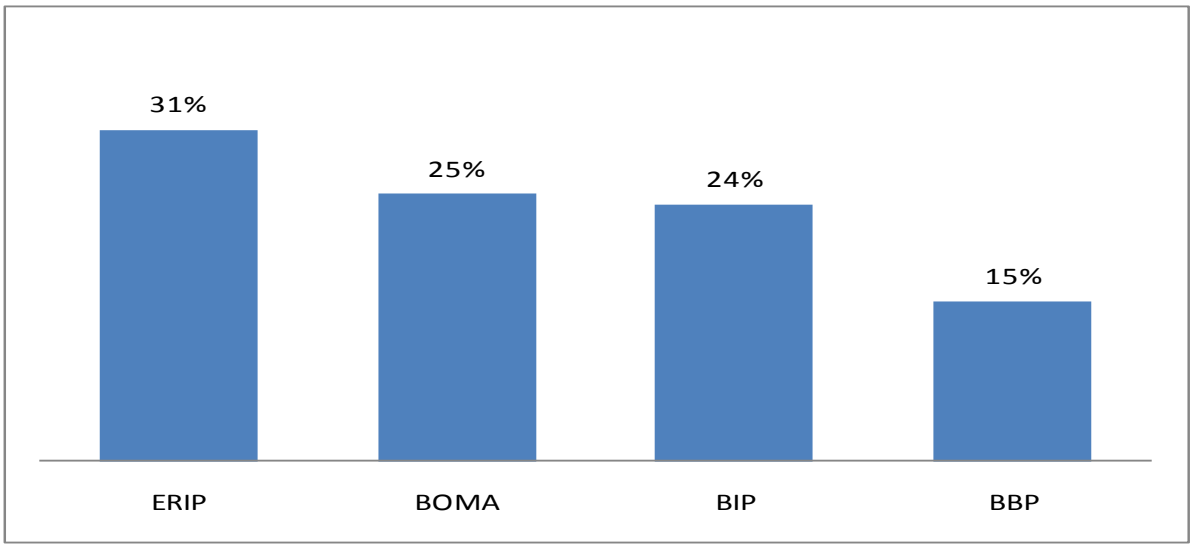


Table 2-25. Estimating Free Riders

Measures of Free Riders	Source	Results
Free riders from SPSS algorithm	2.4.1	40%
Considering measures before aware of program	q2	46%
Program not extremely/very significant in decision to implement measures	q3	39%
Would have implemented the measures within one year without the program	q4a	34%
Definitely would have implemented measures of same/similar efficiency	Q5	29%

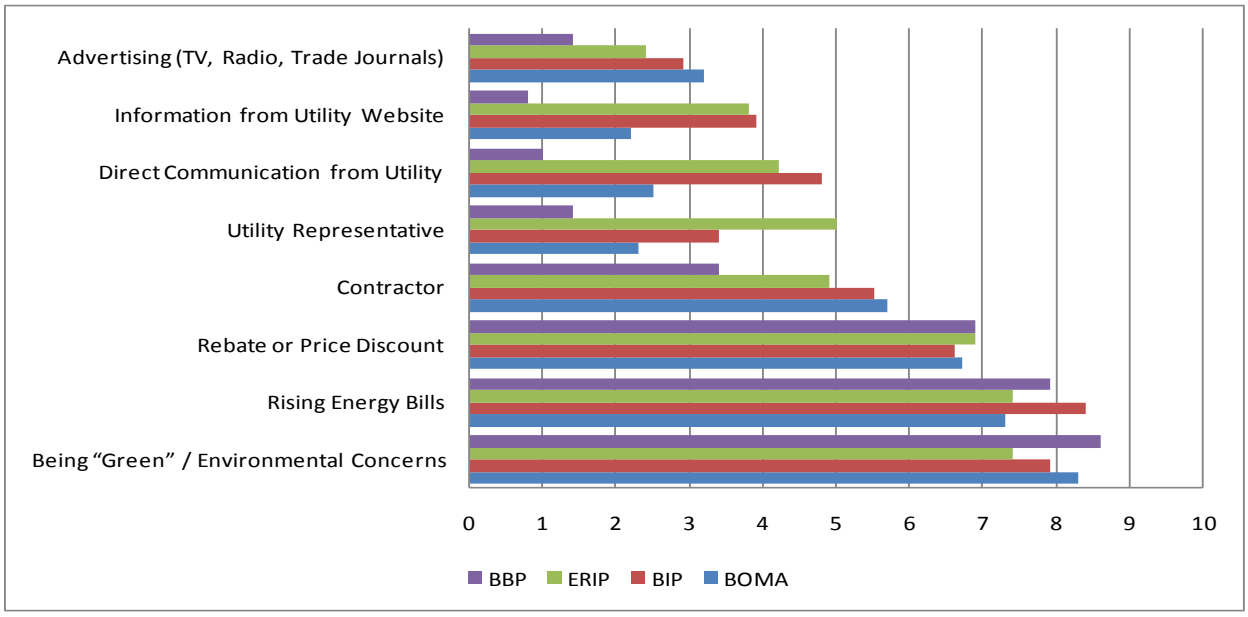
A large number of participants were considering implementing measures before they became aware of the program. As shown in Table 2-26 below, 46% of respondents were not aware of the program when they began thinking about implementing measures. Program awareness varies significantly by program. Almost three-quarters of BIP respondents were considering such measures before they were aware of the program, whereas less than a quarter of BBP-EB respondents were considering measures before they became aware of the program.

Table 2-26. Awareness of Program When Deciding to Implement Measures

AWARENESS OF PROGRAM BEFORE OR AFTER THINKING ABOUT IMPLEMENTATION OF MEASURES	TOTAL MEASURES (n=246)	PROGRAMS			
		BOMA CDM (n=40)	BIP (n=39)	ERIP (n=135)	BBP-EB (n=32)
Before	50%	45%	23%	53%	78%
After	46%	45%	74%	43%	22%
DK/RF/NA	4%	10%	3%	4%	0%

The incentive was not the most significant influence in the adoption of measures. As shown in Figure 2-7, being "green" and rising energy prices were the factors rated by respondents as having the highest influence on the decision to implement energy efficient measures. The program incentive was the third highest rated factor. No other factors shown in the figure were rated higher than the midpoint of the scale.

Figure 2-7. Rating of Factors Influencing Decision to Implement Measures[55]



[55] Source: Questionnaire Q11. Mean scores calculated on an 11-point scale of influence where 0= Not at all influential and 10= Very influential with the mid-point of the scale being 5.5.

Most respondents in all four programs indicated that if assistance from the program had not been received they would have implemented the measures in the foreseeable future (Table 2-27). Fifty to sixty percent would have implemented the measure sometime in the future; about a third would have implemented the measures within a year (not shown). Results for such projects that would have been implemented within a year are considered to be free riders. Just over 20% overall would not have implemented these measure in the foreseeable future without the program; these customers are most likely to have been influenced by the program.

Table 2-27. Whether Participants Would Have Implemented Measures

IF ASSISTANCE FROM PROGRAM WAS NOT RECEIVED WOULD YOU HAVE IMPLEMENTED MEASURES	TOTAL MEASURES (n=246)	PROGRAMS			
		BOMA CDM (n=40)	BIP (n=39)	ERIP (n=135)	BBP-EB (n=32)
Yes, in foreseeable future	55%	60%	64%	50%	59%
Not sure	24%	28%	15%	28%	9%
No, not in foreseeable future	21%	13%	21%	21%	31%

Another question about the likelihood of implementing measures without the program (Table 2-28) shows responses consistent with the free ridership finding from applying the free ridership algorithm. Thirty percent definitely would have implemented the measures without the program. This percentage is consistent across all four programs. On average, another 23% of program participants would probably have implement the energy efficient measure without the program.

Table 2-28. Likelihood of Implementing Measures without Program

LIKELIHOOD WOULD HAVE IMPLEMENTED MEASURES OF SAME/SIMILAR EFFICIENCY WITHOUT PROGRAM ASSISTANCE	TOTAL MEASURES (n=246)	PROGRAMS			
		BOMA CDM (n=40)	BIP (n=39)	ERIP (n=135)	BBP-EB (n=32)
TOP 2 BOXES	22%	15%	21%	22%	28%
o Definitely would not have (x5)	*4%*	*8%*	*0%*	*3%*	*9%*
o Probably would not have (x4)	*17%*	*8%*	*21%*	*19%*	*19%*
Might/Might not have (x3)	25%	28%	18%	28%	19%
BOTTOM 2 BOXES	52%	55%	59%	49%	53%
o Probably would have (x2)	*23%*	*25%*	*26%*	*22%*	*22%*
o Definitely would have (x1)	*29%*	*30%*	*33%*	*27%*	*31%*
MEAN SCORE (OUT OF 5)	2.4	2.4	2.3	2.5	2.5

2.4.4 Spillover

Table 2-29 shows that a quarter of respondents said their organization installed measures not reported to but influenced by the program. An analysis conducted with respondents who were unlikely to have installed the incentive measures without the program within a year. The analysis reduced the total number of respondents to six (3 %) for BIP and ERIP respondents as shown Table 2-30. Respondents also estimated the percent of extra savings relative to what was incented. Estimates ranged from less than 10% to 30%. This small amount of participant spillover findings was not significant enough to include in the estimate in the NTG ratio.

Table 2-29. Percent of Respondents Indicating Installing Measures Not Reported

PROGRAM INFLUENCE ON ADDITIONAL MEASURES INSTALLED AT SITE NOT REPORTED IN PROGRAM (Q7)	TOTAL SITES (n=208)	PROGRAMS			
		BOMA CDM (n=37)	BIP (n=39)	ERIP (n=110)	BBP-EB (n=22)
YES – INSTALLED	47 (23%)	9 (24%)	6 (15%)	30 (38%)	3 (10%)
NO - DID NOT INSTALL	161 (77%)	28 (76%)	33 (85%)	80 (62%)	6 (90%)

Table 2-30. Extra Energy Savings Achieved Without Program - Best Estimate

Program	<10%	15%	25%	30%	Total
BIP	0	0	2	0	2
ERIP	2	1	0	1	4
TOTAL	2	1	2	1	6

2.4.5 Net Energy and Demand Savings

Table 2-31 presents the results for the net to gross analysis for each program based on applying the NTG algorithm as described in Section 2.4.1 to determine free riders using only free riders to adjust measures. The NTG ratios—which range from a low of 41%, for ERIP projects implemented in other than the multi-residential sector, to a high of 62% for BOMA CDM—are similar to what is found in other jurisdictions and for natural gas C&I customers in Ontario.[56]

[56] Ibid.

Table 2-31. Net Energy and Demand Savings by Program and Portfolio

Variable	BBP-EB	BIP	BOMA CDM	ERIP		TOTAL
				Commercial	Multi-Family	
Verified Gross kW savings	1,028	834	5,920	16,989	367	25,138
Verified Gross MWh savings	38,342	5,479	22,140	86,369	10,862	163,192
NTG Ratio (%)	58%	59%	62%	58%	41%	57%
Net kW savings	596	492	3,670	9,854	150	14,763
Net MWh savings	22,238	3,233	13,727	50,094	4,453	93,745

3 PROCESS EVALUATION

The process evaluation consists of the following tasks:

1. Evaluation of program process efficiency
2. Review of incentive levels
3. Compliance of M& V methods

3.1 Program Process Efficiency

This section describes the evaluation of the process efficiency of the various programs—what worked and what did not work and recommendations for improvements to help increase participation and savings. The following subsections present the approach and findings.

3.1.1 Approach

The Summit Blue Team drew material from multiple sources to support each substantive conclusion and recommendation; this ensures confidence that the findings are well-grounded and do not reflect anomalies in individual data sources. The focus was on identifying concrete recommendations for improvements to the program with results stated as integrated recommendations for program improvements (and findings of components of the program that are working well) and with data from multiple sources in support.

The following activities provided the sources for the findings:

- Reviewed the existing program logic models and created a generic logic model, which could be used to apply to all the C&I programs.
- Added questions to the participant survey of 208 respondents to obtain customer viewpoints and feedback. (See section 2.4 and Appendix D for a description of the survey and respondents.)
- Conducted in-depth interviews with staff involved in program design, development, and implementation, as well as other key market actors:
    - Interviews were done with program delivery staff for each of the four programs
    - Nine interviews were conducted with six large LDCs
    - Ten interviews were conducted with nine small LDCs
    - Eight interviews were conducted with project evaluators
    - Interview with Osram-Sylvania
- Reviewed program marketing material and the web sites.
- Reviewed program tracking data, program database structure and purpose, availability of back up M&V documentation, procedures used to gather and record data, and procedures used for calculating and distributing incentives.

3.1.2 Findings

This section provides the findings from the process efficiency review, program logic models review, customer feedback, stakeholder input, marketing and outreach approach, and results tracking systems.

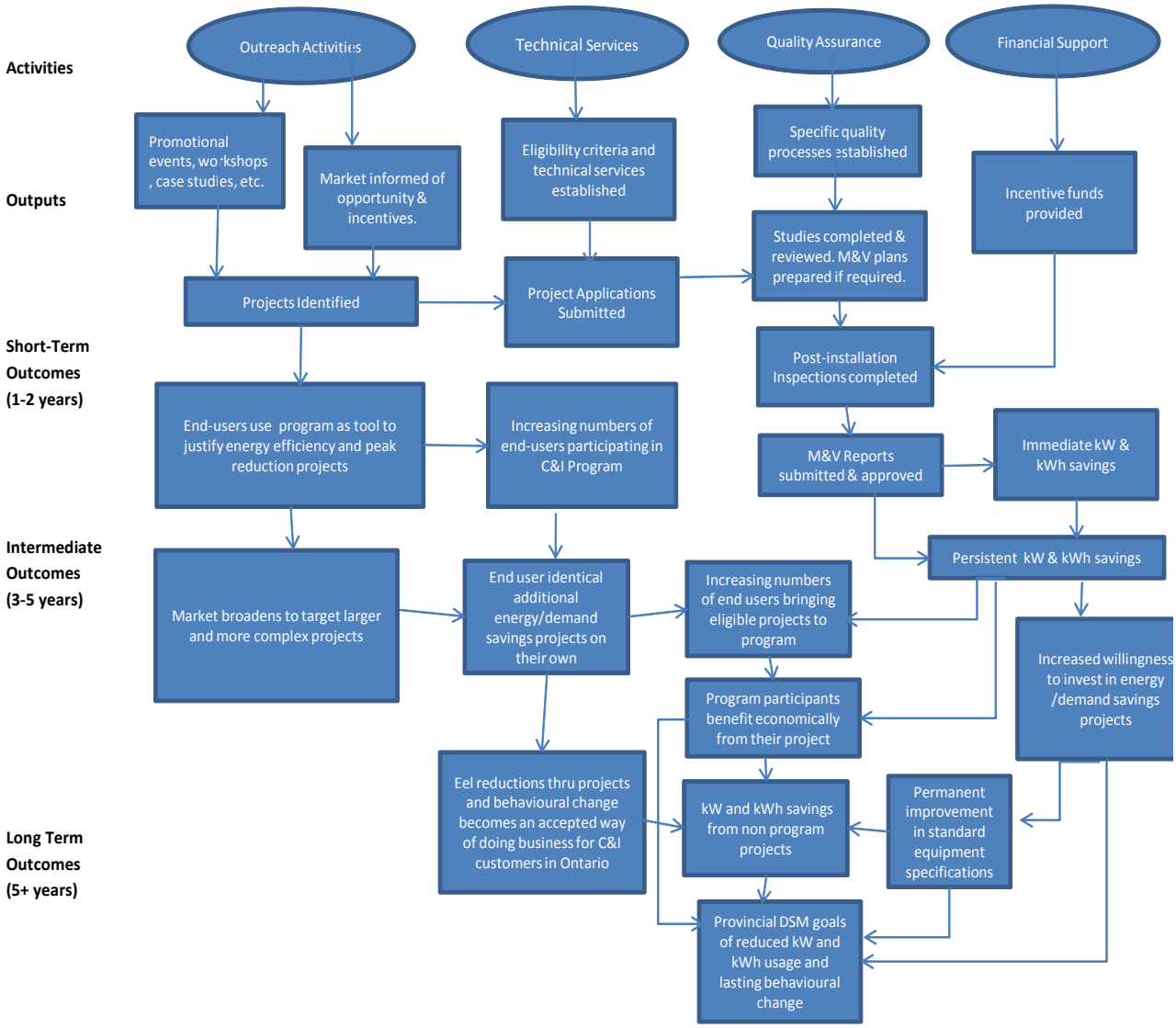
3.1.3 Program Logic Model

The program logic models (PLM) provided for BOMA CDM and ERIP were program process flows rather than PLMs. A logic model is a clear, simple model that identifies underlying assumptions, goals, resources, inputs, activities, outcomes, and long term impacts and serves as a tool in the planning and evaluation of programs. It graphically identifies relationships between inputs, outputs, and outcomes.

For evaluation purposes, a logic model will: summarize the key elements of a program; explain the rationale behind program activities; clarify the differences between the activities and the intended outcomes of the program; show the cause-and-effect relationships between the activities and the outcomes; and help identify the critical questions for the evaluation.

The same logic model could be applied to each of the four programs as shown in Figure 3-1 below. This diagram shows the linkages between activities, outputs and outcomes, and identifies inputs and potential external influences. It is important to distinguish between outputs and outcomes. For the purposes of this logic document, outputs are defined as the immediate results from specific program activities. These results are typically easily identified and can often be counted by reviewing program records. Outcomes are distinguished from outputs by their less direct (and often harder to quantify) results from specific program activities. Outcomes represent anticipated impacts associated with OPA's program activities and will vary depending on the time period being assessed. On a continuum, program activities will lead to immediate outputs that, if successful, will collectively work toward achievement of anticipated short, intermediate and long-term program outcomes.

Figure 3-1. C&I Retrofit Incentive Program Logic Model



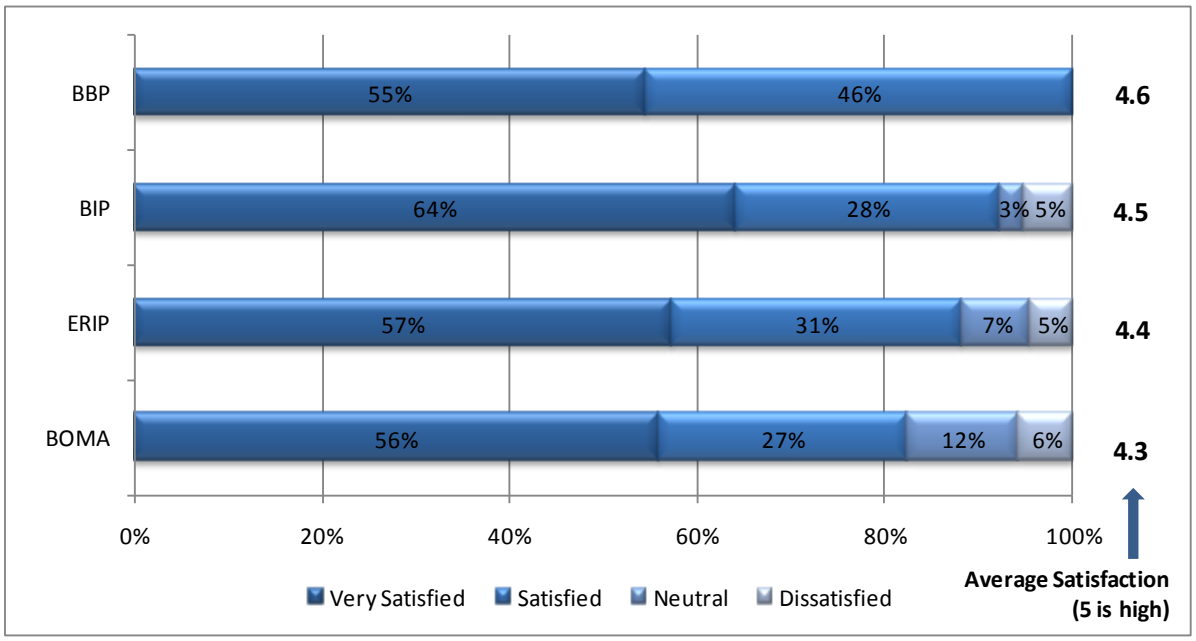
3.1.4 Customer Feedback

As seen in Figure 3-2, each program has high levels of overall customer satisfaction. More than 50% of participants report that they were very satisfied with the program they participated in. None of the programs have more than 6% of participants reporting that they are unsatisfied with the program. The differences in overall satisfaction ratings amongst the four programs are *not* statistically significant at the 90% confidence level.

- BBP started conducting regular customer satisfaction surveys starting in early 2009. They are also relying on word-of-mouth knowledge of customer satisfaction via personal contact networks. All (100%) of BBP-EB's participants are satisfied or very satisfied with the BBP-EB program. The BBP-EB program earns especially high marks with customers in the "services provided by program sponsor" category (an average of 4.4 on a 5-point scale, with 5 being the highest score).

- Most BIP participants (92%) are satisfied with the program and almost two-thirds (64% are very satisfied. Relative to other programs, more BIP customers are very satisfied with the program, especially compared to BOMA CDM participants.
- In the ERIP program, the LDC's perspective is that customers like the program and it increases their satisfaction with their utility and that approval and incentive distribution happens in a timely manner. Some LDCs noted that customers were motivated by non-energy benefits such as aesthetics and health reasons, not just energy savings and cost savings. The majority of LDC customers interviewed as part of the participant survey (88%) are satisfied or very satisfied with the ERIP program.
- Most BOMA CDM participants (82%) are satisfied or very satisfied with the BOMA CDM program.

Figure 3-2. Satisfaction of Respondents with C&I Programs[57]

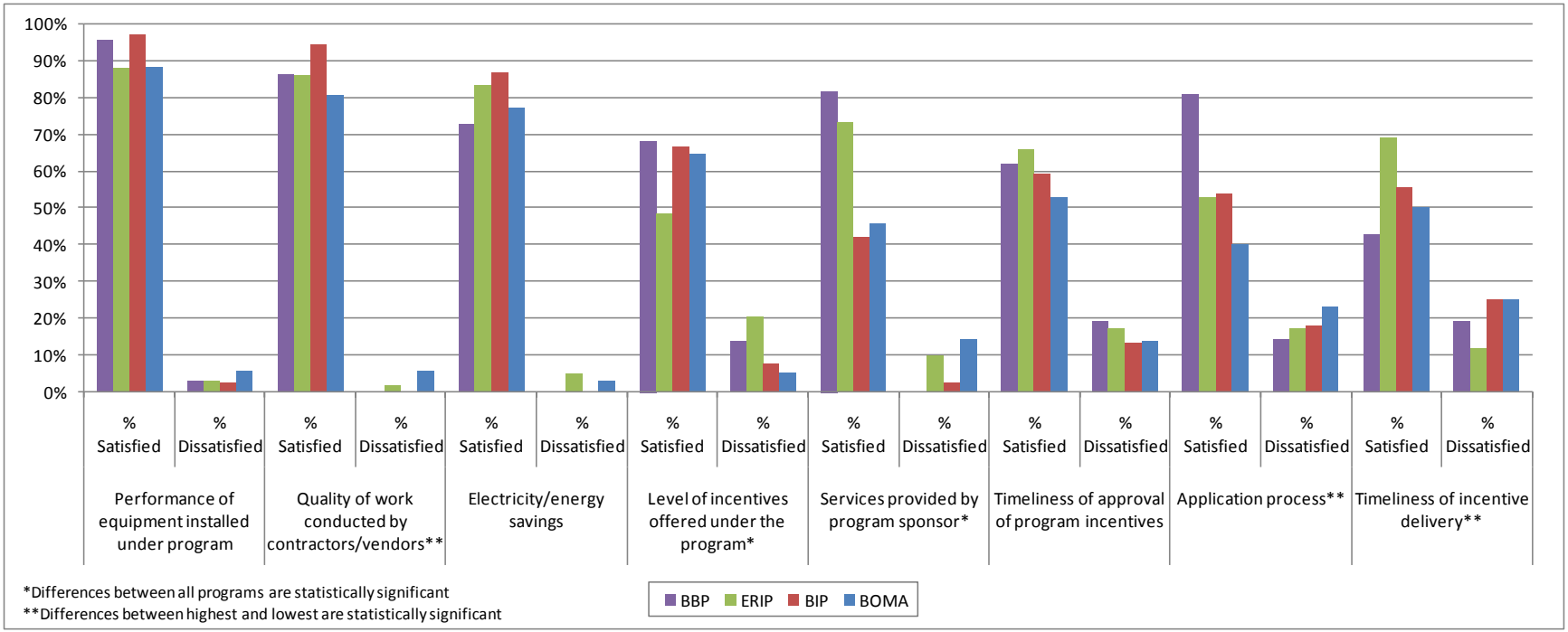


The program elements earning the lowest marks include the application process and the level of incentives (Figure 3-3**).** However, the average participant scores for those program elements are still higher than the midpoint of 3 on a 5-point scale with 5 being the highest score, so overall respondents are neutral or satisfied with these elements, not dissatisfied. Figure 3-3 shows the satisfaction with program elements. Many ERIP participants feel that the custom application and worksheets are too difficult to complete and not worth the effort given the size of the incentive. BOMA CDM has the lowest participant satisfaction with the application process (nearly one-quarter of respondents were dissatisfied or very dissatisfied). The application process is generally the program element that customers are least satisfied with, but the average satisfaction remains higher than the midpoint on a 5-point scale, meaning that customers more often feel neutral or satisfied, not dissatisfied, with the process.

[57] Source: Q13: Mean scores calculated on a 5-point scale where 1=Very Dissatisfied and 5=Very Satisfied with the mid-point of the scale being 3.0.

There are no differences between the programs for the performance of the equipment installed, energy savings, and timeliness of application approval. Statistically significant differences may be found for the other program elements, especially services provided by program delivery agents (BBP-EB and ERIP customers are more satisfied than the others), application process (BBP-EB customers are more satisfied), timeliness of incentive delivery (ERIP customers are more satisfied), and incentive level (ERIP customers are less satisfied).

Figure 3-3. Satisfaction with Program Elements[58]



[58] Source: Q14. Respondents rate their satisfaction with each program element on a 5-point scale where 1=Very Dissatisfied and 5=Very Satisfied with the mid-point of the scale being 3.0. The graphic does not display the respondents with neutral (3) ratings.

Environmental concerns and rising energy bills are key motivators for customers to participate in the programs. Overall results shown in Table 3-1 show respondents are motivated primarily by environmental concerns and rising energy bills, followed by rebate or price discounts. The customer survey found environmental concerns are more motivating for BBP-EB and BOMA CDM customers than others. BIP customers are primarily concerned with rising energy costs. For ERIP, some LDCs observed that some customers are motivated by non-energy benefits like aesthetics and health/safety benefits, not just energy savings or cost savings. Rising energy costs and environmental concerns are equally motivating. Customers in the two utility programs (BIP and ERIP) are unsurprisingly more influenced by the utility representative, direct communication from utility, and information from utility website factors. There are no statistically significant difference between the programs in terms of the influence of rebate or price discounts and advertising. Table 3-1 shows the influence of factors in customer decisions to implement measures.

Table 3-1. Influence of Factors in Customer Decisions to Implement Measures[59]

	PROGRAMS			
	BBP-EB	BOMA CDM	BIP	ERIP
Average Mean Influence Score	**(n=32)**	**(n=40)**	**(n=39)**	**(n=135)**
Being "Green" / Environmental Concerns	8.6[c]	8.3	7.9	7.4
Rising Energy Bills*	7.9	7.3	8.4	7.4
Rebate or Price Discount**	6.9	6.7	6.6	6.9
Contractor	3.4	5.7[b]	5.5[b]	4.9
Utility Representative	1.4	2.3	3.4[b]	5.0[a,c]
Direct Communication from Utility*	1.0	2.5	4.8	4.2
Information from Utility Website*	0.8	2.2	3.9	3.8
Advertising (TV, Radio, Trade Journals)**	1.4	3.2	2.9	2.4

*Statistically significant differences between all programs, based on a one-way ANOVA test at the 90% confidence level.

**No statistically significant differences between any programs.

[a] Statistically significantly higher than BOMA CDM.

[b] Statistically significantly higher than BBP-EB.

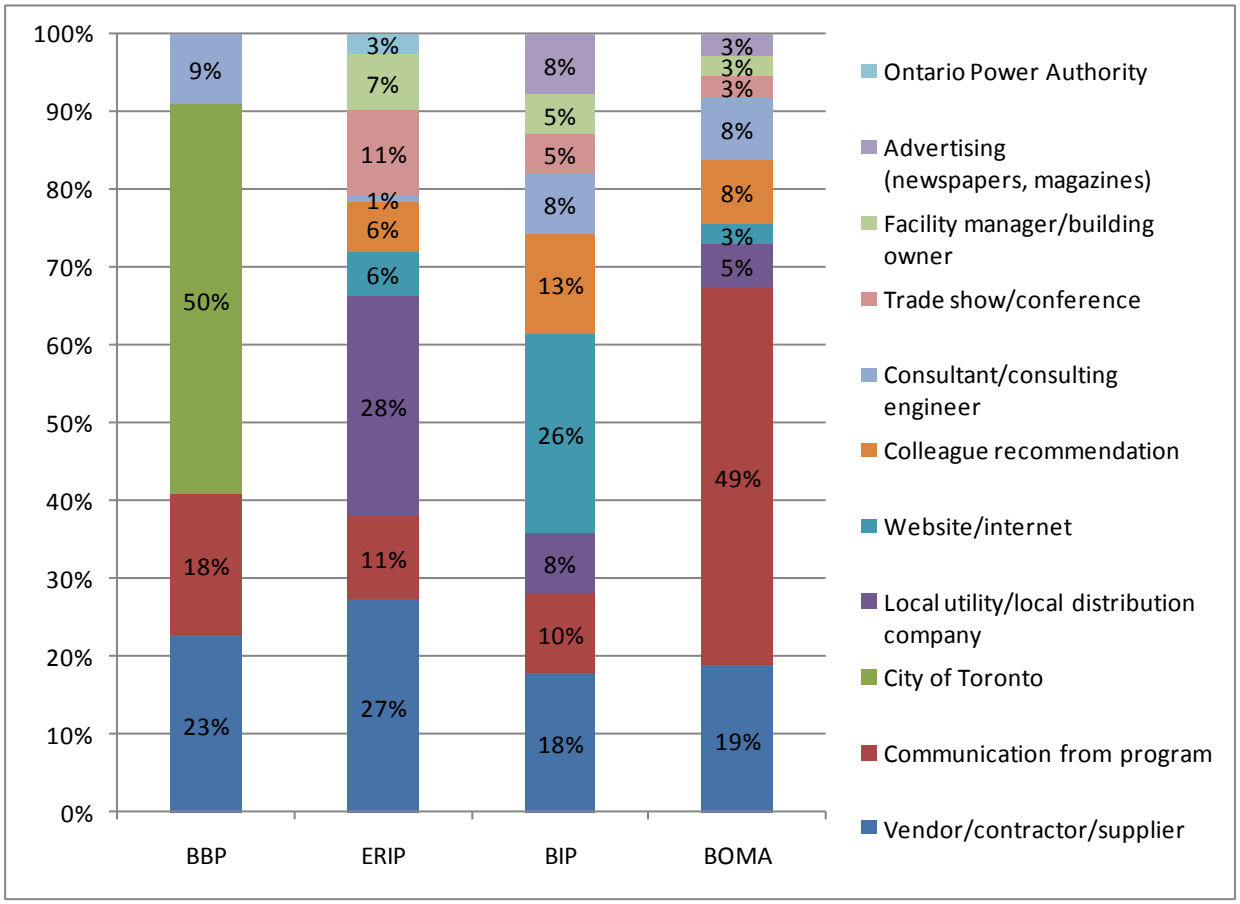
[c] Statistically significantly higher than ERIP.

Respondents learn about programs through a variety of channels. As shown Figure 3-4, BOMA CDM participants are more likely than other program participants to indicate that communication from

[59] Source: Q11 Mean scores calculated on an 11-point scale of influence where 0= Not at all influential and 10= Very influential with the mid-point of the scale being 5.5.

the program was the primary source of information the program. Half of the participants in BBP-EB identified the City of Toronto as the primary source of their organization's awareness of the program. The website/internet was named by about a quarter (26%) of BIP participants as the primary source of program awareness; this was the only program in which respondents commonly listed the program website as the primary source. The local utility/distribution company was named by 28% of ERIP participants as the source of program awareness, followed by communications from the program.

Figure 3-4. Most Influential Source of Respondents' Decision to Participate in Program



As shown in Table 3-2, there were several influences on respondents' decisions to participate in a program. Across all programs, respondents noted organizational cost-savings targets as the most influential element. This was particularly true for the utility programs—BIP and ERIP. BIP respondents were also motivated by the level of incentives, internal energy manager recommendations and high energy prices. BBP-EB respondents rated organizational policies to be "green" and level of incentives available as the most important program elements. Internal energy manager recommendations were also considered very important to the decision to participate. BOMA CDM respondents did not rate any of the program elements higher than 3.7 on the 5 point scale with results similar to those for BBP-EB. The least important drivers were the level of support/training offered by the program (especially for BIP) and industry standards.

Table 3-2. Importance of Program Elements in Decision to Participate[60]

Importance of Factors on Program Participation (5=highest)	BBP-EB	BOMA CDM	BIP	ERIP
Level of financial incentives/rebates offered by program*	4.4	3.7	3.9	3.5
Organizational financial cost-saving targets*	3.6	3.5	4.2	4.0
Organization's policies to be "green"*	4.6	3.7	3.4	3.5
Internal energy manager recommendations**	4.0	3.6	4.0	3.6
Higher energy prices in winter versus summer*	2.9	2.9	3.9	3.0
Current economic conditions*	2.6	3.0	3.7	3.3
Level of support/training offered by program sponsors*	3.0	2.4	1.9	2.7
Industry standards	2.9	2.9[a]	2.3	2.9[a]

*Statistically significant differences between all programs, based on a one-way ANOVA test at the 90% confidence level.

**No statistically significant differences between any programs.

[a] Statistically significantly higher than BIP.

Respondents for each of the programs had suggestions about expanding prescriptive incentives measures. Over a quarter of BBP-EB respondents and about a fifth of the BOMA CDM respondents think the program should include more measures.

3.1.5 Stakeholder Input

Stakeholders are generally satisfied with the programs, but there is some market confusion with competing programs.

What's Working

ERIP. Larger LDCs delivering the ERIP program especially value the opportunity to increase customer satisfaction and provide value-added services to their key customers. They report that the program is easy to use and the paperwork is not burdensome (for the most part – smaller customers can find the paperwork to be too time consuming, and smaller LDCs find the program to be more burdensome than the large LDCs). The program is highly concentrated in the lighting sector as lighting consultants design lighting systems at no cost to customer. The evaluators' perspective is that the program has been around long enough to have relatively good market presence. Evaluators also like the recent additions to the prescriptive measures list. Informal networks have developed between the LDCs, through attendance at seminars, industry organizations and industry events. In some cases, larger LDCs are supporting smaller

[60] Source: Q12 Mean scores calculated on a 5-point importance scale where 1=Not at all important and 5=Extremely important with the mid-point of the scale being 3.0.

LDCs, who have less resources, through knowledge-sharing and problem -solving. An improved head office model would help. Almost all LDCs are very pleased with the training and workshops provided by OPA. LDCs appreciate the technical expertise of OPA.

> *"Another objective is to use this good news story to foster and improve relationships with key accounts." – Large LDC*

BOMA CDM. The BOMA CDM program was built around internationally approved M&V standards, understands how to reach busy executives, has a well-established training program, and knows how to deliver the one-on-one marketing techniques needed to be successful in the large commercial market. M&V procedures are viewed as the bedrock of the program's integrity. Evaluators work with customers to agree upon incentive levels, so the customer isn't surprised by the final incentive amount. From the evaluators' perspective, the program is a well-oiled machine.

> *"I don't think we're going to get a perfect program, but I think we're pretty close to that." - BOMA CDM Evaluator*

BBP-EB. BBP staff is constantly trying to streamline and improve processes to ensure response times are adequate and the target market is being reached. Evaluators say many program elements were adopted from the BOMA CDM program model and that M&V principles and incentive calculation methodologies are sound. The managers believe they have sufficient resources with the latest staff hired, which included a program operations manager and an additional account manager.

BIP. The BIP program has the credibility of Toronto Hydro brand name. Marketing to channel partners is cost-effective and helps them leverage their limited marketing budget. Evaluators perceive that data tracking has improved enormously.

What's Not Working

ERIP. The biggest problem with ERIP is competition from other OPA programs with higher incentives – customers have cancelled projects with their LDC to move to another OPA program, which hurts LDCs' credibility with customers and negates one of the key benefits of the program: relationship building. Unstable program funding has made it difficult for LDCs to increase staffing levels. Inconsistency in incentive schedules, with higher incentives for "low technology" measures such as CFLs but lower incentives for more complex measures such as motors has also hampered program growth. The head office model results in unfair distribution of incentives to one LDC on projects in another LDC's territory and placed perceived unfair burdens on the LDC's who are trying to use the model to meet their customer needs. Customer education levels are not ideal, and there are negative associations with the term "energy efficiency." Smaller LDCs have found that the requirement to submit and process an application and complete a project within one calendar year is unrealistic and prevents some customers with larger projects from making use of the program. Evaluators observe that the LDCs have to take on a lot of risk by putting a lot of resources into evaluating custom applications, which have to be pre-approved; if projects don't go forward, the LDC has wasted scarce internal resources. Many LDCs mentioned that the method that OPA pays LDC invoices is confusing; they use direct deposits with little or no clarification of which projects are included in the payment placing an unacceptable burden on program and accounting staff.

> *"The OPA has given us a program to operate and then put a richer program on top of us. We are not competitive and our reputation is sullied." – Large LDC*

Some LDCs say they need more staff to market and process applications, but most are uncomfortable taking on additional staff when they perceive the funding for this program is unstable. They need

consistency for planning purposes. Both large and small LDCs have noted that the most effective marketing strategy is personal contact (ideally face-to-face) and relationship building, which is a very resource-intensive form of marketing; additional staff to assist with marketing would probably benefit all LDCs. Smaller LDCs also expressed a desire for more staff with technical expertise to assist with customers' applications.

> *"A lot of the small to midsized utilities don't have the resources. Whenever you can find time to promote them. A lot of us are multi-tasking already. It is too difficult to find time. We can't afford to have someone spend all day with this stuff." – Small LDC*

BOMA CDM. BOMA would like to expand beyond the Toronto city limits; this is partially driven by multi-site customers who would like to implement BOMA CDM program measures at sites both in and outside of Toronto. BOMA needs to refine M&V procedures for newer measures that have been added, and they need to change the perception that M&V requirements are more onerous than they really are, by better communicating to customers what the steps are and what will be required of them. There is a need to educate the public about the program being more than just changing light bulbs. The Evaluators' perspective is that the program isn't getting the number of applicants that they expected or should be getting. The program manager indicated that they would benefit from an increase in staff.

BBP-EB. The BBP-EB program is starting to work with channel partners such as manufacturers to encourage them to integrate the program incentive into their marketing. There are many competing needs for internal resources and money. Programs do not necessarily have credibility at the outset, and they need to get off the ground quickly because customers can't wait around for incentives. Evaluators feel that there is not enough communication between the evaluator and the applicant to provide feedback on the accuracy of savings estimates.

BIP. The BIP program manager said there is a need for a more specific program mission with clearly defined goals from the outset and that they would benefit from an increase in staff. Evaluators could use additional staff resources in the summer because one key staff member is also working on the Peak Saver program during the summer.

> *"The program has a lot of scope and could achieve even bigger and more types of measures than what we are currently doing…We need to look at our need for sales beyond one person and we also need to look at the IT function." – BIP Program Manager*

BIP staff would like to see better defined M&V protocols across the programs. All projects receive some type of post-project M&V inspection. However, they do not want to make M&V a burden that could deter customers from participating. Evaluators expressed a need for good sources for input assumptions, citing specific data that is frequently missing from customers such as occupancy sensors operating hours/profile, VSD operating profile, window characteristics for window film measures, etc.

> *"M&V is the single most important thing to ensure that you get what you set out to get. It is silly have different groups using different ways. Needs to be some reconciliation."*

Program application process

LDCs participating in the ERIP program report that the application paperwork can be burdensome; for smaller customers, even prescriptive spreadsheets are too difficult and time consuming to complete. Larger customers tend to have in-house engineering resources to assist with applications. Many customers feel that the custom project incentives are not worth the effort required to complete the application. For custom applications, the incentives are based on average peak, and some projects are difficult to define in those terms; some customers shy away due to the difficulty of calculating average peak for their project.

Some LDCs said their customers have been pleasantly surprised with the speed of project approval, compared to other programs they have participated in. One LDC completes all paperwork for their customers, but many do not have resources to do that.

> *"The forms are confusing – are written by engineers – we fill out every application for the customer. They only have to sign the form." – Large LDC*

BOMA CDM, BBP-EB, and BIP program staff would like their programs to be timelier in the processing of applications. BOMA staff would like to develop an online application that would input directly into the database. About 90% of the time, BOMA customers need help with the application, especially for more complex installations such as chillers. The BBP-EB salesperson helps the customer complete the application as it is quite technical; nearly one-third of BBP-EB participants think that the application process should be simplified and streamlined. Relative to the other programs, BBP-EB customers have the highest satisfaction with the approval process (an average rating of 3.9 on a 5-point scale with 5 being the highest score). Over one-third of participants think the application process should be simplified and streamlined. BIP staff would like to improve the capability of their website to allow completion of the application online to automatically feed into the project database, but they are concerned about the improvement costs. BIP staff does not play a large role in helping customers with the application, but channel partners generally perform that role.

Timing of Delivery of Customer Incentives

Timing of incentive delivery to customers is generally good. The ERIP incentive check is generally processed within 7-10 days of project completion. Relative to other programs, ERIP customers have the highest satisfaction with the timeliness of incentive delivery (an average of 3.9 on a 5-point scale with 5 being the highest score). BOMA CDM, BBP-EB, and BIP program staff report that their customers are satisfied with the length of time it takes to receive their incentives. For BIP, it takes about two weeks from the time that invoices are approved and verified to process the incentive. They have had no complaints on the length of time. Evaluators observe that sometimes the incentive payments take more like 4-8 weeks, but don't perceive it to be a significant problem.

LDCs have found some customers feel the incentives are not high enough to motivate them to do the paperwork. Higher incentives for "low technology" measures like CFLs and lower incentives for motors and variable speed drives doesn't make sense. Lower incentives don't generally sell new projects, but may accelerate a project or free up capital to make additional investments; still, high incentives for "low technology" measures with high market saturation could result in high free ridership rates. Relative to other programs, ERIP receives the lowest satisfaction ratings on incentive levels (an average of 3.4 on a 5-point scale). Evaluators have observed that an extremely high number of customers submit applications and then do not follow through with the program, and they speculate that this lack of follow-through is due to the low incentive levels which typically account for a small percentage of total project costs.

> *"A lot of it probably has to do with the size of the carrot being dangled in front of the customer. If the incentive was huge, I'm not suggesting it should be, but if you snapped your fingers, they'd probably jump and give you all their attention. But that's not the intent of the program to give them huge sums of money and pay off their project." – ERIP Evaluator*

BOMA CDM would like to see differing incentive levels for different measure types, to drive more results for the measures most desired. While there are advantages to a simple $400/kW incentive, which allowed the program to get off the ground without too much complexity, the program could evolve to promoting certain more-desired measures with graduated incentive levels. They would like to see increased incentives for complex applications such as deep lake water cooling. Incentives are generally

paid within 30 days of receipt of the invoices. Program staff report that the most frequent cause of delays is incomplete information from the customer. Relative to other programs, BOMA CDM customers have the lowest satisfaction with timeliness of incentive delivery (an average of 3.3 on a 5-point scale).

BBP-EB staff would like to see incentives offered to hire consultants to help design and implement their projects for smaller customers who don't have the in-house technical expertise needed to complete more complex projects. The BIP program is currently using a flat incentive. Program staff would like to see an incentive plan with higher incentives for high value measures, to focus the program on specific, highly desired measures.

Osram-Sylvania, who are aware of and maintain links to both Canadian and US programs on their website, find it very difficult to access and process applications for the OPA C&I programs. They have full time staff assigned to fill out forms and find it a "nightmare".

Quality of Lighting Products

Osram-Sylvania expressed concerns about the quality of lighting products incented by the programs. Highly efficient, energy-conserving lamps typically contain small quantities of mercury. If the level of mercury is too low, then lamp life, number of starts, color and light output can be dramatically affected. Lamps will consume all the pure mercury before reaching rated life, requiring additional lamp replacement, which increases mercury usage. The mercury is therefore critical to achieving the lamps higher level of operating efficiency.[61] Osram-Sylvania and other reputable manufacturers continually strive to reduce the level of mercury in their lamps. It costs extra to remove mercury so lower cost lamps typically contain higher levels of mercury. Studies, such as one conducted for the U.S. Department of Energy,[62] documented evidence of poor quality products and the impact on the market.

The quality of LED products is even more of an issue for lighting products, especially in terms of effective useful life. These products still do not produce enough lumens/watt and costs are extremely high. The major manufacturers are very careful with product claims and have comprehensive warranty policies to protect the customers. LEDs operate well in cold temperatures, whereas fluorescents lose life, so there is value for customers and with "daily requests for high incentives" for LEDs, Osram Sylvania sees product quality as an upcoming issue. They believe that quality should include non-technical criteria such as warranty and that the OPA should strongly consider quality testing as is required by similar Hydro Quebec programs which require manufacturers to provide 3rd party verification of their products. Osram-Sylvania also notes that the University of Toronto has set up an LED testing laboratory which would likely be willing to work with the OPA and other program delivery agents. Another approach used by NRCan's Office of Energy Efficiency is to use an advisory committee of stakeholders, including manufacturers.

Osram-Sylvania concerns about LED product quality were backed up an example application described by a BIP manager. About three years ago, Toronto Hydro helped Casino Rama in Orillia with an LED retrofit project (no incentives were involved). The supplier was EDtronics from California who had an office in Peterborough. It involved 300 to 400 35W MR16 lamps at $50/lamp. Toronto Hydro was not pleased with colour shifts in the sample but Casino Rama went ahead with the project anyway. Six

[61] Source: Osram-Sylvania literature.
[62] Pacific Northwest National Laboratory, Compact Fluorescent Lighting in America: Lessons Learned on the Way to Market, prepared for U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Building Technologies Program, June 2006.

months later the light had faded away and Casino Ramo considered it a "failed project". The warranty was not pursued but it may not have been honoured since the lamps were still producing some light. Lessons learned were: 1) good products are expensive; 2) LEDs have problems with colour shifts (lack of consistency); and 3) warranties are critical and it is best to buy from an established reputable lighting manufacturer (Osram-Sylvania, Phillips) who will be around to honour the warranty.

Other Osram-Sylvania concern was about the use of the US-based Consortium for Energy Efficiency (CEE) standards for prescriptive measures and providing incentives for "standard" performance T8 ballasts. CEE is a US organization and not all of the products eligible for incentives were listed, for example, 347-volt ballasts are only available in Canada and represented many of the product applications. It took many months to have this measure added to the CEE list. Osram Sylvania recommends that only "high performance" T8 ballasts be incented; currently "standard performance" ballast are incented at a lesser amount than for "high performance" ballasts. Standard performance T8 technology is no longer a best practice for lighting applications. Incenting only "high performance" electronic T8 ballasts going forward would provide increased savings from the balance of T12 to T8 retrofits in Ontario.

3.1.6 Marketing and Outreach

LDCs delivering the ERIP program believe education/outreach is needed to change the perception of the term "energy efficiency" as doing without. The large LDCs use four main marketing and outreach strategies: one-on-one direct contact with customers (most successful strategy), trade shows and seminars, breakfast meetings and other group activities, and bill inserts. Some LDCs concentrate on training contractors and trade allies to market directly to their customers; some rely heavily on this word-of-mouth and contractor channel marketing. Most report that their website is least helpful in marketing (although it plays an important role in facilitating access to needed forms and documents). When customer representatives receive high bill complaints, they refer those customers to ERIP to explore ways of lowering their bills through efficiency upgrades. Most LDCs mentioned wanting to focus marketing efforts on more narrowly defined groups of customers. One LDC has a particularly well-developed plan in which they leverage their success stories by finding similar customers and educating them about the success of the previous project; they remove any perceived barriers to participation, including filling out all of the application paperwork themselves. They utilize an outbound communication strategy which involves constantly presenting information to customers in the customer's language, not in industry jargon.

LDCs believe that broad education/outreach efforts are needed to change people's perception of the term "energy efficiency". They would like to see cooperative advertising with OPA and other LDCs, and they would like OPA to provide more resources for marketing the program, such as province-wide advertising and media coverage of success stories and outreach to wholesalers who work throughout the province – point of purchase materials for suppliers and wholesalers. The biggest barrier for ERIP is customer education levels – customers don't understand the technologies. Suppliers such as lighting contractors don't always take the time to understand the program and how it can help them sell their services.

Most LDCs report that their website plays a limited role in marketing. They have some information and the application forms to download, but not much else. Many would like to see their websites improved, with case studies and possibly online applications. One LDC complains of terrible support from their IT/communications departments and prefers that potential customers just call him directly. Most think that their customers seek out the website *after* they've learned about the program, to get the application forms – they aren't learning about the program on the website.

Survey respondents for programs other than ERIP view the biggest barrier to implementation of more measures is that energy shifting or reducing peak demand is not an option at their site. More technical assistance may be needed to better educate customers on ways to save energy and reduce peak demand.

BOMA believes its training session will improve participation and would like to increase the functionality of its website. BOMA has found great success with its current training program and has held 11 training sessions this year. Program managers expect that these training sessions will increase future program participation. BOMA has found that customers need to hear about success stories and other customers who have had a positive experience with the program. They have found that the number of overlapping programs in the Toronto market is confusing to customers, and too often, customers base their impressions of the BOMA CDM program on their experiences with other programs. BOMA has to spend time convincing the customer that their application form is easier, approval is quicker (two days compared to a month for other programs), and incentives come sooner (within 30 days of project completion). The training program helps them overcome these preconceived notions. Face-to-face marketing is key, as is educating property management companies and asset managers. BOMA uses traditional advertising (newspapers and magazines) as well as email messaging. Evaluators write up 3-4 case studies and submit to BOMA to use for marketing and public relations. BOMA would like to increase the functionality of the website to allow customers to complete their applications online and track their project's status through the site. Very few customers (3%) rated the BOMA website as the most important source of information in their decision to participate.

BBP focuses on face-to-face selling and relationship marketing and has found customers are not aware of basic energy efficiency measures. BBP-EB's focus is on face-to-face selling and relationship marketing. BBP has offered lighting workshops and customer breakfast sessions to explain their program and the benefits of demand reduction. Additional workshops and seminars are needed to sell the BBP and to increase its value to customers. BBP customers are all in the Municipal, Academic, Social Services, and Hospital sectors, and tend to have several smaller sites and are driven by opportunity costs more than profits. An innovative way to approach this sector would be to evaluate the customer's worst and best performing sites to determine what measures could be cost-effectively implemented using life cycle cost criteria; these customers tend not to understand life cycle costs and instead are opting for flashier, more visible measures rather than the hidden measures with greater economic benefits. BBP has found a lack of awareness of basic energy efficiency measures among its target audience. The primary barriers to installing additional measures for BBP participants are that shifting energy use and reducing peak demand is not an option at their site, followed by a perception that all energy saving measures that could be installed have already been implemented. Further technical assistance could help with these perceptions. About a third of BBP survey respondents think that the program should be promoted more to increase awareness. Thirty-one percent of BIP survey respondents think the program should provide more education and advice on the technologies.

BIP markets through vendors and consultants, and their website is considered an influential source of information by about a quarter of participants. BIP's strategy is to market to vendors and consultants, who then market to end-use customers. They have only one salesperson and rarely interact directly with customers in the sales process. BIP is starting to focus on segmentation and studying the behavior of different market segments. BIP staff would also like their website to allow completion of the application online which would automatically feed into the project database, although they are worried about the costs it will take to do that.

Osram-Sylvania has done considerable marketing of the program by conducting a series of workshops. The Canadian division of Osram-Sylvania is based in Mississauga, Ontario and provides general and specialty sales, marketing and distribution throughout Canada to industrial, commercial, retail, automotive, photo-optic and OEMs. The company also has a division which provides

comprehensive energy management and maintenance services across Canada. It is one of the three major lighting manufacturers in North America and the only lamp and ballast manufacturer in Canada. Long a supporter of energy efficiency, the company has been working closely with the OPA and the LDCs to promote efficient lighting products. Osram-Sylvania has conducted workshops for customers and the OPA, CLD, BBP, BIP, and ERIP; they consider this the only way to do marketing – target customers and invite them to workshops. Their facility is specifically designed to show the products and various characteristics associated. The key players at Osram-Sylvania, including the Director of Sales for Eastern Canada, remain committed to promoting these products and supporting the programs, but would like to see more coordination across programs and with the OPA and other players.

3.1.7 Results Tracking and Monitoring

Each program tracks results in databases, but each has a different structure and naming convention. Some capture more data than others, but none are ideal. The BOMA database was the most comprehensive but did not capture measures and projects in the same dataset. The ERIP centralized database was the least comprehensive with both missing fields and missing data in existing fields.

- Most LDCs delivering the ERIP program use Excel spreadsheets for data tracking. Some of the large LDCs use paper files, and one scans all paper files into a digital archive.
- BOMA uses an Access database that was developed in-house and is simple and functional. It tracks all of the application and M&V data for each project. Program managers are able to access general status reports. They would like to develop a web application form that would input directly into the database; staff would still have to check the application for missing information, but they wouldn't have to input the data into the database.
- The BBP-EB project database is also in Access and stores building, project, and measure information. It has some project status tracking capabilities. The program is working to improve the database by streamlining and pre-populating the fields.
- The BIP project database was developed in Cold Fusion and needs updating/ and enhancing as it does not contain all forms. Data can be extracted into Excel spreadsheets. Improving the current database would require significant BIP internal resources, which staff say are not available.

Table 3-3 below compares each database's ability to capture costs, savings, and contact/building information. The table shows BOMA has the most complete tracking system. BBP-EB's database, modeled after that of BOMA does not include incentives or costs breakdowns, number of floors, or estimated peak demand and energy consumption, but does include fairly good details on savings except for measures. BIP provides incentives and similar information to BBP-EB, but energy savings are not tracked and measures are only identified by a code. The ERIP database, on the other hand, was quite sparsely populated.

Table 3-3. Results Tracking Systems Compared Across Programs

	BOMA CDM	BBP-EB	BIP	ERIP
Costs				
Total Project Costs	√	√		Incomplete
Cost Breakdowns	√			
Incentive	√		√	√
Savings				
Peak demand	√	√	√	√
Energy savings	√	√	Not tracked	Not tracked
Measure details	√	Limited	None	√
Other				
Contact Information	√	√	√	
Project id	√	√	√	
Project status	√	√	√	
Building size	√	√	√	
Sector/building type	√	√	√	√
# of floors	√			X
Est. Annual Peak Demand	√			X
Est. Annual Consumption	√			X

3.2 Review of Incentive Levels

This section presents a discussion of incentives for Ontario's C&I retrofit energy efficiency programs – how they are set; whether they are offered for energy, demand, or both; and how they can be adjusted according to changing market conditions.

The purpose of energy efficiency (EE) programs is to cost-effectively get more EE measures installed than would naturally occur in the market. Programs should be designed to overcome market barriers to EE, minimize free riders, increase spill-over, and, in the long-term, transform the market. Cash incentives, or rebates, are one way to achieve these goals. Incentives work by reducing the up-front costs to the customer, which is often one of the most important barriers that need to be overcome.

Any discussion of incentives should be done with the understanding that they are only one of many tools in the program designer toolbox, and that their effectiveness should be considered within the context of the following three factors:

- The program design through which they are being offered;
- The market which is being targeted and the barriers that exist in that market; and
- The savings and market transformation goals for each program and the portfolio of programs.

Ideally, with a well-designed incentive program the customer will benefit from a significantly reduced payback period for the measure and possibly other non-energy benefits, and the utility will benefit from achieving energy and demand savings to meet its goals in a cost-effective manner. The general population also will get the secondary benefit of a gradual market transformation as the number of efficiency measures being installed increases, contractor familiarity with those measures increases, and eventually the measures become standard practice.

This section is organized to first give the background necessary for an in-depth discussion of incentive structures in Ontario by comparing the Ontario EE market with other jurisdictions. This is followed by a more general discussion of how incentives are designed. The report concludes with recommendations for revising and also redesigning the incentives.

3.2.1 Incentives for C&I Energy Efficiency Programs

As incentives are designed within the context of a program and a market for energy efficiency, it is important to review the particular environment in which incentives are being used, and also to review common practice in C&I retrofit programs in other jurisdictions.

Incentive Structures and Risks

There are several ways to define incentive structures. At the most basic level they can be classified as either cost-based or performance-based. This is in reference to the way that savings are paid for – either based on the measure that is installed or based on the savings that are achieved.

Cost-based incentives provide a fixed fraction of the expenditures on efficiency, or in some cases the incremental expenditures on efficiency, as the incentive.

Performance-based incentives pay a fixed amount of money for meeting a specified performance level or pay a fixed amount per unit of energy savings for products that meet or exceed a threshold. These amounts are the same irrespective of the incremental cost of achieving the efficiency and are even available if the incremental cost turns out to be zero or negative.[63]

Incentive structures can be further described in terms of how they are managed over the program life.

Managed (or negotiated) incentives are programs in which an administrator actively manages the program to maximize its savings within a given cost budget. Managed incentives can be changed in terms of the dollar amount or the qualifying level in response to market conditions.

Long-term incentives are fixed for a multi-year period. They are intended to give designers and manufacturers some assurances that the incentives will be there in order to plan for investments that would not otherwise be justified in a business plan. [64]

There are other classifications that refer to the way that incentives are calculated and the channels through which they are paid out as shown in Table 3-4.

[63] Ibid.
[64] Ibid.

Table 3-4. Types of Financial Incentives As Defined by National Action Plan[65]

Financial Incentives	Description
Prescriptive Rebate	Usually a predetermined incentive payment per item or per kW or kWh saved. Can be provided to the customer or a trade ally.
Custom Rebate	A rebate that is customized by the type of measures installed. Can be tied to a specific payback criteria or energy savings. Typically given to the customer.
Performance Contracting Incentive	A program administrator provides an incentive to reduce the risk premium to the ESCO installing the measures.
Low Interest Financing	A reduced interest rate loan for efficiency projects. Typically provided to the customer.
Cooperative Advertising	Involves providing co-funding for advertising or promoting a program or product. Often involves a written agreement.
Retailer Buy Down	A payment to the retailer per item that reduces the price of the product.
MW Auction	A program administrator pays a third party per MW and/or per MWh for savings.

Prescriptive rebates can be either cost-based, when participants are paid a standard amount for a particular piece of equipment (as in the ERIP program prescriptive measures) or performance-based, when a standard amount is paid for each unit of energy saved (kW or kWh). Custom rebates can also be either performance-based or cost-based. The custom part refers to the fact that the savings must be calculated individually at each site and are not deemed for each piece of equipment. A performance-based incentive structure can ensure that not only is equipment installed correctly but that the expected savings are achieved consistently over a period of time. This method has the highest level of confidence in terms of proving savings associated with a program, but it does require the extra expense and customer time to perform the M&V and would only be cost-effective for large projects. However, many large C&I customers already have an in-house energy manager and may have M&V procedures in place as part of their normal operation, so this additional cost may not always be necessary.

Risks

As stated in the introduction, a well-designed program ideally produces benefits for the customers, utility, and society in general. However, in reality there can be complications and risks, especially related to the use of cash incentives to enable energy efficiency:

- **Performance Risk:** The utility may not get the anticipated return for the incentive dollar if EE equipment doesn't perform as expected throughout its expected useful life.
- **Targeting the Right Barrier:** The up-front cost may not be the primary barrier for some customers, thus reducing the impact of the incentive dollar.
- **Distorted Market:** Cash incentives in some cases can distort the market as the cost of equipment is raised in order to capture the maximum incentive payment.
- **Diminishing Returns:** Beyond a certain point, usually measured in terms of the payback period, additional incentives may produce marginal benefits.
- **Customer Commitment:** If participants do not have any "skin in the game," they may not retain or even install the measures.

[65] Source: National Action Plan on Energy Efficiency, US DOE and EPA, July 2006

Approaches to mitigating these risks are presented at the end of this section in the Recommendations sub-section.

3.2.2 Programs in Other Jurisdictions

Approaches used to set incentive levels for EE programs in other jurisdictions in North America were researched for a previous study[66] submitted to OPA. The study showed that although there are a variety of approaches used, there are some common metrics used to determine incentives levels through many of the programs. These include:

- A limit based on the total incentive as a percentage of project costs (many programs set a limit on the incentive to 40% or 50% of project costs);
- Estimated years of customer payback (target one or two years maximum);
- Avoided costs for demand and energy (e.g., incentives cannot be higher than avoided costs); and
- Net utility benefits ((utility benefits minus utility costs)

Table 3-5 presents highlights of surveyed programs and a comparison with Ontario's programs. Most of the programs offer incentives based either on demand or on energy savings, and some offer incentives only for energy savings. Only the incentive for energy storage offered by NYSERDA is for demand savings only. Some of the programs have a custom approach, requiring M&V (plus energy audits) to determine energy savings, and some incentives are set in advance as prescriptive incentives for a range of defined measures.

Of the four Ontario EE programs, the BOMA CDM and BBP-EB program designs are not very different from the programs found in many other jurisdictions in that incentives are calculated differently for custom and prescriptive measures, and incentives are offered for either energy or demand savings. However, the BIP and ERIP programs offer incentives solely for demand reductions, which is unusual.

When comparing the level of incentives offered in Ontario to other jurisdictions, the $400/kW peak demand incentive offered through the BOMA CDM and BBP-EB programs is higher than most of the incentives for demand savings found in the research; only NYSERDA's energy storage incentive in upstate New York is higher. On the other hand, the $0.05/kWh is at the lowest end of the range of incentives offered for energy savings. This reflects the emphasis on efficiency measures that save peak demand in Ontario.

[66] "Incentives For Electricity Retrofit Programs In Commercial And Industrial Markets", prepared by Summit Blue Consulting, submitted to Evaluation, Measurement & Verification Department, Ontario Power Authority, November 28, 2008

Table 3-5. Comparison of Incentive Types, Determination, and Levels with Other Jurisdictions[67]

Program Jurisdiction	Incentives Offered	Incentive Types	Determination of Incentive Levels	Example Incentives
Arizona (Arizona Public Service)	Energy or demand	Prescriptive or custom	Prescriptive: 50-75% of incremental measure cost, payback 2 years or less, must pass TRC	Prescriptive lighting: T8/T5 $5, Premium T8 $8, LED Exit sign $25, Lighting Controls $0.12/connected watt
California (Standard Performance Contract)	Energy only	Prescriptive	Approximately equal to one year of simple payback; based on customer tariff, cannot equal more than 50% of measure cost	Lighting: US$0.05/kWh, Air-conditioning and refrigeration: US$0.08/kWh (category I) or US$0.14/kWh (category II), Motors and other equipment: US$0.08/kWh
New York (NYSERDA)	Energy or demand (Demand only for energy storage)	Pre-qualified or performance based	Historical data, professional judgment, past years' participation rates, and future participation and/or savings targets; incentive cannot be more than 50% of project cost.	Electric Efficiency: US$0.12/kWh (Upstate), US$0.16/kWh (Con Edison) Energy Storage: US$300/kW (Upstate), US$600/kW (Con Edison)
Texas (Austin Energy & Oncor Electric Delivery Co)	Energy or demand	Prescriptive and performance-based	Based on avoided costs and achieving energy and demand savings goals at the lowest reasonable cost per program. Incentives not allowed to exceed avoided costs.	Austin Energy: US$175-250/ kW reduced Oncor Electric Delivery Co: incentives based on 50% of Oncor's avoided costs. Incentive levels offered during 2003 and 2004 were US$270 per kW, US$0.0925 per kWh.
Vermont (Efficiency Vermont)	Energy or demand	Prescriptive and custom	Customer-specific for custom projects: based on optimized technical and financing options	Incentives based not only on the equipment and financing, but also the customer's needed payback threshold and available funding.
Nova Scotia (Nova Scotia Power)	Energy or demand; financing option	Custom	Cost-effectiveness, the equipment involved, and other factors. Financing option: interest-free loans, repaid through payments on the customer's bill for up to 24 months.	Maximum incentives for any project may be up to: $1,000 for a preliminary energy audit/scoping study, $15,000 for a feasibility study, and $500,000 or 50% of eligible costs for implementation.
Ontario – BOMA CDM	Energy or demand	Custom	Verified summer peak demand savings or annual energy savings, up to 40% of project capital costs.	$400/kW of verified summer peak demand savings, or $0.05/kWh of verified energy savings.
Ontario – BBP-EB	Energy or demand	Custom	Verified summer peak demand savings or annual energy savings, up to 40% of project capital costs.	$400/kW of summer on-peak demand reduction, or $0.05/kWh of annual energy savings,
Ontario – BIP	Demand only	Custom	Tiered incentives paid for verified average peak kW savings:	Average peak kW savings: < 100 kW: $150/kW; 100-350 kW: $250/kW; >350 kW: $350/kW
Ontario – ERIP	Demand only	Prescriptive and custom	Verified demand savings or prescriptive based on measure type, up to 50% of total EE project cost.	$150/kW saved: kW saved is the maximum of 100% summer kW, 80% winter kW and 50% of spring/fall kW.

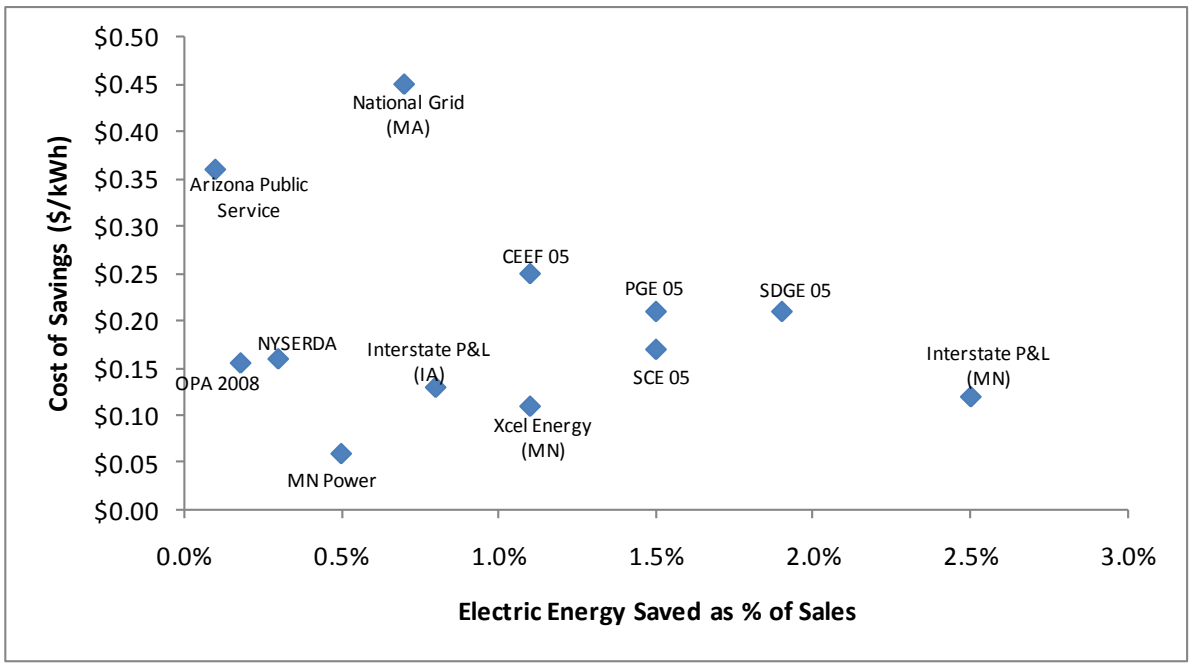
[67] *Source: "Incentives For Electricity Retrofit Programs In Commercial And Industrial Markets", prepared by Summit Blue Consulting, submitted to Evaluation, Measurement & Verification Department, Ontario Power Authority, November 28, 2008; OPA program descriptions; Summit Blue research*

In terms of the success of different program and incentive designs, a benchmarking study by Summit Blue for C&I energy efficiency programs shows that some programs achieve a much higher percentage of savings of net sales per $ spent than others. Figure 3-5 below shows a selection of the organizations surveyed and the relationship between achieved savings levels and cost of savings. The median values for the surveyed organizations are $0.18/kWh for cost of savings and 0.8% for the percentage of sales saved.

Interstate P&L (MN) achieved the greatest rate of C&I energy savings as a percentage of total energy sales, of 2.5%, at below median costs of $0.12/kWh. Alliant Energy's (the parent company of Interstate P&L) C&I program, called Shared Savings, offers customers the opportunity to upgrade equipment with no up-front capital investment. The utility pays for the initial cost of the high-efficiency equipment and the customer repays the utility each month on their utility bill over a contract term, which is typically five years. The California utilities also achieved high rates of savings, but at costs around $0.20/kWh, well above the median of the surveyed organizations. Xcel Energy (MN), MidAmerican (IA), and Interstate P&L (IA) also achieved above median energy savings rates at below median costs.

OPA's programs saved approximately 0.2% of sales in Ontario, based on net program savings in 2008 and electric energy used in 2006.[68] This is at the lower end of the range of savings, compared to the other organizations; however, the cost of savings is slightly lower than the median. Ontario's goal is approximately 1.2% of peak demand by 2012. Although this cannot be compared directly to the metric of percent of total energy sales (most likely to achieve that level of demand savings through energy efficiency, an even higher percentage of energy savings will need to be achieved) it indicates that the goal is ambitious compared to what has been achieved elsewhere.

Figure 3-5. Scatter Plot of C&I Electric Energy Savings vs. Cost of Savings ($/kWh)



Source: Summit Blue internal research and OPA program evaluation results

[68] http://www.oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/com_on_1_e_3.cfm?attr=0

The study also provides estimates of the percentage of total program costs that go to incentives. In the programs surveyed, the share of total program costs that went to incentives ranged from 63.7% to 85.8%. All of OPA's programs are below this range, except for the BOMA CDM program, at 71%. The other three programs have a ratio of 48% or lower. Total program costs per kWh achieved, for organizations in the benchmarking study, ranged from 5 cents to 34 cents per kWh. OPA programs ranged from 2 cents to 24 cents per kWh saved, with the average over the four programs being 16 cents, which is on the low end of the range when compared to other programs.

The incentives offered through OPA's programs are at the lowest part of the range when compared with these surveyed programs, as far as incentives for energy savings are concerned. They study does not give details of incentives on a per kW basis for the surveyed energy efficiency programs.

Table 3-6. Performance and Cost Data for Sample C&I Programs

		Program Design				Program Results		
Utility	**Program Name**	**Incentive Costs as % of Total**	**Incentive (US$ /kWh)**	**Total Program Costs (US$ /kWh)**	**Program Costs (US$M)**	**Incentive Costs (US$M)**	**Program Energy Savings (GWh)**	**Program Costs for Achieved Savings (US$ /kWh)**
MidAmerican	Non-Res Equipment Program	85.8%	$0.05	$0.06	3.4	2.9	63.5	$0.05
PG&E	Upstream Motors and HVAC	81.3%	$0.28	$0.33	6.4	5.2	18.6	$0.34
OPA	BOMA CDM	71%	$0.05	$0.06	3.0	2.16	13.7	$0.21
OPA	BBP-EB	48%	$0.05	$0.08	0.5	0.23	22.2	$0.02
OPA	BIP	22%	n/a*	n/a*	0.8	0.16	3.2	$0.23
OPA	ERIP	40%	n/a*	n/a*	9.9	4.41	54.5	$0.06
PG&E	Express Efficiency	79.0%	$0.04	$0.05	15	11.9	319.6	$0.05
SCE	Prescriptive Non-Residential	83.2%	$0.13	$0.15	32.9	27.4	205.1	$0.16
SDG&E	Prescriptive Rebates	75.4%	$0.07	$0.09	5.9	4.4	62	$0.10
Xcel Energy	Lighting Efficiency - C&I	63.7%	$0.05	$0.07	1.9	1.2	25.3	$0.08
Xcel Energy	Lighting Efficiency - Small Business	65.1%	$0.06	$0.08	0.6	0.4	6.7	$0.09
Xcel Energy	Cooling Efficiency - C&I	78.9%	$0.16	$0.19	1.8	1.4	8.4	$0.21
Xcel Energy	Cooling Efficiency - Small Business	73.9%	$0.18	$0.23	0.4	0.3	1.6	$0.25
Xcel Energy	Motor Efficiency - C&I	65.8%	$0.04	$0.05	1.5	1.0	22.2	$0.07
Xcel Energy	Motor Efficiency - Small Business	65.2%	$0.08	$0.11	0.1	0.1	1.1	$0.09

Source: Summit Blue internal research

* Incentives for BIP and ERIP programs not offered for energy savings, only for demand savings

Assumes a US/Canada exchange rate of 4%.

In order to fairly compare OPA's programs with the programs in the study, it is necessary to examine the major cost variances or other factors that go into determining an appropriate incentive:

1. The ratio of incentive to customer costs (i.e., equipment costs)
2. The ratio of equipment costs to savings achieved by the measure, either energy or demand
3. The ratio of demand savings to energy savings for the measure type (can be weather dependent)
4. The goals and budget for the program
5. The market barriers the program is designed to overcome

For the OPA programs, both the absolute incentive offered and the percentage of total program costs in incentives are at the lowest end of the range or below the range. This could be due to several factors:

- Some OPA program results are given in terms of MW with energy savings in MWh were estimated from these results. There could be a lack of accuracy in this conversion.
- OPA programs are designed primarily to reduce demand, and the comparison above is based on energy savings only. Energy savings may be more expensive for measures that primarily save demand. For example, Xcel's cooling efficiency programs average 23 cents per kWh, but its lighting and motor programs both average 8 cents per kWh.
- Some OPA programs are designed to incent a single measure (e.g., lighting efficiency, cooling efficiency); programs targeted to particular end-use equipment can often be more efficiently run and cost-effective than general C&I programs because incentives can be tailored for the targeted measure, taking into consideration equipment costs and expected savings. OPA's programs incent a range of different measure types though most savings were from lighting.

At first glance, the comparison between OPA's programs and the programs in the benchmarking study indicates that OPA may be setting their incentives for energy savings too low and therefore not meeting the market needs in Ontario's C&I sector. However, this cannot be said conclusively because of the points made above. This comparison also points to the likelihood that a financing-based program such as Alliant Energy's Shared Savings program, which is the best performing program, should be examined as a model that could produce a higher reduction in overall energy sales for a reasonable price.

3.2.3 Decision-Making Processes

This section assesses the influence of both economic and other considerations on the decision-making processes that go on in the C&I sector with regards to energy use and in designing energy efficiency programs in that sector. Key conclusions from this section are:

- Some of the barriers to participation have more to do with the way businesses are run (payback period requirements and operational priorities) than the structure of the programs.
- A more finely tuned incentive structure in terms of the incentive levels for different measures could encourage more participation for a range of measures and higher performing measures.
- Incentive levels are currently on the low side in terms of the percentage of equipment costs that they represent, which is a barrier to program participation.
- There is some market confusion because of the different incentive levels offered through the four different programs, sometimes in the same territory and sometimes in different territories.

The rest of this section contains details of the analysis of decision-making processes.

Barriers to EE in the C&I Market

Research into barriers to the uptake of EE measures were outlined in reports submitted as part of the OPA's IPSP. The reports indicate that the barriers mainly relate to two areas:

- The **payback period**, which is a common way for businesses to determine if they will go ahead with a project, must be below a threshold established within the business; this threshold may not necessarily be appropriate when applied to EE measures.

- Managing energy use is low on the list of **operational priorities** for both building owners and tenants, mainly because energy costs are such as small part of their operating budget, and for other reasons.

Highlights of incentive-related feedback from Summit Blue's recent research into the current OPA programs are provided here:

Structure of Incentives

The feedback related to the programs' incentive structures indicate that for many customers the current structure of offering a flat value for demand savings (for BIP), or demand or energy savings (for BOMA CDM and BBP-EB), are not ideal in terms of encouraging a range of different measures. Certain measures that would contribute significant savings to the program need to have higher level incentives in order for it to be worthwhile for the customer to participate. This is supported by the comments below.

- *The structure of the incentive has been a barrier for the BIP as the incentive does not necessarily relate to the cost of the project. Customers ask: "What is in it for me?" BIP program staff has concluded that one size fits all incentives are not effective and are trying to implement graduated incentives in a limited way. (BIP Staff)*

- *Currently, the program provides a flat incentive regardless of measure type. The major BIP design improvement would be to develop an incentive plan that accounted for the type and quality of the measure to focus the program on high value measures. Special programs could be embedded within the BIP to encourage the implementation of specific measures in a targeted approach. (BIP Program Implementers)*

- *There is also value in having a common, simple incentive of $400 a kW that greatly aids program understanding and there is an argument on the other side of the spectrum that (different incentives cause)… complexity and misunderstanding. So I think differentiated incentives could be a natural evolution of the program. That said, I believe the standard incentive was the right way to start." (BOMA Program Designer)*

Level of Incentives – ERIP

Data from the program budgets shows relatively low ratios between incentives and customer costs (customer costs are the difference between the total project costs and the distributed incentives) as shown

in Table 3-7 below. A rule of thumb in this sector is that the incentive should be at least 25% of the total project as discussed previously. The current incentives may not be enough to make the efficiency upgrade acceptable for most businesses.[69]

Table 3-7. Incentives as a Percentage of Customer Costs

	BOMA CDM	BBP-EB	BIP	ERIP
Incentives as % of Customer Costs	18%	2%	13%	12%

Comments from LCD managers also point to a need to revise upwardly the ERIP incentives and to restructure the BOMA CDM and BIP standard incentives for demand savings.

- *The custom forms are difficult to complete and the incentives are not generous enough. (ERIP LDC Managers)*
- *Some customers don't feel the incentives are high enough. Changes to the custom [incentives] have been significant - have changed some custom lighting to prescriptive and the incentive went down. Some projects that should have been done now have been stalled as a result. It will be more difficult to meet the OPA objectives. (ERIP LDC Managers)*
- *The incentives are not high enough to be worthwhile based on the amount of money they would have to put out. This year [the incentives] increased and made it more comprehensive which is good. But customers don't feel it is enough to warrant the investment. (ERIP LDC Managers)*
- *…we got three people who decided not to go through with it as the incentive was not enough to warrant the project. (ERIP LDC Managers)*
- *It's amazing how frequently a customer applies and then drops off the face of the planet—probably reflects how important the incentive is to them—may not be that important and may not be a high priority at that time. In some cases, you can see why, because the incentive level probably doesn't represent a very big portion of their project and they have bigger fish to fry. (ERIP LDC Managers)*

These comments point to a need to revise upwardly the ERIP incentives and to restructure the BOMA CDM and BIP standard incentives for demand savings.

Market Confusion

There is some confusion in the EE market due to the different levels of incentives offered in different parts of Ontario for the same measures. Currently, a customer with a facility outside of the area defined as City of Toronto would receive $150/kW through the ERIP program, compared to the $400/kW they could get through the BOMA CDM or BBP-EB programs if their facility were located inside the City of Toronto area. This means that the same EE installation could be being cost-effective within the city and not cost-effective outside of the city, and this creates complications for large customers with facilities both within and outside the city.

[69] This information provided by James Darrach of Burman & Fellows Group Inc., an EE contractor operating in Ontario.

Some comments on this issue from LDC Managers include:

- *One of the barriers is the competing programs (sponsored by OPA) to the same eligible customer base.*
- *…some customers feel they are missing out on the incentive amount based on where they are located*
- *Program design issues and OPA policy are the largest barriers to ERIP participation. Design issues include…competition from OPA programs with higher incentives.*

3.2.4 Getting Demand Savings from EE Programs

Most EE programs save both energy and demand, and the ratio between the two types of savings for each program will vary depending on the measures installed, the facilities where they are used, and local weather conditions. The OPA's goals are defined in MW, not MWh, so demand savings should be the priority for the EE programs.

In Ontario, lighting measures provide high-value permanent peak demand reductions in both winter and summer as lighting use is almost entirely coincident with Ontario's peak periods. HVAC use, which varies during the day with higher cooling load at the start of the day and another high use period ending around 17:00, also has high coincidence with the OPA's on-peak hours, although obviously winter use is a lot lower than summer use. HVAC provides permanent peak demand reductions in summer but much smaller peak demand reductions in winter.

Measure Level

Table 3-8 shows typical ratios between summer peak demand and energy savings for different measure sub-categories within the categories of motors, lighting, and cooling, taken from a 2007 study by ACEEE estimating peak demand impact of energy efficiency[70] As would be expected, air conditioning measures have the highest ratios, but some premium efficiency motors also have high ratios. Lighting shows a lower ratio than would be expected. These values are taken from a wide range of programs in North America, and climate conditions and peak periods are likely different than those that exist in Ontario. However, they do give an indication of which measure types are more likely to give a high ratio of demand to energy savings.

Entries for OPA's BOMA CDM program have been included in Table 3-8 to compare to the data in the study. The ratio between demand and energy savings is generally lower for the BOMA CDM program compared to other programs; only the lighting ratio is close. Entries for BOMA CDM are shown on a per project basis, while entries for the study are shown on a per measure basis; tracking data did not include measure counts.

[70] Source: Examining the Peak Demand Impacts of Energy Efficiency: A Review of Program Experience and Industry Practices, by Dan York, Martin Kushler, and Patti Witte, February 2007, ACEEE

Table 3-8. Energy and Peak Demand Savings for Selected C&I Measures

End Use	Measure	Ave. Coincident Summer Peak Demand Savings (kW)	Ave. Annual Energy Savings (kWh)	Ratio of Demand/Energy Savings (MW/ GWh)
Lighting	Compact fluorescent light bulbs	0.026	143	0.18
	T-8 fluorescent lamps with electronic ballasts	0.008	46	0.17
OPA – BOMA CDM	Lighting Retrofit	42 (per project)	268,840 (per project)	0.16
HVAC	EE chillers 150 tons centrifugal	12.45	21,450	0.58
	EE chillers 300 tons centrifugal	24.90	42,900	0.58
OPA – BOMA CDM	HVAC Redesign	64.9 (per project)	349,030 (per project)	0.19
OPA – BOMA CDM	Deep Lake Water Cooling	632 (per project)	1,583,180 (per project)	0.4
Motors	Premium efficiency motors - 5 hp	0.063	163	0.39
	Premium efficiency motors - 10 hp	0.133	311	0.43
	Premium efficiency motors - 25 hp	0.171	788	0.22
VSDs	Variable speed motor drives - 5 hp	1.015	5,005	0.20
	Variable speed motor drives - 10 hp	2.030	10,010	0.20
	Variable speed motor drives - 25 hp	5.075	25,025	0.20
	Variable speed motor drives - 45 hp	9.135	45,045	0.20
OPA – BOMA CDM	VSDs	35.5 (per project)	255,400 (per project)	0.139

In Ontario, lighting, HVAC upgrades, and deep lake water cooling have provided almost 80% of the total demand savings for all four programs; lighting upgrades alone provided over half of the demand savings. Table 3-9 shows the ratio of demand and energy savings for these main categories of measures. HVAC upgrades have the highest MW/GWh ratio, followed by Deep Lake Water Cooling and then Lighting.

Table 3-9. Top Three Demand Savings Measures for OPA Programs

Measure	OPA Programs Offering Measure	Peak Demand Savings (MW)	% of Total Demand Savings	MW/GWh
Lighting Controls and Retrofit	All	42.7	62%	0.17
Deep Lake Water Cooling	BOMA CDM, BBP-EB	6.6	10%	0.19
HVAC Improvement and Re-Design	All	4.7	7%	0.34

Source: Program tracking data.

Note: MW/GWh ratio is only based on data from BOMA CDM and BBP-EB programs, since BIP and ERIP only report demand savings, not energy savings.

Program Level

Looking at demand savings on a program level, Table 3-10 shows typical ratios between demand and energy savings for a selection of programs. Demand savings as a percentage of energy savings (MW/GWh) vary considerably, from 15% for a Compressed Air Prescriptive Rebate program in Massachusetts up to 77% for an Air Conditioner Installer and Information program run in Texas.

Some of the demand to energy ratios for OPA's programs appear to be on the low side when compared with these ratios, as shown in Table 3-11. The values shown in Table 3-11 are the ratio between gross verified demand savings and gross verified energy savings for each program. However, it should be noted that most of the programs in Table 3-11 are single-measure programs, whereas Ontario's programs are all multi-measure, leading to an averaged ratio for a group of measures.

Table 3-10. Energy and Peak Demand Savings from Sample Programs

State	Program Name	Annual Energy Savings (MWh)	Peak Demand Savings (MW)	MW/GWh*
CA	San Francisco Peak Energy Program	56,768	9.1	0.16
CA	Northern California Power Agency SB5x Programs	37,300	15.9	0.44
CA	California Appliance Early Retirement and Recycling Program	—	—	—
TX	Air Conditioner Installer and Information Program	20,421	15.7	0.77
FL	High Efficiency Air Conditioner Replacement (residential load research project)	—	—	—
CA	Comprehensive Hard-to-Reach Mobile Home Energy Saving Local Program	7,681	3.7	0.48
MA	NSTAR Small Commercial/ Industrial Retrofit Program	27,134	6.0	0.22
MA	2003 Small Business Lighting Retrofit Programs	35,775	9.7	0.27
MA	National Grid 2003 Custom HVAC Installations	980	0.17	0.17
NY	New York Energy $mart^{SM} Peak Load Reduction Program	—	15.0	—
MA	National Grid 2004 Compressed Air Prescriptive Rebate Program	673	0.098	0.15
MA	National Grid 2003 Energy Initiative Program—Lighting Fixture Impacts	36,007	6.5	0.18
MA	National Grid 2004 Energy Initiative and Design 2000plus: Custom Lighting Impact Study	1,593	0.266	0.17

* This column is derived values from reported peak demand savings and annual energy savings.

Source: Examining the Peak Demand Impacts of Energy Efficiency: A Review of Program Experience and Industry Practices, by Dan York, Martin Kushler, and Patti Witte, February 2007, ACEEE

Table 3-11. Ratio Between Demand and Energy Savings for Ontario Programs

Program	Ratio MW/GWh
OPA BBP-EB	3%
OPA BOMA CDM	28%
OPA BIP	15%
OPA ERIP	20%

*Source: Summit Blue Research: *

Because of the congestion problems within the city of Toronto, it makes sense for programs within the City to aim for a high overall MW/GWh ratio and to promote those measures that will provide high permanent load reductions at peak times, in addition to energy savings at other times. It appears that BOMA CDM and BIP are achieving this goal but BBP-EB is not, while ERIP, which is implemented outside of Toronto, is also achieving a high ratio of demand to energy savings.

3.2.5 Adjusting Incentive Levels to Reflect a Changing Market

The adjustment of incentives over time to reflect a measure's progress towards 100% market penetration will ensure that incentives are optimized for net savings rather than gross. When measures are relatively

new to the market, it may be necessary to incent them at a higher rate to offset the perceived risks from customers in using newer technologies. However, it may be worth it in the long term to promote the technologies which show large promise for the sector by offering higher incentives. For example, LED lighting shows good potential for large energy reductions but is still relatively expensive.

As measures are taken up by more and more customers, they will eventually become mainstream, at which point an efficiency program can no longer claim savings from them (i.e., the net to gross is 0%). This is happening, for example, in the lighting equipment area. T8s are now becoming the standard type of lamp in commercial settings, and T12s are due to be phased out altogether in 2011 when replacement lamps for T12s will no longer be sold in Ontario. It is estimated that already around 70% of all T12s have been converted to T8s. Therefore, it would make sense for programs to stop incenting T12 to T8 conversions at the end of the current program cycle and to focus on other opportunities for reducing lighting energy use.[71] For example:

- Retrofitting to advanced lighting controls with high performance T8s and electronic ballasts;
- Retrofits to super high performance T8 lamps (28W versus 32W or 30W); and
- Advanced controls including dimming for over-lit spaces, perimeter day-lighting, tenant enabled controls, and "lighting load attribution" where tenant's lighting energy use is monitored and used to adjust lease rates.

There are benefits to adjusting incentive levels to match market conditions and also some possible drawbacks. However, this adjustment of incentives over time is common practice. For example, in New Jerseys' Clean Energy Program compliance filing it is stated that as *new technologies are introduced and prices for measures change, sometimes in response to program offerings, program managers need to continuously monitor technologies and costs and adjust program incentives accordingly. The utilities will propose adjustments to these offerings based on program experience, the results of any evaluations, program and market studies as well as other state/regional market research, and current pilot/demonstration projects.*[72]

Customers want consistency from EE programs as they plan equipment upgrades over a period of time, so changing incentive levels too often can cause participation to drop. On the other hand, not adjusting incentives to match market conditions could mean that upgrades that would have been done anyway are being incented unnecessarily. Staying in touch with the market, getting customer feedback, and doing regular benefit/cost analyses with good net to gross values will allow program administrators to know when it is time to adjust incentives downwards or even eliminate measures completely.

Finally, because retail electricity tariffs are currently quite low in Ontario due to legislation on rates, a more generous incentive is needed to reduce the payback period to an acceptable timeframe for the business. (A payback calculation is based on the expected retail cost of energy saved per year and the incremental cost and lifetime of the measure. If the retail cost of electricity is low, the benefits will be lower and the payback will be longer.) If electricity rates rise in the future then this will need to be reflected in the incentive design.

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[71] SeeLine Group Ltd., in partnership with Quantec, LLC., *2007 BOMA CDM Program Evaluation*, For The Building Owners And Managers Association, Final Draft Report, April 22, 2008

[72] *New Jersey's Clean Energy Program: 2006 Program Descriptions and Budget*, Revised Compliance Filing, December 2006, https://wwwnet1.state.nj.us/Webdocs/Treasury/DPP/eBid/07-x-38468Other3033-3.pdf

3.2.6 Recommendations – Current Program Cycle

This sub-section provides recommendations for incentive designs for the remainder of the current program cycle, through the end of 2010. These recommendations were developed based on ongoing research into program design and evaluation along with our knowledge of the Ontario market and the performance of the programs currently being run in the province. There are 10 recommendations:

- **Demand/Energy Choice:** Offer a choice to customers to receive incentives based on either kWh or kW saved in all of the four programs or offer incentives based on both kWh and kW savings, since most measures save both energy and demand. This makes it easier for customers to sign up for the program and install the equipment that suits the needs of their building and operations. Reflect the true cost of demand savings by designing incentives to reward demand savings at a much higher rate than energy savings, which will encourage measures that provide a high savings demand/energy ratio. If energy savings are achieved, that will still help the Green Energy Act's overall goal of mitigating climate change, so these should not be discounted by offering only a $/kW option.
- **Use Cost-Effectiveness Methodologies:** When designing incentives, first calculate the TRC to ensure cost-effectiveness, then set the maximum incentive based on either the customer payback period (taking into account incremental measure costs) or Net Utility Benefits. Conduct a literature review of what other jurisdictions are offering for the same measures under similar circumstances.
- **Regular Reviews of Cost-Effectiveness:** Regularly (for example, yearly) do a benefit-cost analysis for each type or class of measure in the program. In the analysis, use avoided costs which accurately reflect the value of the savings at the time and in the area where they will be made. Also use current costs of the technology in the area. Review the status of measures in the market to determine if they are gaining significant market penetration and adjust free riders. For example, a free ridership of 10% would not be appropriate for a technology that has over 70% market penetration. Different levels of free riders can be input to the analysis to provide insight into whether or not the measure is still cost-effective or should be removed from the approved measures list.
- **Phase out Older Measures:** Review whether standard measures such as T8 lights and CFLs should be removed from the programs and more efficient measures such as Super T8s be added, as has been done in other jurisdictions. Most of the measures incented are not new to the market and OPA should consider changing the technologies which are included in the program to reflect current conditions. For example, T8 lights have high market penetration and will be standard by 2011. In addition, many standard CFL bulbs can be purchased for less than the incentive offered by OPA. By focusing on newer and higher quality technologies, OPA will start moving the market to higher efficiency levels. This would also have the added benefit of reducing free riders and maximize net rather than gross impacts. The net to gross analysis and process evaluation should help to evaluate these views.
- **Standardization:** Standardize incentives, or at least bring them closer into line, between programs. Right now, for example, a customer with two buildings close to each other but with one designated as within the Toronto area and one just outside, would receive very different incentives for the same measure - $400/kW within Toronto and $150/kW outside of Toronto. The incentive should reflect the costs that are avoided in each area but be smoothed out so that companies with facilities outside the city boundaries don't end up with a much lower take up rate for EE, and companies that operate both inside and outside the city can upgrade all of their facilities.

- **Consider Electric Rates:** When calculating incentives, take into account the low electric rates for C&I customers in the province and what kind of tariffs they are on, as these affect the customer's payback calculation. The incentive needs to make up for the low customer avoided costs.
- **Reliability Bonus:** In general, pay higher incentives for more reliable savings that are verified with on-site M&V.
- **Target Measures:** Use existing market research and potential studies to identify the technologies that have the most potential for quick implementation, can reduce peak demand on both winter and summer peak days, and are most in need of the incentives.
- **Target Measures in Different Subsectors:** Target specific end uses in different sub-sectors within the C&I sector – for example, Small and Medium Industry, Small Business, Large Office, Small Commercial, and Large Retail. Use existing potential studies to identify the most promising technologies in those sub-sectors. A prescriptive incentive approach for each sub-sector can be used so that savings estimates are more accurate, due to the conformity of building types and operations within each sub-sector, without having to use M&V at each site.

To use this targeted approach, identify preferable incentive design (choosing between a detailed sub-sector prescriptive incentive or a custom incentive or M&V plan) for each combination of sub-sector and measure type. In general, if an end-use (such as refrigeration in grocery stores) consistently represents a large part of energy use in a particular sub-sector, then both primary research and specialist promotion of measures that address that end use in that sub-sector will be cost-effective. On the other hand, the savings from some measures are inherently unique at each site, such as sub-metering. Table 3-12 provides some sample measure type and sub-sector combinations and a suggestion for which incentive design would fit best.

Table 3-12. Sample Sub-Sector & Measure Combinations with Incentive Design

Sub-Sector	Measure Categories with Detailed Prescriptive Incentive	Measure Categories with Custom Incentive or M&V Plan
Medium and Large Industrial		Process-related (Motors, HVAC, Refrigeration, Furnaces, etc.), Demand Management
Small Commercial or Small Office	HVAC (cooling and heating), Lighting	Refrigeration, Sub-Metering
Large Office	Building Automation Systems, Deep Lake Water Cooling, Lighting	VSDs on HVAC, Office Equipment, Lighting Controls
Large Retail – Non Grocery	Lighting, Building Automation Systems, HVAC	VSDs on HVAC, Lighting Controls, Refrigeration
Small and Large Grocery	Refrigeration, HVAC, Lighting	Lighting Controls, VSDs on HVAC

Two Suggested Basic Incentive Structures: To keep program implementation simple and encourage more participation across the province, consider implementing two basic incentive structures.[73]

1. An **Express Efficiency** incentive scheme that would offer standard prescriptive incentives for common measures in different C&I sub-sectors. It would not require any M&V but only proof of purchase and installation, and the incentive would be based on average savings for the measure across the sub-sector. This would need to be based on existing or new research into typical savings for the measure. This approach means that there is some uncertainty about how much actual savings would be achieved at any particular site, hence a lower $/kW or $/kWh incentive would be offered, but it would make it simpler and easier for customers to participate. This would suit the small commercial and small industrial sub-sectors. A different incentive could be offered for different end uses based on the value of the prescribed savings.

2. A **Standard Performance Contract** program that would offer incentives based on actual kW and kWh savings at each site. This would require on-site M&V work, performed by an approved M&V implementer. A minimum size of project would need to be set to make this cost effective. Incentives would be paid over a number of years and be linked to proof of continued savings from the measures. With this type of incentive, the contractor and/or customer assumes the risk of paying for measures that may fail to generate verifiable savings over a period of time, but that risk is lowered by knowing that an incentive will be received as long as savings are being generated.

3.2.7 Recommendations – New Program Cycle

Up to now, OPA's programs have achieved some success in meeting program goals and influencing the market. Approximately 50 MW of savings were achieved through the programs in 2007 and 2008. This represents 15% of the total 320 MW goal for the portfolio of programs to 2010, and therefore an additional 270 MW of savings will be needed to the end of this program cycle in 2010 if goals are to be met. In addition to the savings, many C&I building managers and energy services contractors have become familiar with the incentive structure and format of the current programs. Because program goals for the current cycle are unlikely to be met, and keeping in mind the revised and ambitious savings goals outlined in the Green Energy Act of 2009, the need for a review and possible redesign of the way incentives are paid out for the program cycle starting in 2010 is apparent.

Recently, views on incentives have been changing, with some utilities, such as BC Hydro, trying to phase out direct cash incentives and instead bringing in electricity pricing schemes that encourage energy efficiency. These utilities do not want to be viewed as simply a provider of cash and are now trying to avoid offering monetary incentives whenever possible.

Research into the barriers to EE in the C&I sector in Ontario indicates that equipment cost is one hurdle but often not the most important. Therefore up-front cash rebates, which are primarily given to reduce project costs, may not be the best type of incentive to use. They do not overcome the barrier of "split incentives," meaning that the building owner is not motivated to improve efficiency in the building because they don't pay the energy bills. They also don't address the issue of operational priorities, where energy management is a low priority for both tenants and building owners. Feedback from C&I customers

[73] This dual incentive approach is employed by the California IOUs.

received in past surveys show that the designs of the current programs are addressing some of the needs of the market, but not all of them. The incentives are in general making a difference in the capital investment required, but not offering options such as low-interest financing, or targeting specific market sub-sectors.

For the long term, we recommend revising the current program designs to incorporate feedback and address market barriers, and to address current trends and other market designs. Some of these other incentive designs are outlined here.

Other Candidate Incentive Designs

There are other options that can be used instead of monetary incentives:

- **Innovative rate designs** can be used to reduce or even eliminate the need for monetary incentives. Conservation rates, or two-step rates, are designed to encourage customers to reduce their overall energy use, and they can be set to change by season; however, they are difficult to design. This type of rate structure was introduced by BC Hydro for their residential customers. It is being phased in, starting in October 2008 with a lower rate and then rising in April 2009.[74] The rate structure, which replaces a flat residential rate, is a two-step structure, designed to encourage conservation. BC Hydro says that it is a better reflection of the real cost of new electricity supply and gives customers a greater financial reward for their conservation efforts. Under the Conservation Rate, customers pay a lower price for any electricity used below a threshold level within one billing period, and a higher price for the remaining consumption above the threshold level. The company plans to introduce similar rates for all customer classes.[75]
- **Financing programs** can provide a means for customers to install equipment without any large cash outlay at the time of installation. For example, Alliant Energy's C&I program, called Shared Savings, offers customers the opportunity to upgrade equipment with no up-front capital investment. The utility pays for the initial cost of the high-efficiency equipment and the customer repays the utility each month on their utility bill over a contract term, which is typically five years. With this kind of program, the customer may not see any net outlay of funds over the period in which they are paying for the measure if the money saved through energy savings is equivalent to the monthly addition to their energy bill (the customer has net positive cash flow), and this would eliminate the barrier of businesses needing to meet a maximum payback period. However, this type of program must be designed carefully to ensure that projected energy savings are achieved or the customer will end up paying more than they expected and the utility will end up with a measure that is does not pass a benefit-cost test.
- **Enabling Equipment or Energy Management** incentives can do more than a cash incentive does to enhance program impacts and create a conservation culture. Here are some examples of this type of incentive:
    - An **energy manager** to visit the site periodically, for a period of one to two years, to recommend equipment changes, do energy audits, work with the building operator, etc.
    - A **coupon** for additional energy efficient equipment. For example, if a company buys two energy efficient motors, they would get a coupon for an additional efficient motor. While this

[74] BC Hydro conservation rate described at wwwa1.bchydro.com/emcweb/content/residential_inclining_block.jsp.
[75] BC Hydro Long Term Acquisition Plan 2008.

is still a financial incentive, it is not the same as direct cash; it rewards those who are already doing EE, and it makes customers think about EE when making equipment purchases[76].

- Training and additional services for **equipment vendors**. This educates vendors operating in the region about EE options, which helps to move the whole market towards efficiency due to the interaction between vendors and customers. Payments go to the vendors and not simply as cash to the participants.

If an incentive-based program design is still preferred, there are options that may work better than can be considered along with the current cash-based incentive structure:

- **Combining EE and DR:** An effective combination for highly-congested areas is a program that combines EE and demand response, offering standard rebates for peak demand reductions from energy efficiency and additional rebates for reductions during demand response events on system stress days.
- **Performance-based and long-term incentives:** Long-term management of incentive budgets to match the market as it develops can be more efficient than setting an incentive policy and following it for the lifetime of the program. An ACEEE report on incentive structures concludes that managed incentives and long-term incentives are generally complementary. Used together, they can provide a cost minimizing approach to promoting ever-improving levels of EE, including some very advanced levels.[77]
- **Load shifting technologies:** Many C&I customers are on variable, market-based tariffs, and for these customers it makes sense to use more electricity when it is the cheapest, which is at night or in other off-peak hours. This load shifting could be encouraged with the promotion of technologies such as thermal storage, which can store either heat or cooling at off-peak times for later use at peak times.

3.2.8 Final Recommendations – Blueprint for Redesign of Programs in 2011

This section provides a blueprint for reviewing and relaunching OPA's programs in 2011. There are three parts to this process – background research, reviewing past program experience, and redesigning the program portfolio by selecting one or more incentive designs and setting incentive levels. These tasks need to be done within the context of the changing Ontario energy efficiency market and the regulatory environment that exists or will exist in the province during the time the programs are being run.

Background Research

Several areas of research would be helpful to inform the redesign process:

[76] There are implications associated with this approach in terms of free-ridership – it's possible the program would be paying for measures that building owners were going to implement anyway. There would have to be a mechanism for customers to prove they had only planned to install the non-incented measures.

[77] Philip Fairey and David B. Goldstein, "Getting It Right Matters: Why Efficiency Incentives Should Be Based on Performance and Not Cost," ACEEE 2006 Summer Study.

- Research what different C&I energy efficiency program designs, which have been successfully implemented in other Canadian provinces, the USA, and other countries, have achieved in terms of their cost-effectiveness and meeting savings goals.
- Determine which program and incentive designs used in other jurisdictions have been particularly good at overcoming the most difficult barriers that exist in Ontario's C&I market (energy management is low priority for building owners and tenants alike, and "split incentives" for owners and tenants).
- Identify programs that achieved high demand savings compared to energy savings in other jurisdictions and the reason for this high demand/energy ratio.
- Analyze the potential effect of expected changes in Ontario's electricity rate structure on payback periods and the cost-effectiveness of energy efficiency measures for customers. These changes would more accurately reflect the cost of power, as outlined in the Green Energy Act.
- Conduct Ontario-specific research using customer surveys or focus groups (of both tenants and owners) to determine the likely response to new program designs.
- Consider conducting a diffusion modeling[78] effort to predict market diffusion based on factors like equipment costs, customer payback periods, etc. The modeling may prove useful in terms of planning for meeting energy efficiency goals over the whole program cycle.
- Update studies that OPA has already commissioned to determine the state of the market for energy efficiency products, especially lighting measures such as T-8s. This will help program designers to eliminate measures that already have a high market penetration.

Learn from Previous Program Experience

An analysis of OPA's current portfolio of programs at the end of the program cycle in 2010 will help the redesign process. This will enable lessons learned to be incorporated into the design of the new programs. This data can likely be extracted from the evaluation reports that will be produced by evaluators, with emphasis on the following aspects of the programs:

- How important was the incentive level in the decision to participate or not?
- What were the main reasons for participants to take part in the program, and for non-participants not to?
- For participants: what barriers did the incentive help you to overcome?
- If the incentive was lower or higher, or offered in a different way, would that affect customers' willingness to participate?

Comparison of Incentive Designs – Benefits and Drawbacks for Different Measures and Sub-Sectors

Finally, the various incentive designs that have been presented in this report need to be matched with the results of both the background research and the experience gained from previous programs to determine which incentive designs would be the best to adopt.

[78] Summit Blue has developed an in-house model that predicts technology market diffusion based on factors such as equipment costs, customer payback periods, and customer attitudes to technology.

A summary of the various incentive designs and program designs previously presented in this report is presented in the table below, with the key benefits and drawbacks of each, and the suitability for different sub-sectors and measure types.

Table 3-13. Summary of All Incentive Designs and Approaches

Approach or Program Design	Best Fit for Measure Types	Best Fit for Sub-Sector	Benefits/ Drawbacks
Express Efficiency	Standard measures such as T-8s, CFLs, AC equipment replacement, food service (restaurants), etc.	Small and Large Commercial, Restaurants, Small and Large Retail, Large Office	Low program administrative needs. Simple to understand. Not as accurate on a per-site basis.
Standard Performance Contract	Equipment replacement, refrigeration, VSDs, motors, lighting controls, electric heating	Large Commercial, Large Retail, Large Office, Industrial	Project needs to be large enough to make the M&V cost effective. Incentives paid over a number of years and be linked to proof of continued savings. Contractor and/or customer assume the risk of paying for measures that may fail to generate verifiable savings over a period of time.
Innovative Rate Designs	Lighting, HVAC, Building Automation Systems	Industrial, Large Commercial, Large Retail	Requires more sophisticated metering and billing. Can produce peak reductions without additional equipment needs.
Financing Programs	All measures	Small Commercial, Small Office	Eliminates need for customer initial capital outlay. Longer-term administrative needs for program.
Enabling equipment and energy management	Motors, VSDs, Building Automation Systems, Lighting	Industrial, Large Commercial, Large Retail	Can improve energy performance without need for new equipment. Could change energy management culture
Combining EE and DR	Building Automation Systems, Lighting, HVAC	Industrial, Large Commercial, Large Retail	Can improve impact of programs at peak times. Increased efficiency in administrative expenses.
Target specific measure types in different sub-sectors	Measures that are new/cutting edge. Measures that may not achieve enough savings to make standard incentives worthwhile.	All sub-sectors.	Overcome particular barriers in each sub-sector. Pay enough for the measure to make it cost-effective for the customer.
Fixed incentive for kW or kWh savings	Measures for which costs do not vary very much such as lighting.	All sub-sectors.	Consistently reflects the value of savings to the LSE or OPA. Simple to analyze cost-effectiveness.
Choice for participant to get incentive based on kW or kWh savings	Measures with lower energy/demand ratio such as motors.	All sub-sectors.	Programs may not hit demand savings target. Could enable more participation and different measures. Can tailor energy-based and demand-based incentives to reflect true value of the different types of savings.

To conclude, program designers will need to keep in mind both the key goals of the portfolio and the general market in the province, while considering established or potential new program and incentive designs. Some key issues to keep in mind are:

- There may be differences in the characteristics of the market in different geographical areas of the province (e.g., more electric heating in the north than in the south, more congestion in the south than in the north).

- Any approach that has already been shown not to work in this market should be eliminated, and any approach that has been particularly effective should be included.

- Program administrative requirements should be considered in terms of keeping those costs down. There should be a target for the percentage of program costs that are incentives.

- Programs should be designed to make use of the particular savings potential that has been identified in the market.

- The current economic climate may be affecting program participation.

- Ease of participation is often a key issue in the success of a program.

- Achieving verifiable and persistent savings is more valuable than savings with a high level of uncertainty.

- There are many ways to get energy savings that do not include a direct equipment rebate.

Suggested approaches for reducing the risks identified at the beginning of this section are:

- **Performance Risk:** Require equipment commissioning and revise incentives based on actual vs. projected performance.

- **Distorted Market Costs:** Track equipment costs in the market and pay incentives based on average costs.

- **Diminishing Value of Incentives:** Limit incentives to a predetermined maximum payback.

- **Customer Commitment:** Require the customer pay a minimum portion of the measure cost.

3.3 M&V Compliance

This section compares M&V Methodologies in use in different programs across the Province. In the four programs offering incentives for C&I retrofit measures in Ontario, there are considerable differences in how the M&V, to be performed or commissioned by the applicant, is required to be done.

The document review shows that in most cases, participants are complying with program requirements. The most common M&V method being implemented is a simple equipment verification combined with a spot check of energy and demand use. No examples of more complex M&V procedures such as billing analysis, simulation modeling, or direct kW measurements were seen in the documentation. This reflects the high percentage of lighting as the measure type being installed, as lighting does not normally require complex M&V methodologies.

To conclude, there are no indications that M&V requirements have not been met in a systematic way; however, it cannot be said with a high level of confidence that M&V procedures are being followed consistently in the four programs.

3.3.1 Prescribed M&V Procedures

BBP-EB and BOMA CDM

For the BBP-EB and BOMA CDM programs, there are prescribed M&V requirements that applicants must follow. They are defined in terms of a suite of different M&V procedures, which are published in an M&V guidance document for each program. The choice of which procedure to use depends on the size of the project, which determines the level of rigour (Basic or Enhanced), and the type of measure.

For each unique combination of rigour level and measure category, the M&V procedure defines what data is to be collected and how savings are to be calculated. The methods outlined in the BOMA CDM and BBP-EB M&V guidance documents are based on the four categories of M&V options given in the *International Performance Measurement & Verification Protocol (IPMVP) Volume 1 – Concepts and Options for Determining Energy and Water Savings* although they are named slightly differently. The four options are named in BOMA CDM's project guidance documentation. Table 3-14 below compares the definition from IPMVP and from the BOMA CDM documentation.

Table 3-14. IPMVP M&V Approaches

IPMVP Option	IPMVP Name and Definition	BOMA CDM Name
A	Retrofit Isolation: Key Parameter Measurement – *Engineering calculation of baseline and reporting period energy from: short-term or continuous measurements of key operating parameter(s); and estimated values.*	Engineering calculations using both stipulated values and measurements
B	Retrofit Isolation: All Parameter Measurement – *Short-term or continuous measurements of baseline and reporting period energy, and/or Engineering computations using measurements of proxies of energy use.*	Metering and monitoring (spot, short term, or continuous measurements)
C	Whole Facility – *Analysis of whole facility baseline and reporting period (utility) meter data.*	Utility bill analysis
D	Calibrated Simulation – *Energy use simulation, calibrated with hourly or monthly utility billing data.*	Computer simulation models

In the BOMA CDM program there are 17 different M&V procedures defined, as shown in Table 3-15 below. The first part of the code indicates the measure type and the –B or –E indicates the level of rigour (basic or enhanced). The level of rigour required for each project is determined based on the size of the project: projects that save less than 50kW or 400,000kWh/yr will get Basic M&V and larger ones will get Enhanced M&V.

Table 3-15. Prescribed M&V Procedures for the BOMA CDM Program

Measure Type	M&V Procedure	
	'Basic'	'Enhanced'
Lighting Retrofit	LR-B	LR-E
Equipment Replacement	ER- B	ER-E
HVAC Re-Design		HVAC-E
Variable Speed Drives (VSDs)	VSD-B	VSD-E
Building Envelope	BE-B	BE-E
Building Automation Systems (BAS)	BAS-B	BAS-E
Lighting Controls	LC-B	LC-E
Sub Metering		SM-E
Deep Lake Water Cooling		DLWC-E
Ground Source Heat Pumps		GSHP-E
Other Custom Measures		OCM-E

Source: *BOMA CDM Toronto CDM Program Measurement and Verification: Industry Practice and Principles*

In the BBP-EB program, there are 20 different M&V procedures – the same 17 defined for BOMA CDM plus an additional three for Fuel Substitution Measures and for Sub-Metering Basic M&V.

The M&V guidance documents do not specify which IPMVP option is being used in the prescribed procedures. In general, the Basic level procedures do not require on-site metering and rely on Option A (stipulated values only). The Enhanced level procedures require some kind of on-site metering and are based on either Option A (use of metering to determine key inputs to engineering algorithms) or Option B (measuring savings directly). For example, procedure ER-E (Enhanced Equipment Replacement) for Chillers and Refrigeration requires measurement of both baseline and post retrofit performance to determine savings – Option B. Procedure LR-E (Enhanced Lighting Retrofit) requires spot measurements of wattage readings, an inventory of lamp/ballast fixture types by area, usage area designation and operation periods, and counts of operating and on-operating fixtures and lamps, all of which will be used to calculate savings – Option A.

The exceptions to this are: BE-E, the Enhanced Building Envelope procedure, which requires building simulation (Option D), and DLWC-E, the Enhanced Deep Lake Water Cooling procedure, which suggests to *utilize billing data and interval data for validation where possible* (Option C).

General M&V Approach – BIP

The BIP Measurement and Evaluation Guide (Version 1.0, February 25, 2009) states that there are three Quality Factors that must be assessed for each project:

a) Certainty of load reduction – how certain or reliably the measure will result in kW load reductions.

b) Coincidence with system peak demand – how coincidental the load reductions are with respect to the system peak.

c) Sustainability – how permanent or sustainable the measure are in that they cannot be easily defeated and that they will be in place for many years.

The general approach to M&V, outlined in the guide, is to prefer direct measurement of reduction in kW load (Direct kW Measurement), and if this is not practical, the kW load reduction can be derived from engineering data such as nameplate ratings and operating conditions (Indirect kW Assessment). The Direct kW Measurement approach is equivalent to IPMVP Option B and the Indirect kW Assessment is equivalent to IPMVP Option A. Details on how these two basic approaches are to be carried out are given in the guide, but not specifics for different measure types.

Finally, an approach to the M&V procedure to be used is given. The four main questions directing the format of the procedure are:

- Is it practical to isolate and directly measure the load relevant to the project before and after the conservation work?
- If direct measurement is not practical, is there engineering information that specifies the kW rating or allows the kW rating to be calculated?
- Is the percentage usage known, or can it be calculated from the information available? For example, a recording of the 5-minute-interval kW readings of a food cooler can show what percentage of the hour the compressor is running on the average.
- Are the devices, equipment and appliances on during peak period?

Some examples of M&V procedures are given for lighting, variable speed motors, configuring PCs to go on standby, water heating, and window films.

ERIP

In the ERIP program, M&V on custom projects is not required to be done by the applicant at the time of applying for an incentive. However, an M&V process may be done retroactively on any incentivized project at the discretion of program administrators. ERIP administrators must carry out the optional M&V within a year of issuing an incentive. No information is available on the methods used by ERIP staff in carrying out this M&V work or how many M&V reviews have been done.

3.3.2 Compliance of M&V with Program Requirements

For this study, Summit Blue compared available M&V documentation (for the sample of projects that received on-site inspections) with the requirements for each program. The tables below show what data was available for the review, whether the M&V requirements were met, which type of M&V was done, the measure types, and the realization rates between claimed savings and verified savings.

As shown in Table 3-16 below, data for 10 of the projects in the BIP program was provided to Summit Blue. The documentation shows that in the cases where the M&V method is given in the documentation, it is primarily IPMVP option A - on-site verification or spot checks. An M&V plan was provided for 6 out of the 10 projects. Nine of the projects were lighting retrofit. The realization rates achieved varied between 64% and 100%. In 9 out of 10 projects the M&V requirements were met. For the project where it was not confirmed whether the requirements had been met, the requirement was for direct kW measurements and no M&V report was provided.

As shown in Table 3-17, data for four of the projects in the ERIP program was provided to Summit Blue. The documentation shows that in the cases where the M&V method is given in the documentation, it is primarily IPMVP option A - on-site verification or spot checks, or short term metering. An M&V plan was provided for 2 out of the 4 projects. All of the projects were lighting retrofit. The realization rates achieved varied between 69% and 93%. In all projects the M&V requirements were met.

Data for sixteen of the projects in the BOMA CDM program was provided to Summit Blue (Table 3-18). The documentation shows that in the cases where the IPMVP M&V method is given, the type of method varies according to the prescribed method for the measure category and the size of the project. An M&V plan was provided for only three out of the 16 projects. Ten of the projects were lighting retrofit, three HVAC, and the rest multiple measure types, other or unknown. The realization rates achieved varied between 72% and 111%. In three of the projects, the M&V requirements were not met or this was unknown, and in the rest the M&V requirements were met.

Table 3-16. BIP M&V Compliance Data

Project type	M&V Plan	IPMVP Option		M&V Report	Evaluation report	Gross Realization Rate (kW)	Program M&V Requirements met?	Program M&V requirements
Lighting Retrofit	yes	A	On-site verification/ spot checking	Yes		66%	Yes	On site verification of lighting installation and counts
Lighting Retrofit	yes	A	Short term metering	Yes		93%	Yes	On site verification of lighting installation and counts
Lighting Retrofit	yes	A	On-site verification/ spot checking	Yes		100%	Yes	On site verification of lighting installation and counts
Lighting Retrofit	yes	A	On-site verification/ spot checking	Yes		100%	Yes	On site verification of lighting installation and counts
Lighting Retrofit	yes	A	On-site verification/ spot checking	Yes		70%	Yes	On site verification of lighting installation and counts
Lighting Retrofit	yes	A	On-site verification/ spot checking			64%	Yes	On site verification of lighting installation and counts
Lighting Retrofit		A	On-site verification/ spot checking	Yes		kWh not tracked	Yes	On site verification of lighting installation and counts
Lighting Retrofit		A	On-site verification/ spot checking	Yes		kWh not tracked	Yes	On site verification of lighting installation and counts
Demand Controllers					Yes	kWh not tracked	unknown	Direct KW measurements
Lighting Retrofit		A	On-site verification/ spot checking	Yes		kWh not tracked	Yes	On site verification of lighting installation and counts

Table 3-17. ERIP M&V Compliance Data

Project type	M&V Plan	IPMVP Option		M&V Report	Gross Realization Rate	Program M&V Requirements met?	Program M&V requirements
lighting retrofit					kWh saved but not tracked	yes	no requirement
lighting retrofit		A	On-site verification/ spot checking	Yes	69%	yes	no requirement
lighting retrofit	yes	A	on-site verification/ spot checking	Yes	93%	yes	no requirement
lighting retrofit	yes	A	short term metering	Yes	93%	yes	no requirement

Table 3-18. BOMA CDM M&V Compliance Data

Project Type	M&V Plan	BOMA CDM Method/ IPMVP Option		M&V Report	Evaluation Report	Gross Realization Rate	Notes	Program M&V Requirements met?	Program M&V Requirements
Lighting Retrofit		a	LR-E	yes	yes	100%	(1)	yes	LR-E
Hvac			multiple	yes	yes	99%		yes	Multiple
Lighting Retrofit	yes	a	On-site verification/ spot checking	yes	yes	99%		yes	LR-E
Hvac			BE-E		yes		(1)	Yes	BE-E
Lighting Retrofit			multiple		yes	72%	(1)	Yes	LR-E
Lighting Retrofit	yes		LR-E		yes	100%	(1)	Yes	LR-E
Lighting Retrofit	yes		LR-B					No	LR-E
Lighting Retrofit			LR-E		yes		(1)	Yes	LR-E
Multiple			multiple	no	yes	83%	(1) (2)	Yes	Multiple
Hvac			HVAC-E		yes		(1)	Yes	HVAC-E
Other			OCM-E		yes		(1)	Yes	OCM-E
Lighting Retrofit			LR-E		yes	111%	(1)	Yes	LR-E
Lighting Retrofit					yes		(1)	Unknown	LR-E
Lighting Retrofit			LR-E		yes		(1)	Yes	LR-E
Lighting Retrofit		a	On-site verification/spot checking (LR_E)		yes		(3)	Yes	LR-E

(1) evaluation document references M&V documents that are not included

(2) M&V Report is blank

(3) verification data available, but no M&V reports

3.3.3 Comments from Program Staff

This sub section presents some of the comments regarding M&V methodology compliance that were collected during our research.

Comments from Summit Blue Staff Based on Interviews and Site Visits

The program evaluators who evaluate the M&V reports and (depending on the size of the project) perform their own M&V said that the participants' compliance with providing clear and comprehensive reports varies. At times they have to pull teeth to get all the required information. However, they did not mention that participants are not complying with the M&V requirements. The process is that evaluators tend to review the M&V documentation and then request any missing information.

Evaluators base a certain amount of their M&V assessment on their "Professional Engineer gut feeling". This reflects the significance Canadian Engineers put on engineering integrity if one is accredited and signs off on a project as a Professional Engineer. Summit Blue team interviewers gained the impression that personal judgment is sometimes used as a substitute for a systematic M&V approach. This gut feeling approach includes reviewing how well-documented and accurate the project appears to be, and the approach is taken to avoid perceived unnecessary costs. However, evaluators do try to evaluate the projects that appear to have more documentation holes in them more carefully.

From observations done doing site visits, it was usually not apparent whether or not M&V was performed and no M&V reports were ever seen. Only one out of the 5 BOMA CDM projects inspected affirmed that M&V had taken place. Talking with the building personnel, it sounded like some projects had had M&V done and some not.

Comments from Staff at Large LDCs Implementing ERIP

Many LDCs use 3rd party consultants to pre-approve projects and to verify the equipment was installed. Most M&V conducted by the 3rd party consultants consists of a paper review of the application and the final invoices. One LDC requires the 3rd party consultant to verify the equipment installation of 5% of projects with an on-site audit.

Comments from Project Evaluators

Do you have the information you need to effectively evaluate the energy efficiency measures?

- In 95% of the cases—yes. In the other 5%, a good M&V plan is missing.
- In some cases, there is some back-and-forth with the customer for information. In 60% of the cases, they give us a good M&V plan right off; in the other cases there is some back-and-forth, but it is minimal. It's not overly annoying to us. It's to be expected in this realm of business.
- You would hope that you open the evaluation, and it's all there, but you call them and say, listen, provide some more. And you wish you didn't have to do that, but as I say, some of the applicants aren't as sophisticated as others and if we put up too many roadblocks, we'd have even less people applying.

What is not working well?

- Some people don't realize about the different M&V requirements and how they need to adjust their savings—some are kind of shocked when they change out their lamps and they don't get full

savings due to chunk being taken out for diversity factor (e.g., 60 watt to 15 watt is not 45 watt savings). Same for building automation savings. It's all in the guidelines, but maybe people don't read through it. Not sure how to make it more clear.

These comments show that in general the defined M&V process that is required by the program for verification of installation and savings is being followed by applicants, with some minor problems and communication issues.

Several compliance issues were noted during the review of BBP-EB and BIP M&V methods:

- The M&V approach used varies widely between projects and project evaluators.
- There is a lack of focus on short term and seasonal metering of end use parameters.
- The baseline and retrofit energy use, in most cases, is calculated using equipment nameplate information and stipulated operating hours.
- Spot measurements are conducted for some projects, but there seems to be a lack of standardization in whether these are done or not.

Several compliance issues were noted during the review of BOMA CDM M&V methods:

- Projects over the 100 kW threshold are required to follow an enhanced M&V approach, which involves ongoing metering; however, several sampled projects did not follow this protocol. In these cases, only spot checks were performed on a limited number of control points. The program does not provide guidelines on when spot checks are sufficient and when short term or seasonal metering may have been more appropriate.
- Project evaluators specified that short term or seasonal metering is generally not performed unless it is a special situation, such as requested by the applicant. The reasons cited include:
    - It is not required by the program protocol;
    - During the pre-retrofit application stage applicants are eager to move on to the next step in project;
    - It is deemed not cost effective by the project evaluator; and
    - Chiller projects that are evaluated outside of the cooling season are difficult to meter.

4 CONCLUSIONS & RECOMMENDATIONS

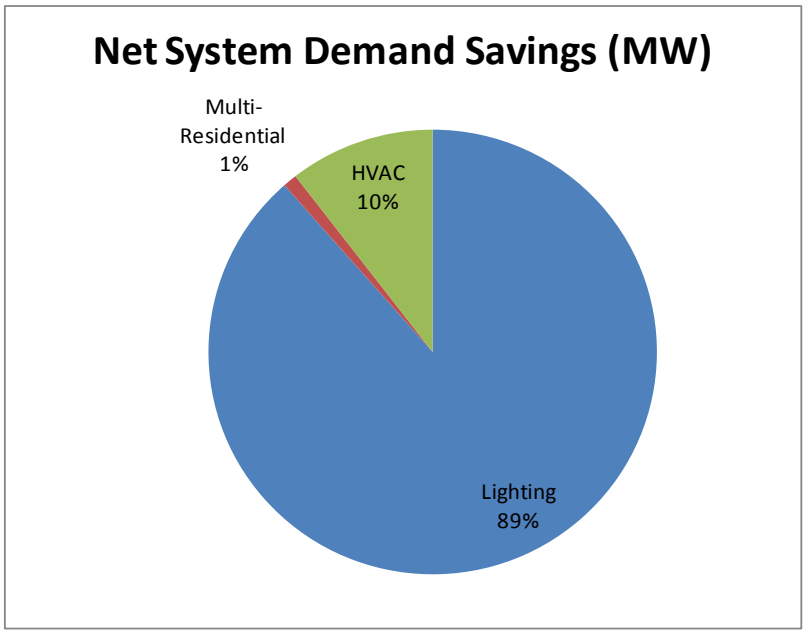
This section provides the Summit Blue team conclusions based on the previous chapters and recommendations to help increase program participation and achieve a higher level of cost-effective demand and energy savings.

4.1 Conclusions

Customers are generally satisfied with the programs; this is a great beginning. More than 50% of participants reported that they were very satisfied with the program in which they participated. None of the programs have more than 5% of participants reporting that they are unsatisfied with the program. Customers are very satisfied with the performance of the equipment installed under the various programs, the quality of the work performed by contractors and vendors, and energy savings achieved by the installed measures

Most of the savings are from lighting whether prescriptive or custom. There were three groups of projects as shown in Figure 4-1 below (lighting, multi-residential, and HVAC). Residential applications do not contribute to the peak demand reduction goal and should not be eligible for C&I retrofit incentives. With the possible exception of CFL bulbs, where the incentive often covered the full incremental cost, the level of incentives was not likely the driving force for the high proportion of demand savings from lighting. It is more likely that there was a higher awareness of lighting applications from marketing efforts such as workshops and manufacturer promotions.[79] Also lighting applications are much less complex than motors, VSDs, or HVAC measures and especially custom projects such as deep lake water cooling.

Figure 4-1. Net System Demand Savings by Types of C&I Projects



[79] Industry sources told Summit Blue that HVAC contractors were not aware of the programs.

There were high demand realization rates for BOMA CDM, BIP and ERIP non-MR custom projects but BBP-EB achieved only a 51% realization rate. Measure quantity installation rates were high across all programs but installation is only one aspect of the realization rate. The low BBP-EB realization rate for demand savings was due to several discrepancies observed in the baseline operating conditions and retrofit end use parameters by the on-site inspectors and from incorrect assumptions about operating hours for three of the sampled projects. BOMA CDM achieved energy and demand realization rates of over 95% and BIP—which measured only demand savings achieved a 94% realization rate. ERIP, which also did not track energy savings, achieved an overall demand realization rate of 82% for non-MR custom projects; however, about a-third of the sampled projects achieved realization rates of less than 50%, generally reflecting projects in residential suites at hospitals or educational facilities.

Savings for the ERIP prescriptive projects are based on generic PIA assumptions leading to inaccuracies. For ERIP projects, custom measures achieved a realization rate of 98% whereas prescriptive projects achieved a realization rate of only 15%. Ninety-seven percent of installed savings were attributed to lighting. However, Summit Blue was unable to procure the OPA's input assumption references and, as a proxy, compared the input assumptions to a number of other representative evaluation study findings (presented in Section 2.2). There was significant variability between the OPA's PIAs and the secondary literature reviewed, especially for operating hour input assumptions and costs For example, the OPA assumes $3.50 for a CFL and OPA has been paying $2 incentives; some LDCs were providing CFLs for less than $2.

Several programs adhere to the IPMVP but, in many cases, protocols are not clearly defined or followed. Logging of operating hours for lighting is virtually never done. M&V procedures vary significantly between projects and evaluators. LDCs believe M&V is the OPA's responsibility; however, the approach to verify custom projects was more rigorous than for prescriptive measures. All programs save ERIP use a tiered approach based on level of savings and incentives, but short term metering is rarely conducted due to cost considerations. Baselines were not always clearly defined or well-documented because of the following factors: 1) poor quality information from customers; 2) good information for non-standard projects but not for standard, e.g. lighting; and 3) they are often calculated using equipment nameplate information and standard operating hours.

Documentation of M&V for projects is either not completed or not available. The Summit Blue review of the backup material provided for the 62 on-site inspections to assess compliance with M&V procedures revealed that only about a third of projects have any M&V documents available to support findings (20 out of 62 projects). In addition, not all of these twenty projects have complete M&V documentation (plans, reports, etc) available to support savings estimates. The evaluation found good correlation claimed savings and verified savings based on independent M&V. Consequently, Summit Blue believes the shortcoming in M&V documentation does not have a significant effect on the results. However, this finding supports the need to implement program procedures to ensure that M&V is not only completed but also supported by documentation that is readily accessible. This would not only increase confidence in the results but also reduce costs for future evaluations.

Environmental concerns and rising energy bills are key motivators for customers to participate in the programs. Overall results show respondents are motivated primarily by environmental concerns and rising energy bills, followed by rebate or price discounts. The customer survey found environmental concerns are more motivating for BBP-EB and BOMA CDM customers than others. BIP customers are primarily concerned with rising energy costs. For ERIP, some LDCs observed that some customers are motivated by non-energy benefits like aesthetics and health/safety benefits, not just energy savings or cost savings.

There are product quality concerns, particularly about lighting measures. Only prescriptive projects require adherence to product quality standards and these standards were based on a U.S. list of products that did not include some available only in Canada. Good quality lighting products (both fluorescent and LEDs) are more expensive than cheaper imports but provide longer life for products as well as good warranties. Poor quality low-cost LED products are increasingly available and could lead to considerable issues related to product failure and inadequate warranties impacting savings and customer satisfaction.

Marketing and outreach are not coordinated across programs and most stakeholders believe that more customer education is needed. Most program delivery agents, as well as Osram-Sylvania, rely on face-to-face meetings with customers and workshops/seminars. LDCs believe broad education/outreach efforts are needed to change people's perception of the term "energy efficiency". They would like to see cooperative advertising with OPA and other LDCs and would like OPA to provide more resources for marketing the program, such as province-wide advertising and media coverage of success stories and outreach to wholesalers who work throughout the province. BOMA CDM has found great success with its current training program and expect these sessions to increase participation. Their customers need to hear about success stories. BBP-EB focuses on face-to-face selling and relationship marketing and has found customers are not aware of basic energy efficiency measures. BIP markets through vendors and consultants, and their website is considered an influential source of information by participants. Osram-Sylvania has done considerable marketing of the program by conducting a series of workshops.

Data tracking systems are inconsistent both in structure and data tracked. In addition, backup M&V documentation was often unavailable, available only in hard copy, or not stored centrally by the program delivery agent. BOMA CDM has the most comprehensive tracking system with ERIP the least—both for savings and costs. Neither ERIP nor BIP tracked energy savings and BBP-EB and BIP did not provide details on measures implemented. Demand savings are calculated differently for various programs yet all programs should be aimed at achieving the same goal—reducing summer peak demand for the Ontario electricity system.

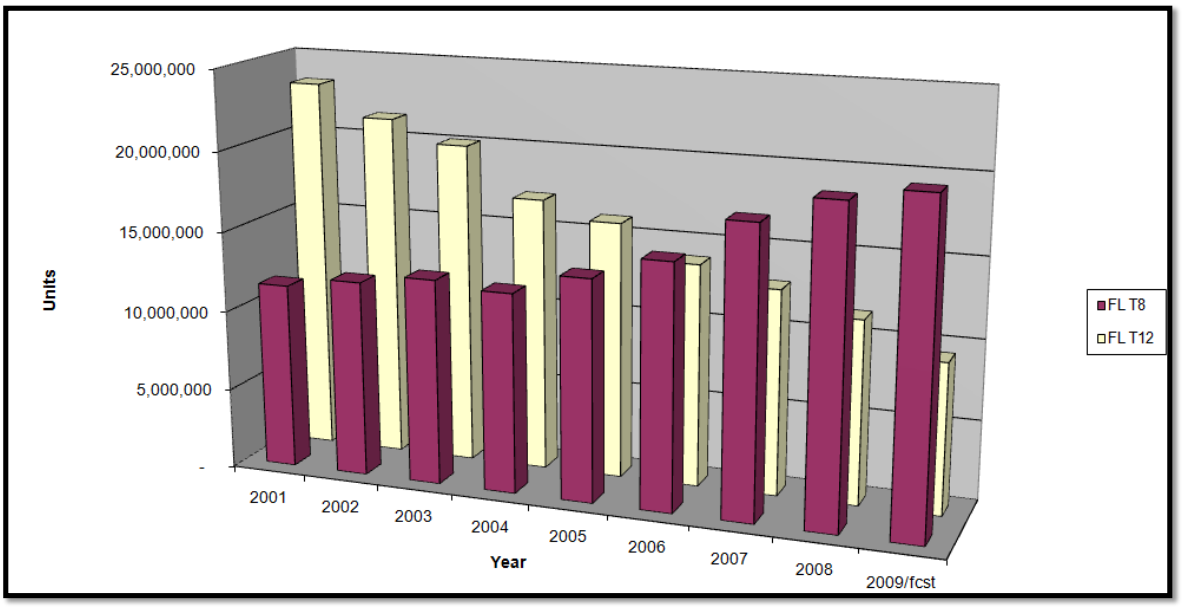
4.2 Recommendations

This section presents recommendations to help the OPA and program delivery agents to increase the chances of meeting the provincial demand savings goals.

4.2.1 Overall Recommendations

Summit Blue recommends implementing a province-wide lighting program using a collaborative approach with the LDCs, other program delivery agents, and manufacturers. Lighting provided close to 90% of t savings in 2008, and there is a still lot of low-hanging fruit in the market, i.e,. easily obtained. Osram-Sylvania estimates that there is at least 100 MW from lighting savings that can be achieved. Data on market share of installed commercial fluorescent lighting provided by Osram-Sylvania indicate that although the installed base of T12 lights dropped lower than that of T8s in 2006, there were still over ten million T12s installed across Canada in the commercial and industrial market in 2008 (see Figure 4-2 below). The lighting program approach could be used as a model for other measures such as motors and drives.

Figure 4-2. Saturation of T8 and T12 Fluorescent Lighting in Canada[80]



The following are some of the design issues identified as part of the evaluation research.

- Educate customers about opportunities and technologies, including broad education on the meaning of energy efficiency and load shifting to reduce negative associations with the terms (i.e., conservation means "going without") and to prime potential customers for participation in the OPA programs. General marketing should focus on publicizing success stories and garnering positive media attention for energy efficiency; this combined with a more focused approach of reaching out directly to targeted customers with case studies of similar companies' successful projects will maximize limited marketing resources.
- Use coordinated approach to the market involving stakeholder such as Osram Sylvania, Phillips, GE, including workshops case studies, webinars, etc. Osram Sylvania, for example, has been a strong supporter of Ontario lighting efficiency programs and pledge to continue this support going forward.
- Develop incentives based on well-defined assumptions about lighting measures and provide differential incentives to ensure the most desirable measures are implemented in the most appropriate locations.
- Provide incentives for both kW and kWh savings and rationale for different levels of incentives.
- Streamline the application process by making it online through the web.
- Provide more technical assistance, e.g., pay customers to hire consultants to help identify and quantify opportunities (consultant studies/audits).
- Ensure quality assurance:

[80] Source: Osram Sylvania communications.

- Develop Ontario-specific product standards, including warranty protections;
- Require product manufacturers to provide 3rd party verifications;
- Conduct periodic, random testing of samples of products; and
- Apply specified standards & deliverables to consultant studies/audits.

The custom projects could be delivered through a combined program design that applies the same procedures (M&V, costs, tracking, etc.) across the province. Lighting equipment incentives would be determined through the lighting program and custom incentives would be based on using the recommended procedures in Section 3.3.2. M&V methods should be modified as discussed below in Section 4.2.2. Data tracking systems should be addressed for the program as a whole, including specifying what data to be tracked, field names with definitions, types of cost breakdowns, etc.

4.2.2 Impact Evaluation Recommendations

The following sections provide recommendations for prescriptive input assumptions and M&V methods.

Prescriptive Input Assumptions

- **Coincident Peak Demand:**
  - Program tracking estimates of peak demand, particularly for the ERIP MR component, should consider coincidence with peak load.
  - Disaggregate demand savings for ultra high efficiency fans in future program cycles.
- **Annual Operating Hours:**
  - Focus should be placed on establishing a better baseline for hours of operation across the lighting program. This is particularly important for the office lighting usage patterns.
  - Certain building categories should be further divided to more accurately capture the magnitude of anticipated impacts for lighting.
- **Energy Savings:**
  - Consider the impacts of HVAC interactive effects in the lighting measure PIAs.
  - Incorporate winter usage patterns into the savings algorithms for dual exhaust ventilation systems in future program cycles.
- **Effective Useful Life (EUL):** The assumed EUL for high wattage metal halide lamps are overstated. Manufacturer specifications for a 400W CMH lamp generally are in the range of 20,000 hours. Given that the average operating characteristics for most of the building types are 5,000 hours per year, it is apparent that a 16-year EUL is overly optimistic. We recommend modifying this assumption to four years.
- **Incremental Costs:**
  - Disaggregating measure incremental costs by the nature of replacement (e.g., New, Retrofit, Replace-On-Burnout, etc.) may improve the accuracy of cost effectiveness tests.
  - Review and refine occupancy sensor cost assumptions to be consistent with the current market.

M&V Methods

BOMA CDM

- Require project evaluators to log end use parameters in cases where variations are expected, including chiller retrofits, VSD installations, and other complex custom installations.
- Increase the M&V budgets in this Tier to allow a greater focus on metering activities.
- Require clear documentation of the baseline equipment (nameplate, size, efficiency, operating hours, seasonal load variations, etc.).
- Standardize the project application and invoice nomenclature.
- Require detailed calculation spreadsheets to be submitted with project application.

ERIP

- Use a tiered approach to categorize projects by measure type and size (incentive thresholds). The projects with greater impact and higher uncertainty should follow an enhanced approach. Such projects should ideally follow a custom path where pre- and post-retrofit scenarios are carefully studied. Projects under the custom path above a certain threshold (e.g., $10,000 incentive) should require short-term pre- and post-metering/logging of operating parameters.
- Improve the clarity of M&V guidelines.
- Require photographs of installed technologies and applications, which yield useful evaluation information.
- Incorporate/inform the LDCs of M&V activities as early as possible in the program Cycle.

BIP

- Standardize the documentation procedure across all projects.
- Standardize the M&V process by establishing thresholds (incentive or project size) to enable a greater focus on projects with greater uncertainty.
- Increase the level of M&V rigour on lighting projects.

BBP-EB

- Increase the level of rigour for projects greater than 50 kW with more focus on short term and seasonal metering of end use parameters, especially when the expected uncertainty is high (e.g., chiller retrofits with high end use variations, VFD installations, lighting retrofits is convention centers etc.)
- Require customers to provide adequate documentation for any changes to the scope of work, and project evaluators should revise savings estimates and conduct additional M&V activities (if necessary) for accurate assessment of the project impacts.

4.2.3 Process Evaluation Recommendations

This section provides some general recommendations to improve the program process and help improve participation and savings results.

- Prepare a program logic model for the lighting and custom projects program in collaboration with program designers.
- Define what data is required to be tracked, including program status, measure details, savings estimates (initial, revised, approved, reported, verified, evaluated), energy savings (by month if possible), demand savings, incentives, total project costs, customer contact information, building information (# of floors, energy use, annual peak demand), market sector, etc.
- Ensure that M&V procedures are specified and that documentation is provided.
- Define what is to be included in cost breakdowns, e.g., marketing, M&V costs, administration, performance bonuses, etc.
- Revise OPA payment method to LDCs to make it easier for both LDCs and evaluators to track costs and payments.
- Simplify application forms and enable them to be filled out online.
- Increase education and outreach for end-users and coordinate across the province.
- Consider a redesign of incentives:
    - Offer a choice to customers to receive incentives based on either kWh or kW saved.
    - When designing incentives, first calculate the TRC to ensure cost-effectiveness, then set the incentive based on either the customer payback period (taking into account incremental measure costs) or the Utility Cost test.
    - Regularly do a benefit-cost analysis for each type or class of measure in the program.
    - Review whether standard measures such as T8 lights and CFLs should be removed from the programs and more efficient measures such as Super T8s be added, as has been done in other jurisdictions.
    - Standardize incentives, or at least bring them closer into line, between programs.
    - When calculating incentives, take into account the low electric rates for C&I customers in the province and what kind of tariffs they are on, as these affect the customer's payback calculation.
    - In general, pay higher incentives for more reliable savings verified with on-site M&V.
    - Use existing market research and potential studies to identify technologies that have the most potential for quick implementation, can reduce peak demand on both winter and summer peak days, and are most in need of the incentives.
    - Target specific end uses in different sub-sectors within the C&I sector, e.g., Small and Medium Industry, Small Business, Large Office, Small Commercial, and Large Retail.
    - To keep program implementation simple and encourage more participation across the province, consider implementing two basic incentive structures: An **Express Efficiency** incentive scheme that would offer standard prescriptive incentives for common measures in different C&I sub-sectors; and a **Standard Performance Contract** program that would offer incentives based on actual kW and kWh savings at each site.

APPENDIX A: DESCRIPTIONS OF OPA'S EXISTING C&I EE PROGRAMS[81]

Building Operators and Managers Association (BOMA) Toronto CDM Program

The Toronto BOMA (Building Operators and Managers Association) Conservation and Demand Management Program (Toronto BOMA CDM Program or Program) is a program collaboration with the Ontario Power Authority and was launched in March 2007. The Program is designed to obtain energy savings through a comprehensive suite of potential measures. This Program is part of an OPA portfolio of programs attempting to achieve 300 MW of conservation in three years in the City of Toronto.

The BOMA CDM program is unique in both its relationship with the OPA and its approach to the market. The OPA has contracted with BOMA for the delivery of program in a manner that allows BOMA a great deal of flexibility in the program design and delivery. BOMA has used that flexibility to develop a business to business program that combines the use of direct incentives and strong messaging targeting both BOMA members and the broader large commercial sector. The use of the Toronto BOMA chapter channel offers a direct contact to the largest single commercial sector building segment in the city – large offices. These buildings account for a significant portion of Toronto's electricity use, in particular summer peak load. BOMA program measures include but are not limited to areas of lighting, heating ventilation and air conditioning, building efficiency improvement and etc.

City of Toronto Better Buildings Partnership—Existing Buildings

The Better Buildings Partnership – Existing Buildings (BBP-EB) is an innovative and successful public private partnership that promotes and implements energy efficiency and building renewal retrofits in industrial, commercial, institutional and multi-residential buildings. The primary goal of the BBP is to reduce carbon dioxide (CO2) emissions caused by the energy used to heat, light, cool and operate buildings.

The BBP has successfully implemented 625 energy efficiency and building renewal retrofits emphasizing the use of triple-bottom line strategies (namely consideration for the environment, equity and the economy) to successfully engage building owners and managers in achieving better buildings. The redesigned BBP will be more appropriately staffed to meet the increased target of 50 MW by 2010.

The BBP-EB will be enhanced and expanded by implementing an aggressive marketing and communications initiative in support of the program implementation process through retrofitting buildings for energy efficiency and builds on the existing City of Toronto Better Buildings Partnership administered by the Energy Efficiency Office (EEO).

BBP-EB measures include but are not limited to areas of lighting, heating ventilation and air conditioning, building efficiency improvement and etc.

81 Source: OPA RFP documents.

This program will target the following:

- Buildings owned by the City of Toronto;
- Buildings owned within the geographic boundaries of the City of Toronto by any municipal organization, school board, and any publicly funded academic, health and social services entity, as well as any corporation or entity, owned or controlled by one or more of the preceding or MASH Entity other than the City of Toronto; and
- Multi-Family Residential Buildings.

There is only Custom Track of program application that eligible customers can apply for incentives. The Program Application Form is available for downloading from www.toronto.ca/eeo.

This program will be administered by the Energy Efficiency Office (EEO). The OPA will ensure that applications are appropriately screened, that electricity savings measures are installed as specified and that savings can be measured, verified and reported.

Toronto Hydro Business Incentive Program (BIP)

On May 7, 2007, Toronto Hydro-Electric System Limited (THESL) signed the Master CDM Agreement (The Agreement) with the Ontario Power Authority (OPA). According to the Agreement, THESL will deliver up to 163 MW of demand reduction in Toronto by December 31, 2010, of which up to 65 MW will be achieved through new programs, including the contribution of 20 MW from the Business Incentive Program.

The Business Incentive Program (BIP) provides financial incentives to program participants to encourage the implementation of energy efficiency improvement projects. Participants can apply for financial incentives using THESL's online application process and will be granted financial incentives based on pre-determined measures with set financial incentives. The financial incentive assists customers in reducing the costs of their energy efficiency projects and reduces the payback periods of their initial investment.

BBP-EB measures include but are not limited to areas of lighting, heating ventilation and air conditioning, building efficiency improvement and etc.

Electricity Retrofit Incentives Program (ERIP)

The Electricity Retrofit Incentive Program ("ERIP") is designed to influence business retrofit decisions towards the most energy-efficient equipment available by providing customers with cash incentives to reduce the incremental costs of installing more energy efficient equipment.

ERIP focuses on the areas of lighting, motors, heating ventilation and air conditioning and overall electricity systems.

Local Distribution Companies (LDCs) will administer this program providing incentives for commercial, industrial, agribusiness and institutional electricity consumers who undertake energy efficiency retrofit projects in their facilities. Eligible projects include upgraded lighting, heating, ventilation, air conditioning (HVAC), electric motors and transformers.

Applicants must be customers of a participating LDC and may be owners or tenants of business premises supplied by a participating LDC. For a list of participating LDCs please refer to http://business.everykilowattcounts.com/feature/ERIP/participating-ldcs.php).

APPENDIX B: CBECS DATA

Table B1. Summary Table: Total and Means of Floorspace, Number of Workers, and Hours of Operation for Non-Mall Buildings, 2003

	Number of Buildings (thousand)	Total Floorspace (million square feet)	Total Workers in All Buildings (thousand)	Mean Square Feet per Building (thousand)	Mean Square Feet per Worker	Mean Hours per Week
All Buildings*	4,645	64,783	72,807	13.9	890	61
Building Floorspace (Square Feet)						
1,001 to 5,000	2,552	6,789	9,936	2.7	683	57
5,001 to 10,000	889	6,585	7,512	7.4	877	61
10,001 to 25,000	738	11,535	10,787	15.6	1,069	67
25,001 to 50,000	241	8,668	8,881	35.9	976	72
50,001 to 100,000	129	9,057	8,432	70.4	1,074	80
100,001 to 200,000	65	9,064	11,632	138.8	779	89
200,001 to 500,000	25	7,176	6,883	289.0	1,043	100
Over 500,000	7	5,908	8,744	896.1	676	115
Principal Building Activity						
Education	386	9,874	12,489	25.6	791	50
Food Sales	226	1,255	1,430	5.6	877	107
Food Service	297	1,654	3,129	5.6	528	86
Health Care	129	3,163	6,317	24.6	501	59
Inpatient	8	1,905	3,716	241.4	513	168
Outpatient	121	1,258	2,600	10.4	484	52
Lodging	142	5,096	2,457	35.8	2,074	167
Retail (Other Than Mall)	443	4,317	3,463	9.7	1,246	59
Office	824	12,208	28,154	14.8	434	55
Public Assembly	277	3,939	2,395	14.2	1,645	50
Public Order and Safety	71	1,090	1,347	15.5	809	103
Religious Worship	370	3,754	1,706	10.1	2,200	32
Service	622	4,050	3,667	6.5	1,105	55
Warehouse and Storage	597	10,078	4,369	16.9	2,306	66
Other	79	1,738	1,819	21.9	956	63
Vacant	182	2,567	Q	14.1	Q	Q

Source: http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set1/2003pdf/b1.pdf

APPENDIX C: MARKET RESEARCH INSTRUMENT

OPA Cross-Cutting Evaluation – GENERIC Program Participants Survey

STUDY	CELL	RESP
1 2 3 4	5 6 7	8 9 10

CONTACT INFORMATION AND MEASURE DATA FROM PROGRAM RECORDS/DATA BASE

Customer Name: _____

Contact Name: _____

Contact telephone number:_____

LCD/Local Distribution Company:_____

Region:_____

RESPONDENT QUALIFICATION AND SCREENING

Hello, my name is _____ from Global Target Marketing, a Canadian marketing research company. We are working with Summit Blue Canada, an independent evaluator of energy efficiency programs conducted on behalf of Ontario Power Authority.

REMIND THE RESPONDENT IF NECESSARY

We are not selling or soliciting anything. This is an independent evaluation of energy efficiency programs offered to organizations and companies in the public and private sectors.

S1. May I speak with _____(INSERT CONTACT NAME FROM DATABASE)?

1 CONTINUE WITH CUSTOMER ONCE THEY ARE ON THE PHONE **[GO TO INTRO TEXT]**

2 IF CONTACT PERSON NOT AVAILABLE **[SCHEDULE CALLBACK]**

3 NOT A GOOD TIME TO CONDUCT SURVEY **[SCHEDULE CALLBACK]**

4 IF CONTACT PERSON NO LONGER AVAILABLE ASK FOR PERSON MOST RESPONSIBLE FOR MANAGING ENERGY-USING EQUIPMENT AND PROCESSSES FOR COMPANY/ORGANIZATION

[INTRO TEXT] We are helping evaluate the **[INSERT**] Program and would like to talk briefly with you about your experience with the program and the energy efficiency equipment and/or process improvements installed or implemented under the program. Your comments will help us understand if the programs have been successful or not, and will guide future energy efficiency programs. The survey will only take about 12-14 minutes and your individual answers will be kept private.

(NOTE: If the respondent is hesitant, use an appropriate combination of the following.)

Confidentiality. We are an independent research firm and will not report your responses in any way that would reveal your identity.

Security. Your responses will not affect your ability to participate in the program in the future.

Sales concern. I am not selling anything. I simply want to understand what factors were important to you in deciding to get the energy efficiency measures offered under the program.

Contact. If you would like to talk with someone from _____ about this effort, you can call **_____(INSERT APPROPRIATE CONTACT INFORMATION NAMES)**

S2. The **[INSERT**] Program provides financial incentives to encourage the implementation of energy efficiency improvement projects in the areas of **[INSERT PROGRAM MEASURES**] etc.. Are you the most appropriate person to talk to about the decision to install the energy equipment or process improvements rebated through this **[INSERT**] Program at _____ **(INSERTSPECIFIC SITE(S)/ LOCATION (S) ON THE DATABASE.)**

1 YES **(SKIPTO S3)**

2 NO **(ASK FOR REFERRAL TO DECICISION-MAKER(S) MOST INFORMED ABOUT DECISIONS FOR [INSERT] PROGRAM SPEAK TO THAT PERSON /THOSE PERSONS AND RESCREEN. SELECT THE MOST KNOWLEDGEABLE RESPONDENT.)**

S3. RECORD RESPONDENT CONTACT INFORMATION AND JOB TITLE BELOW. RESPONDENT CAN ANSWER QUESTIONS ON A MAXIMUM OF 2 SITES. IF RESPONDENT IS A DECISION-MAKER FOR 3 OR MORE SITES ASK THEM TO ANSWER SURVEY ABOUT THE SITES ABOUT WHICH THEY ARE MOST FAMILIAR AND/OR WHERE THE GREATEST ENERGY SAVINGS/ REBATES HAVE OR WILL BE ACHIEVED.

Name:
Phone Number:
Job Title:
Site #1
Site#2

S4. Can I confirm the energy efficiency equipment installed and/or process improvements at _____ **(SITE #1)** rebated through the **[INSERT**] Program. The records show _____**(INSERT MEASURES FROM DATABASE)** as the measures covered under this **[INSERT**] Program**.** Is this correct? In your recollection were/was this energy equipment installed and/or these process improvements instituted and rebated or that will be rebated under the BOMA CDM program.

MEASURES FROM DATABASE	Installed/Implemented			Rebated		
	Yes	No	DK/NS	Yes	No	DK/NS
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
Other Measures	❑	❑	❑	❑	❑	❑

IF MULTIPLE MEASURES WERE INVOLVED AT SITE #1 ASK S5.

IF MULTIPLE MEASURES NOT INVOLVED AT SITE #1 AND RESPONDENT IS DECISION-MAKER FOR ONLY ONE SITE/LOCATION UNDER [INSERT] PROGRAM GO TO Q1 IN MAIN SURVEY.

IF MULTIPLE MEASURES NOT INVOLVED AT SITE #1 AND RESPONDENT IS DECISION-MAKER FOR MULTIPLE SITES/LOCATIONS UNDER [INSERT] PROGRAM SKIP TO S6.

S5. Which measures rebated at _____ **(SITE #1)** under the **[INSERT]** Program do you consider the dominant or most significant with the greatest share of energy savings? (**RESPONDENTS WILL ANSWER FOR A MAXIMUM OF**

2 SIGNIFICANT MEASURES PER SITE/ LOCATION)

MEASURES FROM DATABASE	Dominant/Significant Measures	
	#1	#2
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
Other Measures	❑	❑

IF RESPONDENT IS DECISION-MAKER FOR ONLY ONE SITE/LOCATION UNDER [INSERT] PROGRAM GO TO Q1 IN MAIN SURVEY.

IF RESPONDENT IS DECISION-MAKER FOR MULTIPLE SITES/LOCATIONS UNDER [INSERT] PROGRAM PROCEED TO S6.

S6. Can I confirm the energy efficiency equipment installed and/or process improvements at __________ **(SITE #2)** rebated through the **[INSERT**] Program. The records show _______________**(INSERT MEASURES FROM DATABASE)** as the measures covered at this site/location under the **[INSERT**] program**.** Is this correct? In your recollection were/was this energy equipment installed and/or these process improvements instituted and rebated or that will be rebated under the **[INSERT**] program.

MEASURES FROM DATABASE	Installed/Implemented			Rebated		
	Yes	No	DK/NS	Yes	No	DK/NS
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
[INSERT FROM DATABASE]	❑	❑	❑	❑	❑	❑
Other Measures	❑	❑	❑	❑	❑	❑

IF MULTIPLE MEASURES WERE INVOLVED AT SITE #2 ASK S7.

IF MULTIPLE MEASURES NOT INVOLVED AT SITE #2 SKIP TO Q1.

S7.Which measures rebated at _____ **(SITE #2)** under the **[INSERT**] Program do you consider the dominant or most significant with the greatest share of energy savings? (**RESPONDENTS WILL ANSWER FOR A MAXIMUM OF**

2 SIGNIFICANT MEASURES PER SITE/ LOCATION)

MEASURES FROM DATABASE	Dominant/Significant Measures	
	#1	#2
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
[INSERT FROM DATABASE]	❑	❑
Other Measures	❑	❑

MAIN SURVEY

1a. Why did you decide to implement _____ **(MEASURE NAME)** at _____ **(SITE #1)?** Were there any other reasons? **ENTER VERBATIM COMMENTS BELOW**.

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE [INSERT] PROGRAM FOR THIS SITE/LOCATION SKIP TO Q2a. NOTE PARTICIPANTS ARE ASKED ABOUT A MAXIMUM OF 2 DOMINANT/SIGNIFICANT MEASURES PER SITE.

1b. And for _____**(MEASURE #2)** why did you decide to implement this measure? Were there any other reasons? **ENTER VERBATIM COMMENTS BELOW**.

1a _____**(MEASURE NAME)**

1b _____**(MEASURE NAME)**

2a. When did you first learn about the **[INSERT**] Program**?** Was it before or after you first began **to think about implementing _____ (MEASURE NAME)** at **_____ (SITE #1)?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE [INSERT] PROGRAM AT THIS SITE/LOCATION SKIP TO Q3a.

2b. And was it before or after you first began to think about implementing _____ **(MEASURE #2)** that you first heard about the **[INSERT**] Program**?**

Awareness of Program & Timing Re Thinking About Implementation of Measure	**Dominant/Significant Measures**	
	2a----------	**2b----------**
Before	❑	❑
After	❑	❑
DK/NS/Refused	❑	❑

3a. Did you learn about the **[INSERT**] Program before or after you **decided to implement the specific _____(MEASURE NAME)** that was eventually adopted or installed at **_____(SITE #2)?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE PROGRAM AT THIS SITE/LOCATION SKIP TO Q4a.

3b. And for_____ **(MEASURE NAME**) did you learn about the **[INSERT**] Program before or after you decided to implement the specific _____ **(MEASURE #2)** that was eventually adopted or installed at **_____ (SITE/LOCATION)?**

Awareness of Program & Timing Re Thinking About Implementation of Measure	**Dominant/Significant Measures**	
	3a----------	**3b----------**
Before	❑	❑
After	❑	❑
DK/NS/Refused	❑	❑

4a. How significant was the **[INSERT**] Program versus other factors in the decision to implement the specific _____ **(MEASURE NAME)** that was eventually adopted or installed at **_____(SITE #1)?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE PROGRAM SKIP TO Q5a.

4b. And for_____ **(MEASURE #2)** how significant was the **[INSERT]** Program versus other factors in the decision to implement this specific ____ **(MEASURE #2)** that was eventually adopted or installed at ____ **(SITE #1)?**

Significance of Program Versus Other Factors in Adoption/ Implementation of Measure	**Dominant/Significant Measures**	
	4a----------	**4b----------**
Extremely significant	❑	❑
Very significant	❑	❑
Somewhat significant	❑	❑
Not very significant	❑	❑
Not at all significant	❑	❑
DK/NS	❑	❑

5a. If your organization/company had not received assistance under the **[INSERT]** Program would you have implemented _____

(MEASURE NAME) at **_____(SITE #1)** in the foreseeable future**?**

IF YES OR NOT SURE IN Q5a ASK Q5b. OTHER ANSWER SKIP TO Q5c.

5b. When do you think your organization/company would have implemented _____ **(MEASURE NAME)** at **_____ (SITE #1)** if you had not received assistance under the **[INSERT]** Program**? PROBE:** Within how many months or years of when you participated in the **[INSERT]** Program**?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE [INSERT] PROGRAM AT THIS SITE/LOCATION SKIP TO Q6a.

5c. If your organization/company had not received assistance under the**[INSERT]** Program would you have implemented _____ **(MEASURE #2)** at **_____(SITE #1)** in the foreseeable future**?**

IF YES OR NOT SURE IN Q5c ASK Q5d. OTHER ANSWER SKIP TO Q6a.

5d. When do you think you would have implemented _____ **(MEASURE #2)** at _____ **(SITE #1)** if you had not received assistance under the **[INSERT**] Program**? PROBE:** Within how many months or years of when you participated in the **[INSERT**] Program **?**

When Would Have Implemented Measure, If At All Without Program	**Dominant/Significant Measures**	
	5a----------	**5c----------**
Yes, Would have implemented in foreseeable future	❑	❑
Not sure	❑	❑
No, Would NOT have implemented in foreseeable future	❑	❑
Not stated/Refused	❑	❑
Timing If Yes or Not Sure	**5b----------**	**5d----------**
Within same time frame/within 6 months	❑	❑
6 months to 1 year later	❑	❑
1-2 years later	❑	❑
2-3 years later	❑	❑
3-4 years later	❑	❑
4 or more years later	❑	❑
Never	❑	❑

6. What is the likelihood that energy efficiency equipment would have been installed and/or process improvement measures implemented of the **same or similar levels of energy efficiency** as would have been implemented if your organization/company had not received assistance under the **[INSERT**] Program?

NOTE RESPONDENTS ANSWER FOR A MAXIMUM OF 2 DOMINANT MEASURES PER SITE/LOCATION.

a) For _____ **(MEASURE NAME)** at **_____ (SITE #1)** what is the likelihood that energy efficiency equipment would have been installed and/or process improvement measures of the **same or similar levels of energy efficiency** as would have been implemented if your organization/company had not received assistance under the **[INSERT**] Program?

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE [INSERT] PROGRAM AT THIS SITE/LOCATION SKIP TO Q7.

b) For _____**(MEASURE #2)** at **_____(SITE #1)** what is the likelihood that energy efficiency equipment would have been installed and/or process improvement measures of the **same or similar levels of energy efficiency** as would have been implemented if your organization/company had not received assistance under the **[INSERT**] Program?

Likelihood Would Have Implemented Measure Of Same/ Similar E.E.	**Dominant/Significant Measures**	
	6a----------	**6b----------**
Definitely would NOT have implemented/ installed measure of same/similar ee	❑	❑
Probably would NOT have implemented/ installed measure of same/similar ee	❑	❑
Might/Might not	❑	❑
Probably WOULD have implemented/installed measure of same/similar ee	❑	❑
Definitely WOULD have implemented/installed measure of same/similar ee	❑	❑
DK/NS	❑	❑
Refused	❑	❑

7. Overall, across all the measures implemented and equipment installed at _____ **(SITE #1)** under the **[INSERT**] Program how much of the **extra energy savings** would have been achieved anyway even if your organization/company had NOT received a rebate? Please provide a lower and upper bound and your best estimate.
PROBE/CLARIFICATION: For example 50% means that half of the extra savings from energy equipment and/or process improvement would have been achieved anyway without a rebate. Remember I'm asking only about the **extra savings** from installing energy efficient equipment or instituting energy efficient processes.

Lower bound	-----%	DK/NS ❑	Refused ❑
Upper bound	-----%	DK/NS ❑	Refused ❑
Best estimate	-----%	DK/NS ❑	Refused ❑

IF RESPONDENT IS QUALIFIED DECISION-MAKER TO ANSWER ABOUT AN ADDITIONAL SITE/LOCATION FOR THE SAME PROGRAM FOR WHICH THEY HAVE COMPLETED Q1 THROUGH Q7, THEY COMPLETE QUESTIONS S8 THROUGH S11 FOR THIS ADDITIONAL LOCATION/SITE.

IF RESPONDENT IS QUALIFIED DECISION-MAKER FOR ONLY ONE SITE/LOCATION UNDER PROGRAM FOR WHICH THEY HAVE COMPLETED Q1 THROUGH Q7, THEY SHOULD SKIP TO Q15.

I would now like to ask you about **_____(SITE/LOCATION)** and the specifics of energy efficiency equipment installed and/or process improvements rebated through this same **[INSERT**] Progra**m** at **_____(SITE #2)** before we discuss this program in general.

8a. Why did you decide to implement **_____(MEASURE NAME)** at **_____(SITE #2)?** Were there any other reasons? **ENTER VERBATIM COMMENTS BELOW**.

IF ONLY ONE MEASURE IMPLEMENTED UNDER THE PROGRAM FOR THIS SITE/LOCATION SKIP TO Q9a.

8b. And for _____ **(MEASURE #2)** why did you decide to implement this measure? Were there any other reasons? **ENTER VERBATIM COMMENTS BELOW**.

8a _____**(MEASURE NAME)**

8b _____**(MEASURE NAME)**

9a. When did you first learn about the **[INSERT**] Program**?** Was it before or after you first began **to think about implementing** _____ **(MEASURE NAME)** at **_____ (SITE #2)?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE [INSERT] PROGRAM AT THIS SITE/LOCATION SKIP TO Q10a.

2b. And was it before or after you first began to think about implementing _____ **(MEASURE #2)** that you first heard about the **[INSERT**] Program**?**

Awareness of Program & Timing Re Thinking About Implementation of Measure	**Dominant/Significant Measures**	
	9a----------	**9b----------**
Before	❑	❑
After	❑	❑
DK/NS/Refused	❑	❑

10a. Did you learn about the **[INSERT**] Program before or after you **decided to implement the specific _____(MEASURE NAME)** that was eventually adopted or installed at **_____(SITE #2)?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE PROGRAM AT THIS SITE/LOCATION SKIP TO Q11a.

10b. And for_____ **(MEASURE NAME**) did you learn about the **[INSERT**] Program before or after you decided to implement the specific _____ **(MEASURE #2)** that was eventually adopted or installed at **_____ (SITE #2)?**

Awareness of Program & Timing Re Thinking About Implementation of Measure	Dominant/Significant Measures	
	10a----------	10b----------
Before	❑	❑
After	❑	❑
DK/NS/Refused	❑	❑

11a. How significant was the **[INSERT**] Program versus other factors in the decision to implement the specific _____ **(MEASURE NAME)** that was eventually adopted or installed at **_____(SITE #2)?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE PROGRAM SKIP TO Q12a.

11b. And for_____ **(MEASURE #2**) how significant was the **[INSERT**] Program versus other factors in the decision to implement this specific ____ **(MEASURE #2)** that was eventually adopted or installed at ____ **(SITE #2)?**

Significance of Program Versus Other Factors in Adoption/ Implementation of Measure	Dominant/Significant Measures	
	11a----------	11b----------
Extremely significant	❑	❑
Very significant	❑	❑
Somewhat significant	❑	❑
Not very significant	❑	❑
Not at all significant	❑	❑
DK/NS	❑	❑

12a. If your organization/company had not received assistance under the **[INSERT]** Program would you have implemented _____

(MEASURE NAME) at **_____(SITE #2)** in the foreseeable future**?**

IF YES OR NOT SURE IN Q12a ASK Q12b. OTHER ANSWER SKIP TO Q12c.

12b. When do you think your organization/company would have implemented _____ **(MEASURE NAME)** at **_____ (SITE #2)** if you had not received assistance under the **[INSERT]** Program**? PROBE:** Within how many months or years of when you participated in the **[INSERT]** Program**?**

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE [INSERT] PROGRAM AT THIS SITE/LOCATION SKIP TO Q13a.

12c. If your organization/company had not received assistance under the**[INSERT]** Program would you have implemented _____ **(MEASURE #2)** at **_____(SITE #2)** in the foreseeable future**?**

IF YES OR NOT SURE IN Q12c ASK Q12d. OTHER ANSWER SKIP TO Q13a.

12d. When do you think you would have implemented _____ **(MEASURE #2)** at **_____ (SITE #2)** if you had not received assistance under the **[INSERT]** Program**? PROBE:** Within how many months or years of when you participated in the **[INSERT]** Program?

When Would Have Implemented Measure, If At All Without Program	**Dominant/Significant Measures**	
	12a----------	**12c----------**
Yes, Would have implemented in foreseeable future	❑	❑
Not sure	❑	❑
No, Would NOT have implemented in foreseeable future	❑	❑

Not stated/Refused	❑	❑
Timing If Yes or Not Sure	**12b----------**	**12d----------**
Within same time frame/within 6 months	❑	❑
6 months to 1 year later	❑	❑
1-2 years later	❑	❑
2-3 years later	❑	❑
3-4 years later	❑	❑
4 or more years later	❑	❑
Never	❑	❑

13. What is the likelihood that energy efficiency equipment would have been installed and/or process improvement measures implemented of the **same or similar levels of energy efficiency** as would have been implemented if your organization/company had not received assistance under the **[INSERT**] Program?

NOTE RESPONDENTS ANSWER FOR A MAXIMUM OF 2 DOMINANT MEASURES PER SITE/LOCATION.

a) For _____ **(MEASURE NAME)** at **_____ (SITE #2)** what is the likelihood that energy efficiency equipment would have been installed and/or process improvement measures of the **same or similar levels of energy efficiency** as would have been implemented if your organization/company had not received assistance under the **[INSERT**] Program?

IF ONLY ONE DOMINANT MEASURE IMPLEMENTED UNDER THE [INSERT] PROGRAM AT THIS SITE/LOCATION SKIP TO Q14.

b) For _____ **(MEASURE #2)** at **_____ (SITE #2)** what is the likelihood that energy efficiency equipment would have been installed and/or process improvement measures of the **same or similar levels of energy efficiency** as would have been implemented if your organization/company had not received assistance under the **[INSERT**] Program?

Likelihood Would Have Implemented Measure Of Same/ Similar E.E.	Dominant/Significant Measures	
	13a----------	13b----------
Definitely would NOT have implemented/ installed measure of same/similar ee	❑	❑
Probably would NOT have implemented/ installed measure of same/similar ee	❑	❑
Might/Might not	❑	❑
Probably WOULD have implemented/installed measure of same/similar ee	❑	❑
Definitely WOULD have implemented/installed measure of same/similar ee	❑	❑
DK/NS	❑	❑
Refused	❑	❑

14. Overall, across all the measures implemented and equipment installed at _____ **(SITE #1)** under **[INSERT**] Program how much of the **extra energy savings** would have been achieved anyway even if your organization/company had NOT received a rebate? Please provide a lower and upper bound and your best estimate.
PROBE/CLARIFICATION: For example 50% means that half of the extra savings from energy equipment and/or process improvement would have been achieved anyway without a rebate. Remember I'm asking only about the **extra savings** from installing energy efficient equipment or instituting energy efficient processes.

Lower bound	-----%	DK/NS ❑	Refused ❑
Upper bound	-----%	DK/NS ❑	Refused ❑
Best estimate	-----%	DK/NS ❑	Refused ❑

Now I would like to know whether the assistance received from the **[INSERT**] Program has influenced the company/organization to install any additional energy efficient equipment or implement any process improvements for which you did not receive a rebate.

15a. Did in fact the assistance received from the **[INSERT**] Program **influence** the company/ organization to install any additional energy efficient equipment or implement any process improvements **at_____ (SITES #1 and/or #2) that did not get reported under the program**?

1 YES **(WRITE IN DETAILS BELOW IN Q15b.)**

2 NO/DK **(SKIP TO Q16)**

15b. What are the other measures either energy efficiency equipment installed or process improvements **at_____ (SITES #1 and/or #2)** that would **not** have been installed without the influence of the program and what year were they installed or implemented?

RECORD DETAILS OF EQUIPMENT AND/OR PROCESSESSS BELOW AND CHECK FOR SPECIFIC SITE IF REPORTING ON MULTIPLE SITES.

EE EQUIPMENT INSTALLED/PROCESS IMPROVEMENTS	YEAR	Site#1	Site#2
		❑	❑
		❑	❑
		❑	❑
		❑	❑

16a. Did in fact the assistance received from the **[INSERT**] Program influence the company/ organization to install any additional energy efficient equipment or implement any process improvements **at other buildings or facilities in the Province of Ontario** that did not get reported under the program?

1 YES **(WRITE IN DETAILS BELOW IN Q16b.)**

2 NO/DK **(SKIP TO Q17)**

16b. What are the other measures either energy efficiency equipment installed or process improvements **at other buildings or facilities in the Province of Ontario** that would not have been installed without the influence of the program and what year were they installed or implemented? **RECORD DETAILS OF EQUIPMENT AND/OR PROCESSESSS BELOW.**

EE EQUIPMENT INSTALLED/PROCESS IMPROVEMENTS	**YEAR**

17. How did you first become aware of the **[INSERT**] Program**?**

DO NOT READ PRECODES BELOW. MULTIPLE MENTIONS POSSIBLE.

18. **FOR EACH SPONTANEOUS MENTION IN Q17 ABOVE ASK**: On a scale of 1 to 5 where 1 is "Not at all influential" and 5 is "Extremely influential" how influential was **_____ (INSERT ANSWERS FROM Q17**) in your decision to participate in the **[INSERT**] Program?

IF MORE THAN ONE SOURCE MENTIONED IN Q17 ASK Q19. IF ONLY ONE OR ZERO MENTIONS IN Q17 SKIP TO Q20.

19. Which was the most influential **_____(ANSWERS IN Q17)** in your organization's/ company's decision to participate in the **[INSERT**] Program?

Source	Q17 Unaided Mention	Q18 INFLUENTIAL RATING FOR SOURCES WITH UNAIDED MENTION						Q19 Most Influential
		Extremely Influential 5	4	3	2	Not at All Influential 1	DK/NS 9	
Email from BOMA CDM								
BOMA CDM (non-specific)	❑	❑	❑	❑	❑	❑	❑	❑
Facility manager	❑	❑	❑	❑	❑	❑	❑	❑
Building Owner	❑	❑	❑	❑	❑	❑	❑	❑
Recommendation from a colleague	❑	❑	❑	❑	❑	❑	❑	❑
Trade ally or vendor	❑	❑	❑	❑	❑	❑	❑	❑
Consulting engineer	❑	❑	❑	❑	❑	❑	❑	❑
Local Utility/Local Distribution Company	❑	❑	❑	❑	❑	❑	❑	❑
Toronto Hydro	❑	❑	❑	❑	❑	❑	❑	❑

Hydro One	❑	❑	❑	❑	❑	❑	❑	❑
Ontario Power Authority/OPA	❑	❑	❑	❑	❑	❑	❑	❑
City of Toronto/City of Toronto Office of Energy Efficiency	❑	❑	❑	❑	❑	❑	❑	❑
Email	❑	❑	❑	❑	❑	❑	❑	❑
Website	❑	❑	❑	❑	❑	❑	❑	❑
Direct mail	❑	❑	❑	❑	❑	❑	❑	❑
Magazine advertisement	❑	❑	❑	❑	❑	❑	❑	❑
Trade event/trade show	❑	❑	❑	❑	❑	❑	❑	❑
Other SPECIFY	❑	❑	❑	❑	❑	❑	❑	❑
	❑	❑	❑	❑	❑	❑	❑	❑
	❑	❑	❑	❑	❑	❑	❑	❑

20. On a scale of 1 to 5 where 1 is "Not At All Important" and 5 is "Extremely Important" how important were ____ **(READ OUT ELEMENTS LISTED BELOW ONE AT A TIME. ROTATE ORDER.)** in your decision to participate in the **_____(PROGRAM)** and install energy efficient equipment and/or implement process improvements?

	Q27 IMPORTANCE RATING					
	Extremely Important				**Not at All Important**	**DK/NS**
Source	**5**	**4**	**3**	**2**	**1**	**9**
Level of financial incentives/ rebates offered under the program	❑	❑	❑	❑	❑	❑
Level of support/training offered by program sponsors						
Company/organizational financial cost-saving targets	❑	❑	❑	❑	❑	❑
Company/Organization policies i.e. to be a "green" company/organization	❑	❑	❑	❑	❑	❑
Industry standards	❑	❑	❑	❑	❑	❑
Higher energy prices in winter versus summer						
Internal Energy manager recommendations	❑	❑	❑	❑	❑	❑
Current economic conditions	❑	❑	❑	❑	❑	❑

21a. Overall, how satisfied are you **[INSERT]** Program? Would you say you are **… (READ LIST)?**

Very satisfied	Somewhat satisfied	So-so	Somewhat dissatisfied	Or, Very dissatisfied	Don't know (DO NOT READ)
5	4	3	2	1	x

21b. IF SOMEWHAT DISSATISFIED OR VERY DISSATISFIED (1 OR 2) IN Q.21a, PROBE WHY?

22. I would now like to go over various elements of the **[INSERT]** Program. I am going to read a list and I'd like you to rate your satisfaction with each element again using the scale of 1 to 5 where 1 is "Very Dissatisfied" and 5 is "Very Satisfied" with a rating of "3" being "So-so or neither satisfied or unsatisfied". How satisfied are you with _____? **(READ OUT ELEMENTS LISTED BELOW ONE AT A TIME. ROTATE ORDER.)**

	Q29 SATISFACTION RATING					
Source	**Very Satisfied 5**	**Some-what satisfied 4**	**So-so, neither satisfied or Dissatisfied 3**	**Some-what Dissatisfied 2**	**Very Dissatisfied 1**	**Not Applicable DK/NS 9**
Performance of any equipment installed under program	❑	❑	❑	❑	❑	❑
Quality of work	❑	❑	❑	❑	❑	❑

conducted by contractors and/or vendors						
Electricity/Energy savings	❑	❑	❑	❑	❑	❑
Level of Incentives offered under the program	❑	❑	❑	❑	❑	❑
Application process	❑	❑	❑	❑	❑	❑
Timeliness of incentive delivery	❑	❑	❑	❑	❑	❑
Timeliness of approval of program incentives	❑	❑	❑	❑	❑	❑
Services provided by **[INSERT PROGRAM SPONSOR]**	❑	❑	❑	❑	❑	❑

23. As a result of participation in the **[INSERT**] Program**,** would you say that your organization/company is A Lot More Likely, A Little More Likely or there is No Difference to the likelihood of making the following changes/upgrades?

Measures	A Lot More Likely	A Little More Likely	No Difference
Upgrade lighting/lighting controls	❑	❑	❑
Replace equipment with more energy efficient equipment	❑	❑	❑
Upgrade HVAC	❑	❑	❑
Change out motors/variable speed motors	❑	❑	❑
Building envelope improvements	❑	❑	❑
Fuel substitution e.g. switch to natural gas – fired generators	❑	❑	❑
Sub metering	❑	❑	❑
Deep lake water cooling	❑	❑	❑
Ground source heat pumps	❑	❑	❑
Adopt technologies/products for energy efficiency of building loads/shifting to off-peak periods	❑	❑	❑
Participate in future energy management programs	❑	❑	❑
Any other actions? Please specify.	❑	❑	❑

24. What suggestions or advice would you offer to the people designing energy programs like the **[INSERT**] Program to make them more valuable to your business/organization?

25a. Some businesses and organizations qualified to participate in more than one energy efficiency rebate program. Apart from **[INSERT**] Program did your company/organization qualify for and participate in other energy efficiency programs that provide financial incentives?

1 YES **(RECORD DETAILS IN Q25b)**

2 NO **(SKIP TO Q26)**

3 DON'T KNOW/NOT SURE **(SKIP TO Q26)**

25b. What other programs did your company/organization qualify for or participate in the past two years? RECORD DETAILS OF PROGRAMS QUALIFIED FOR AND PARTICIPATED IN BELOW. DO NOT READ LIST.

PROGRAM	**YEAR**	**Qualified**	**Participated**
City of Toronto Better Buildings Partnerships Program		❑	❑
OPA's Electricity Retrofit Incentive Program (ERIP)		❑	❑
Toronto Hydro –Electric System Ltd (THESL) Business Incentive Program		❑	❑
Toronto BOMA Conservation and Demand Management Program		❑	❑
Other WRITE IN		❑	❑
DK/NS			

IF IN Q25b RESPONDENT INDICATES THEY QUALIFIED FOR ANY PROGRAMS AND DID NOT PARTICIPATE IN PROGRAM(S) ASK Q25c.

OTHERWISE SKIP TO Q 26

25c. Why did you choose to participate in the **[INSERT**] Program over the _____ **(INSERT PROGRAM(S) QUALIFIED FOR BUT WHICH DID NOT PARTICIPATE IN FROM Q25b)? PROBE FULLY.**

26. Thinking about possible steps that could be taken to reduce peak and/or save energy, what is preventing more saving or shifting of energy use in the organization/ business? DO **NOT** READ LIST. ENTER AS MANY AS MENTIONED.

Too expensive, costs too much money up front	❑
Pay back too long	❑
Do not think will save enough energy to make it worthwhile	❑

Need more information on how to do it	❑
Do not have enough time	❑
Will do it at a later time	❑

Lack resources	❑
Lack technical expertise/knowledge	❑
Lack of available staff to handle it	❑

Limitations to the building code	❑
Restrictions of the fire code	❑
Already done	❑

Any other –SPECIFY	

BASIC DATA -- In order to classify and interpret the data of this survey, we need some basic information about your company/organization. This is for statistical purposes only, and as indicated early, is confidential.

F1. Which industry best classifies _____ (company/organization)? READ LIST AS REQUIRED

- ❑ Agriculture & Mining
- ❑ Banking/Financial Services
- ❑ Computer Hardware Manufacturing
- ❑ Computer Software
- ❑ Construction & Engineering
- ❑ Consulting/Professional Services
- ❑ Distributor
- ❑ Education
- ❑ Government
- ❑ Health Care
- ❑ Internet Service Provider
- ❑ Manufacturing (non-computer)
- ❑ Research/Development
- ❑ Retail
- ❑ Systems Integration
- ❑ Telecommunications

F2. Is the location where you work the primary one for this organization, or is it one of the satellite or secondary sites for this organization, or is it one of several sites but neither a primary or secondary site?

Primary location	1
Satellite or secondary site	2
One of several sites but neither primary or secondary	3

F3. About what percent of the total annual operating cost for the site where you work is spent on electricity?

Under 10 per cent	1
10 to 24%	2
25% or more	3
Don't know	9

F4. Approximately how many full-time employees are there at this location?

Under 5 employees	1
5 - 24	2
25 - 99	3
100 - 499	4
500 - 1000	5
1001 and over	6

F5. Do you have a single employee with all the Energy Management responsibilities for this location?

- ❑ Yes
- ❑ No

F6. , What were your organization's approximate revenues last year – across all sites? (READ LIST. RECORD ONE RESPONSE ONLY)

Under $5,000,000	1
$5,000,000 to $10,000,000	2
$10,000,000 or more	3
Don't know	

F7. What other energy programs or policies would help you and your organization/ company better manage its energy and equipment investments in the future? PROMPT Audits, rebates, online info, new rate structures.

THANK AND TERMINATE INTERVIEW

INTERVIEWER'S NAME: _____

DATE OF INTERVIEW: _____

FOR OFFICE USE ONLY

CODED BY: _____

CHECKED BY: _____

VERIFIED BY: _____

ENTERED BY: _____

APPENDIX D: MARKET RESEARCH FINDINGS

Findings -- Customer Survey

Overview of Methodology

The sample frame for the survey of Participants was the customer database lists of participants in each of the programs:

- BOMA Conservation and Demand Management Program
- Toronto Hydro's Business Incentive Program (BIP)
- OPA's Electricity Retrofit Incentive Program (ERIP)
- City of Toronto Better Buildings Partnerships Program (BBP)

A master file of program participants and the locations where measures were implemented was created, with the database records being checked and consolidated for multiple entries.

The sampling unit for the survey was the individual site or location. Measures and program incentives were site specific. In this context, a decision-maker who had responsibility for multiple sites/locations could provide information during the survey about multiple sites/locations.

A modular survey was developed with common questions for all of the programs (BOMA, BIP, ERIP and BBP). Content area covered the research objectives inclusive of energy saving measures implemented, influences to program participation, free ridership and spillover.

The survey was administered by telephone during the week of June 15-19th. On average, each interview was approximately 22 minutes. A census approach was taken and multiple attempts were made to contact all program participants where contact information was available.

In total, interviews covering 208 locations and 246 measures were completed.

Interviews Completed

PROGRAM	TOTAL INTERVIEWS	
	SITES	MEASURES
BOMA Conservation and Demand Management Program	37	40
BIP Toronto Hydro – Electric System Ltd. Business Incentive Program	39	39
ERIP OPA's Electricity Retrofit Incentive Program	110	135
BBP City of Toronto Better Buildings Partnerships Program	22	32
TOTAL ACROSS ALL PROGRAMS	**208**	**246**

Measures Implemented

Retrofit incentive programs resulted in implementation of customer energy saving measures focused primarily on lighting

- Lighting measures dominated the measures rebated under ERIP (97%) and BIP (82%). The balance of the measures rebated under the ERIP program were for HVAC (2%) and transformers (1%) whereas under the BIP program the balance of the measures rebated were HVAC (8%), equipment replacement and upgrades (8%) and energy management (3%).

- For BOMA the majority (59%) of the measures rebated under the program were lighting retrofits and controls with the balance being equipment replacements & upgrades (9%), HVAC (7%), motor measures (7%), BAS (4%), sub metering (2%) or other custom measures (13%).

- For BBP lighting retrofits and controls represented the largest category (32%) rebated under the program. The balance of the measures rebated under the BBP program were for HVAC (27%), motor measures (14%), water heating measures (11%), BAS (8%), equipment replacement & upgrades, transformers and other custom measures (3% each).

- Where more than one measure was implemented at a location, participants were asked to identify the most **"dominant**" measure that is the most significant measure with the greatest share of energy savings. Again lighting measures were the largest category of dominant measures for all programs except BBP (for BBP HVAC at 31% was marginally higher than lighting at 28%).

- ***During the interview process, respondents indicated that they did not view the energy saving actions taken in the context of individual measures. In contrast, they viewed the work in totality as a project and that is how they generally approached implementation.***

MEASURES INSTALLED Under Program(s)	TOTAL MEASURES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=366)	(n=46)	(n=39)	(n=244)	(n=37)
LIGHTING	**84%**	**59%**	**82%**	**97%**	**32%**
Fluorescent Lighting Systems	***54%***	---	---	***80%***	---
• *T8 (Standard / High)*	*30%*	---	---	*45%*	---
• *CFL (Screw In / Hard Wired)*	*15%*	---	---	*23%*	---
• *T5 (High Bay / Fixture)*	*9%*	---	---	*13%*	---
Lighting Retrofits and Controls	***19%***	***59%***	***82%***	---	***32%***
Energy Star Exit Signs	***6%***	---	---	***9%***	---
Occupancy Sensors	***4%***	---	---	***7%***	---
Metal Halide Systems	***1%***	---	---	***1%***	---
HVAC	**6%**	**7%**	**8%**	**2%**	**27%**
MOTORS (VSDs / VFDs)	**2%**	**7%**	**---**	**---**	**14%**
EQUIPMENT REPLACEMENTS & UPGRADES MEASURES	**2%**	**9%**	**8%**	**---**	**3%**
OTHER CUSTOM MEASURES	**2%**	**13%**	**---**	**---**	**3%**
BAS	**1%**	**4%**	**---**	**---**	**8%**
WATER HEATING	**1%**	**---**	**---**	**---**	**11%**
TRANSFORMERS	**1%**	**---**	**---**	**1%**	**3%**
ENERGY MANAGEMENT	**<1%**	**---**	**3%**	**---**	**---**
SUB METERING	**<1%**	**2%**	**---**	**---**	**---**

Source: Screening question S4

DOMINANT MEASURES Installed Under Program (s)	TOTAL MEASURES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=246)	(n=40)	(n=39)	(n=135)	(n=32)
LIGHTING MEASURES	**79%**	**63%**	**82%**	**95%**	**28%**
Fluorescent Lighting Systems	***46%***	---	---	***84%***	---
• *T8 (Standard / High)*	*24%*	---	---	*44%*	---
• *CFL (Screw In / Hard Wired)*	*11%*	---	---	*21%*	---
• *T5 (High Bay / Fixture)*	*10%*	---	---	*19%*	---
Lighting Retrofits and Controls	***27%***	***63%***	***82%***	---	***28%***
Energy Star Exit Signs	***2%***	---	---	***4%***	---
Occupancy Sensors	***3%***	---	---	***5%***	---
Metal Halide Systems	***1%***	---	---	***1%***	---
HVAC MEASURES	**8%**	**5%**	**8%**	**4%**	**31%**
MOTOR MEASURES (VSDs / VFDs)	**2%**	**5%**	---	---	**13%**
EQUIPMENT REPLACEMENTS & UPGRADES MEASURES	**3%**	**10%**	**8%**	---	**3%**
OTHER CUSTOM MEASURES	**2%**	**10%**	---	---	**3%**
BAS MEASURES	**2%**	**5%**	---	---	**6%**
WATER HEATING MEASURES	**2%**	---	---	---	**13%**
TRANSFORMERS	**1%**	---	---	**1%**	**3%**
ENERGY MANAGEMENT	**<1%**	---	**3%**	---	---
SUB METERING	**<1%**	**3%**	---	---	---

Source: Screening question S5

Drivers of Behaviour and Influences on Measure Implementation

Program participants were asked direct and indirect questions probing the drivers of their participation in the programs and the factors influencing the decision to implement energy-efficiency measures under the specific programs. These questions included rating a series of factors on an 11-point scale of influence where 0= Not at all influential and 10= Very influential with the mid-point of the scale being 5.5, a rating of elements on a 5-point importance scale where 1= Not at all important and 5= Extremely important with the mid-point of the scale being 3.0 and open-ended questions on the most influential reasons for participating in the program(s).

Being "green" and cost issues have the highest influence on decision to implement measures on an aided basis

- Across all four programs the factors that were rated as having the greatest influence on implementing the measures are being "green" / environmental concerns and rising energy bills. For BBP and BOMA the "green" / environmental concerns dominate rising energy costs whereas the reverse is true for BIP. For ERIP "green" / environmental concerns and rising energy bills have equal influence.

- The rebate or price discount was the third highest rated factor for all four programs.

- For ERIP, the channel members representing the utility representative and contractors were viewed to be important secondary influences in the decision to implement measures (ranked fourth and fifth with importance scores of 5.0 and 4.9 respectively). For BOMA and BIP the contractor was rated as being of secondary importance (ratings of 5.7 and 5.5 at or above the mid-point of the scale).

- Advertising from TV, radio, trade journals was generally rated as having little influence on measure implementation (importance ratings of 3.2 or lower).

INFLUENCE OF FACTORS IN DECISION TO IMPLEMENT MEASURE(S) Average Mean Influence Score	TOTAL MEASURES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=246)	(n=40)	(n=39)	(n=135)	(n=32)
Being "Green" / Environmental Concerns	7.7	8.3	7.9	7.4	8.6
Rising Energy Bills	7.6	7.3	8.4	7.4	7.9
Rebate or Price Discount	6.8	6.7	6.6	6.9	6.9
Contractor	4.9	5.7	5.5	4.9	3.4
Utility Representative	3.9	2.3	3.4	5.0	1.4
Direct Communication from Utility	3.7	2.5	4.8	4.2	1.0
Information from Utility Website	3.2	2.2	3.9	3.8	0.8
Advertising (TV, Radio, Trade Journals)	2.5	3.2	2.9	2.4	1.4

Source: Q11
Mean scores calculated on an 11-point scale of influence where 0= Not at all influential and 10= Very influential with the mid-point of the scale being 5.5.

Internal cost saving targets, corporate policy to be "green" and level of financial rebates offered are all important drivers

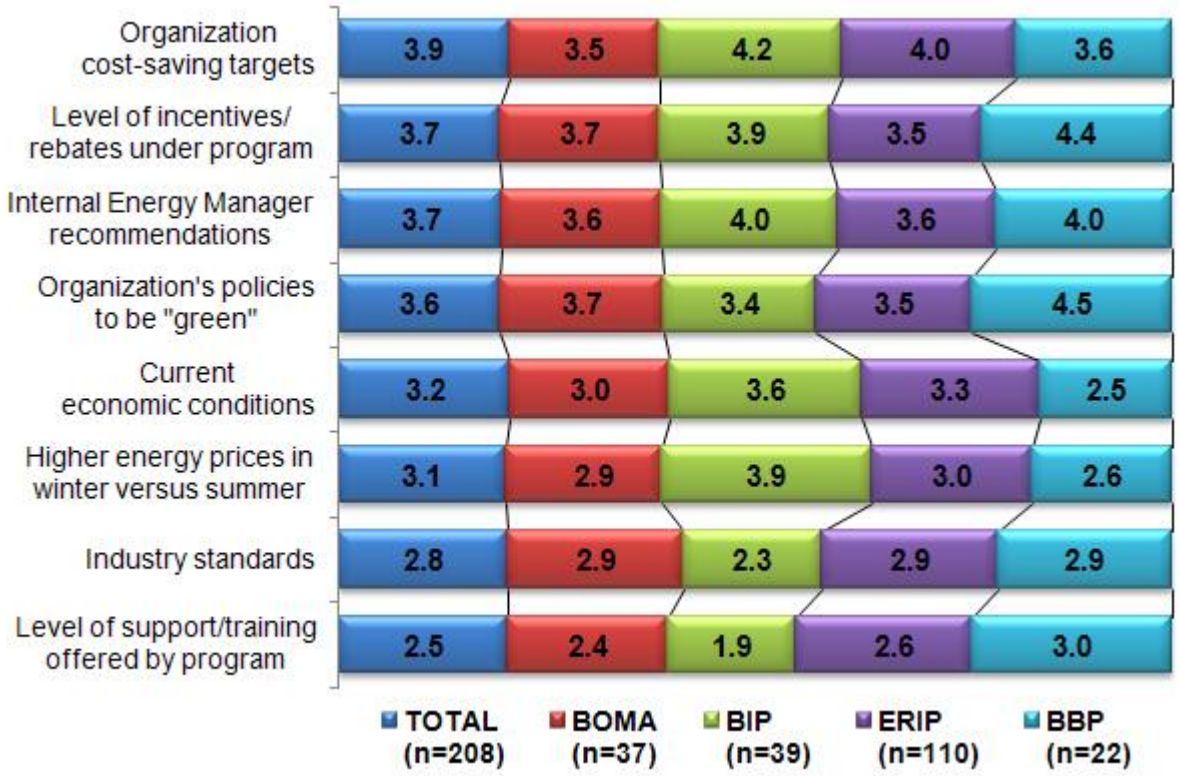
- Across all four programs most of the eight program elements listed were rated as above average importance in the decision to participate in the specific programs. There is no clear hierarchy of importance which suggests multiple internal and external elements are at play in a company's/organization's decision to participate in the respective programs.

- The level of support/training offered by the program sponsors, however, was the lowest ranked element for BIP, BOMA and ERIP with an average importance score below 3.0 out of 5. For BBP this element was ranked 5th out of the 8 elements and received an average importance score of 3.0 at the mid-point of the scale.

- For BBP and BOMA, the top two elements in the hierarchy of importance are company/organization policies such as being "green" and the level of financial rebates offered under the program, followed by recommendations of the internal Energy Manager and company/organizational financial cost-saving targets.

- For BIP and ERIP, the top three elements in the hierarchy of importance are company/organizational financial cost saving targets, recommendations of the internal Energy Manager and then the level of financial incentives/rebates offered under the program. Company/organization policies such as being "green" is ranked the 6th most important element for BIP and equal 3rd for ERIP.

IMPORTANCE OF ELEMENTS IN DECISION TO PARTICIPATE IN PROGRAM



Source: Q12
Mean scores calculated on a 5-point importance scale where 1=Not at all important and 5=Extremely important with the mid-point of the scale being 3.0.

- BIP is the only program where higher prices for energy in winter versus summer received an importance score above the mid-point of the scale at 3.9.

- For BIP also industry standards was rated lower in importance than it was in the other three programs (2.3 for BIP versus 2.9 for the other programs).

- BBP is the only program where current economic conditions received a very low importance score (2.5 below the mid-point of the scale at 3.0).

Program design and delivery is influential in the decision to participate in a given program.

Half of the participants (50%) in **BBP** identified the **City of Toronto** as the most influential source in the organization's decision to participate in the program.

Communication from BOMA about the program was identified by about half (49%) of BOMA participants as the most influential source in the organization's decision to participate in the program.

The local utility/distribution company was named by between a quarter to a third (28%) of **ERIP** participants as most influential in the organization's decision to participate in the ERIP program.

The website/internet was named by about a quarter (26%) of **BIP** participants as most influential in the organization's decision to participate in the BIP program.

Consistent with the findings in Section 1.3.1, channel members representing the **vendors, contractors and/or suppliers are viewed to be important secondary influences** in the decision to participate in the programs (ERIP 27%; BBP 23%; BOMA 19%; BIP 18%).

MOST INFLUENTIAL SOURCE IN ORGANIZATION'S DECISION TO PARTICIPATE IN PROGRAM	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
Vendor/Contractor/Supplier	**24%**	**19%**	**18%**	**27%**	**23%**
Communication from Program	18%	**49%**	10%	11%	18%
Local Utility/Distribution Company	17%	5%	8%	**28%**	---
Website/Internet	8%	3%	**26%**	5%	---
Colleague Recommendation	7%	8%	13%	6%	---
Trade Show/Conference	7%	3%	5%	11%	---
Facility Manager/Building Owner	5%	3%	5%	7%	---
City of Toronto	5%	---	---	---	**50%**
Consultant/Consulting Engineer	4%	8%	8%	1%	9%
Advertising (Newspapers, Magazines)	2%	3%	8%	---	---
Ontario Power Authority (OPA)	1%	---	---	3%	---

Source: Q 11

Impact of the Programs on Timing and Implementation of Specific Measures

The impact of the programs on the timing and the specific measures implemented plus the influence of the program itself versus other factors is addressed in this section. As is shown below there are significant differences between the programs in terms of the impact of timing and potential free ridership.

Major differences by program on the learning of program before or after beginning to think about implementing measures

- For the City of Toronto Better Buildings Partnerships Program (BBP), approximately **four out of five of participants (78%) were aware of the BPP program before** they began to think about implementing any of the measures rebated under this program. A major factor in this result may be attributed to pre-program consultations with target participants on program design. This process gave some participants a "heads up" about the program and a longer window pre-program launch.

- For the **ERIP** program, the **majority (53%)** of respondents stated they were aware of the ERIP program **before** they began to think about implementing any of the measures rebated under this program.

- For **BOMA,** participants were **evenly divided** as to whether they were aware of the BOMA program **before or after** they began to think about implementing any of the measures rebated under this program (45% before and 45% after with 10% either unable or refusing to give an answer).

- For BIP, however, the situation is the reverse of that for the BPP with just over one-in-five **(23%) of participants claiming they were aware of the BIP program before** they began to think about implementing any of the measures rebated under this program.

AWARENESS OF PROGRAM BEFORE OR AFTER THINKING ABOUT IMPLEMENTATION OF MEASURES	**TOTAL MEASURES**	**PROGRAMS**			
		BOMA	**BIP**	**ERIP**	**BBP**
	(n=246)	**(n=40)**	**(n=39)**	**(n=135)**	**(n=32)**
Before	50%	**45%**	23%	**53%**	**78%**
After	46%	**45%**	**74%**	43%	22%
DK/RF/NA	4%	10%	3%	4%	0%

Source: Q2

Programs considered very significant relative to other factors in implementation of the majority of specific measures implemented

- Whereas there are differences between the four programs in terms of the awareness of the program before thinking about implementing measures that were rebated under the program, **there is consistency in terms of the programs being rated on average as very significant relative to other factors in the implementation of specific measures at the sites in question**.

- The top 2 box scores or the percentage of program participants who rated the programs as extremely or very significant falls in the range of 58% to 68% (58% for ERIP; 62% for BIP; 66% for BBP; 68% BOMA).

- The mean score falls in the range of 3.6 to 3.9 out of 5 which is between the "Somewhat significant" at 3.0 and the "Very significant" at 4.0 and actually closest to "Very significant".

SIGNIFICANCE OF PROGRAM VERSUS OTHER FACTORS IN IMPLEMENTATION OF MEASURES AT YOUR SITE	TOTAL MEASURES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=246)	(n=40)	(n=39)	(n=135)	(n=32)
TOP 2 BOXES	**61%**	**68%**	**62%**	**58%**	**66%**
o Extremely significant (x5)	*24%*	*25%*	*15%*	*24%*	*31%*
o Very significant (x4)	*37%*	*43%*	*46%*	*34%*	*34%*
Somewhat Significant (x3)	27%	25%	31%	27%	25%
BOTTOM 2 BOXES	**12%**	**8%**	**8%**	**16%**	**9%**
o Not very significant (x2)	*9%*	*5%*	*5%*	*11%*	*9%*
o Not at all significant (x1)	*3%*	*3%*	*3%*	*3%*	*0%*
MEAN SCORE (OUT OF 5)	**3.7**	**3.8**	**3.7**	**3.6**	**3.9**

Source: Q3
Mean scores calculated on a 5-point scale where 1=Not at all significant and 5=Extremely significant with the mid-point of the scale being 3.0.

Assistance offered by the respective programs activated interest and clearly advanced measure implementation.

- Participants were probed directly on whether measures would have been implemented in the foreseeable future had program assistance not been received. On balance **a majority** of participants in all four programs **indicated that if assistance from the program had not been received that they would have implemented the measures in the foreseeable future** (64% for BIP; 60% for BOMA; 59% for BBP; 50% for ERIP).

- Participants, who responded "Yes or Not Sure" on the same measures being implemented in the foreseeable future without program assistance, were further probed on when exactly the measures would have been implemented. **For all four programs, only a minority of any of these same measures would have implemented within 6 months** (7% for BIP; 16% for BPP; 24% for ERIP; 25% BOMA). **Between a third and four-in-ten of all measures would have been implemented within a year** (33% for BIP and ERIP; 35% for BPP; 38% BOMA).

- It is clear therefore that even when measures would have been implemented at some future date without the program assistance and rebates being available, the existence of the program

advanced the timetable of measure implementation for all four programs.

IF ASSISTANCE FROM PROGRAM WAS NOT RECEIVED WOULD YOU HAVE IMPLEMENTED MEASURES	TOTAL MEASURES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=246)	(n=40)	(n=39)	(n=135)	(n=32)
Yes, in foreseeable future	55%	60%	64%	50%	59%
Not sure	24%	28%	15%	28%	9%
No, not in foreseeable future	21%	13%	21%	21%	31%

Source: Q4a

TIMING OF IMPLEMENTATION OF SAME MEASURES WITHOUT PROGRAM ASSISTANCE	TOTAL MEASURES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=246)	(n=35)	(n=31)	(n=106)	(n=22)
TOTAL "YES/NOT SURE" FOR IMPLEMENTATION IN FORESEEEABLE FUTURE	**79%**	**88%**	**79%**	**79%**	**69%**
Net up to I year later	34%	38%	33%	33%	35%
o Within 6 months	20%	25%	7%	24%	16%
o 6 months to 1 year later	14%	13%	26%	9%	19%
o 1 – 2 years later	23%	22%	26%	19%	34%
o 2 – 3 years later	14%	13%	10%	19%	-
o 3 – 4 years later	-	-	-	-	-
o 4 or more years later	2%	5%	-	2%	-
o DK/RF/NA	6%	10%	10%	5%	-
TOTAL "NO" FOR IMPLEMENTATION IN FORESEEEABLE FUTURE	**21%**	**13%**	**21%**	**21%**	**31%**

Source: Q4a and b

Some measures would have been implemented and substantial energy savings would have been achieved without program rebates.

- There is evidence that the majority of the measures rebated under the programs probably or definitely **would** have been implemented without program assistance. The bottom two box scores or the percentage of measures that **probably or definitely would have been implemented without the program** falls in the range of 49% to 59% (49% for ERIP; 53% for BPP; 55% for BOMA; 59% for BIP).

- The mean score falls in the range of 2.3 to 2.5 out of 5 which is between the "Probably would have" at 2.0 and the "Might /might not" at 3.0 and actually closest to "Probably would have".

- Participants in the different programs were asked to provide a **lower and upper bound and best estimate of how much of the extra energy savings** across all the measures implemented at a specific site would have been achieved anyway even **if the organization/company had not received a rebate.**

- The "Don't know/Refused/Not stated" response rate was about one-in-seven among the participants in the BIP (13%) and BBP (14%). It was over a quarter (27%) for ERIP and even higher at 43% for BOMA.

- Among participants who did provide estimates, the BBP program has the lowest estimates of the percentage of the extra energy savings that would have been achieved without rebates at lower bound 21.8%, upper bound 32.1% and best estimate 25.8%.

- The BOMA program has the highest estimates of the percentage of the extra energy savings that would have been achieved without rebates namely lower bound 41.7%, upper bound 58.3% and best estimate 50.2%.

- The estimates for the ERIP program of the percentage of the extra energy savings that would have been achieved without rebates are lower bound 30.7%, upper bound 47.3% and best estimate 39.5%.

- The estimates for the BIP program of the percentage of the extra energy savings that would have been achieved without rebates are lower bound 34.3%, upper bound 53.9% and best estimate 40.2%.

- Using just **the best estimate metric** the proportion **of how much of the extra energy savings** across all the measures implemented at a specific site would have been achieved anyway even **if the organization/company had not received a rebate falls between 26% and 50% depending on the program.**

- ***It is recommended a discounting be taken on the measures and extra energy that participants indicate would have been implemented without program assistance or rebates. The hard metric is the bottom box score with the percentage of measures of same/similar energy efficiency that "Definitely would" have been implemented measures without program assistance. This metric at 27% to 33% is relatively stable across all programs.***

LIKELIHOOD WOULD HAVE IMPLEMENTED MEASURES OF SAME/SIMILAR ENERGY-EFFICIENCY WITHOUT PROGRAM ASSISTANCE	TOTAL MEASURES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=246)	(n=40)	(n=39)	(n=135)	(n=32)
TOP 2 BOXES	**22%**	**15%**	**21%**	**22%**	**28%**
o Definitely would not have (x5)	*4%*	*8%*	*0%*	*3%*	*9%*
o Probably would not have (x4)	*17%*	*8%*	*21%*	*19%*	*19%*
Might/Might not have (x3)	25%	28%	18%	28%	19%
BOTTOM 2 BOXES	**52%**	**55%**	**59%**	**49%**	**53%**
o Probably would have (x2)	*23%*	*25%*	*26%*	*22%*	*22%*
o **Definitely would have (x1)**	***29%***	***30%***	***33%***	***27%***	***31%***
MEAN SCORE (OUT OF 5)	**2.4**	**2.4**	**2.3**	**2.5**	**2.5**

Source: Q5

EXTRA ENERGY SAVINGS ACHIEVED AT SITE WITHOUT PROGRAM REBATE (ACROSS ALL MEASURES)	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
Average Lower Bound	**31.9%**	**41.7%**	**34.3%**	**30.7%**	**21.8%**
Average Upper Bound	**48.4%**	**58.3%**	**53.9%**	**47.3%**	**32.1%**
Best Estimate	**39.4%**	**50.2%**	**40.2%**	**39.5%**	**25.8%**

Source: Q6

EXTRA ENERGY SAVINGS ACHIEVED AT SITE WITHOUT PROGRAM REBATE (ACROSS ALL MEASURES)

LOWER BOUND	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
0 – 24%	35%	24%	38%	35%	50%
25 – 49%	15%	11%	10%	16%	27%
50 – 74%	14%	5%	26%	14%	9%
75 – 100%	10%	16%	13%	8%	0%
DK/RF/NA	26%	43%	13%	27%	14%
AVERAGE LEVEL MEAN	**31.9%**	**41.7%**	**34.3%**	**30.7%**	**21.8%**
UPPER BOUND					
0 – 24%	20%	8%	26%	20%	27%
25 – 49%	16%	16%	13%	13%	41%
50 – 74%	18%	11%	18%	21%	18%
75 – 100%	20%	22%	31%	19%	0%
DK/RF/NA	26%	43%	13%	27%	14%
AVERAGE LEVEL MEAN	**48.4%**	**58.3%**	**53.9%**	**47.3%**	**32.1%**
BEST ESTIMATE					
0 – 24%	26%	14%	31%	26%	36%
25 – 49%	16%	11%	13%	15%	41%
50 – 74%	18%	14%	31%	17%	9%
75 – 100%	13%	19%	13%	15%	0%
DK/RF/NA	26%	43%	13%	27%	14%
AVERAGE LEVEL MEAN	**39.4%**	**50.2%**	**40.2%**	**39.5%**	**25.8%**

Source: Q6

Spillover

Programs influenced other measures to be installed not reported in program results.

- Over a quarter of sites participating in BOMA (27%) and ERIP (27%) report installing additional energy efficiency equipment and/or implementing process improvements that **did not get reported under the program.** For BIP, one-in-seven sites (15%) and for BBP one-in-eleven sites (9%) report installing additional energy efficiency equipment and/or implementing process improvements that **did not get reported under the program.**

- As with measures implemented under the programs, the **most common measure implemented not captured by the program was lighting.**

- The extra measures not reported under the program could include measures that were not specifically covered by the four current programs and /or measures implemented after the program rebates were processed.

PROGRAM INFLUENCE ON ADDITIONAL ENERGY-EFFICIENT EQUIPMENT/ MEASURES INSTALLED AT SITE NOT REPORTED IN PROGRAM	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
YES – INSTALLED	**23%**	**27%**	**15%**	**27%**	**9%**
Lighting	*85%*	*70%*	*100%*	*87%*	*100%*
Motors/Variable Speed Drives	*35%*	*60%*	*17%*	*33%*	---
HVAC/Water Cooling	*33%*	*40%*	*17%*	*37%*	---
Equipment Upgrade/Replacement	*6%*	---	---	*10%*	---
NO - DID NOT INSTALL	**77%**	**73%**	**85%**	**73%**	**91%**

Source: Q7

Program Satisfaction

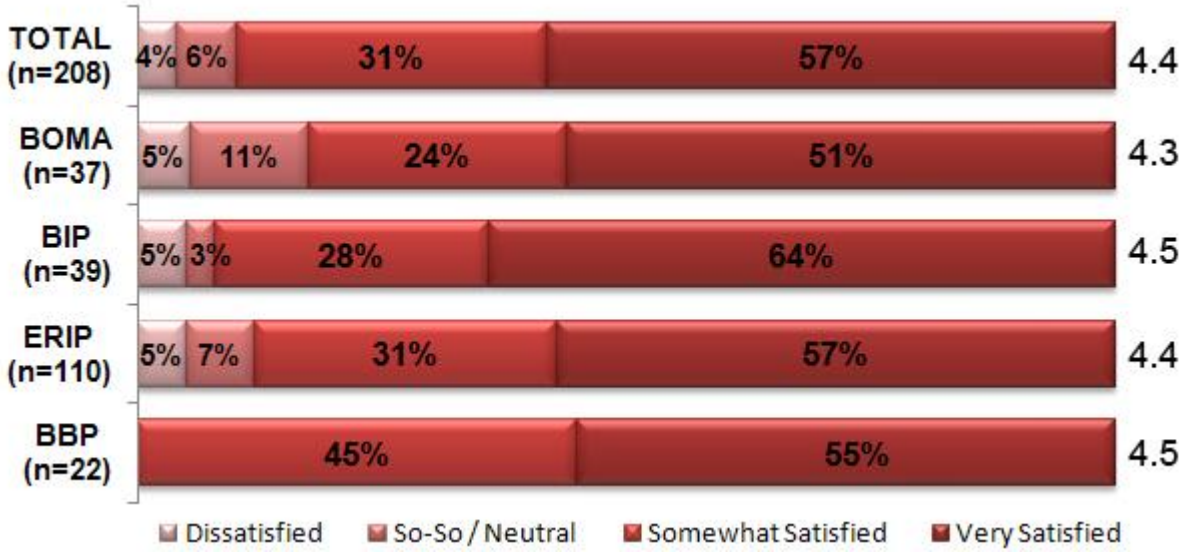
High levels of satisfaction with program and program elements were registered

- Overall, participants were satisfied with all four programs. The top 2 box scores or the percentage of participants at the different sites who were very or somewhat satisfied falls in the range of 76% to 100% (76% for BOMA; 88% for ERIP; 92% for BPP; 100% for BIP).

- The mean score falls in the range of 4.3 to 4.5 out of 5 which is above the "Somewhat satisfied" and below the "Very satisfied".

- Levels of strong dissatisfaction are very low at 5% or less.

OVERALL SATISFACTION WITH PROGRAM

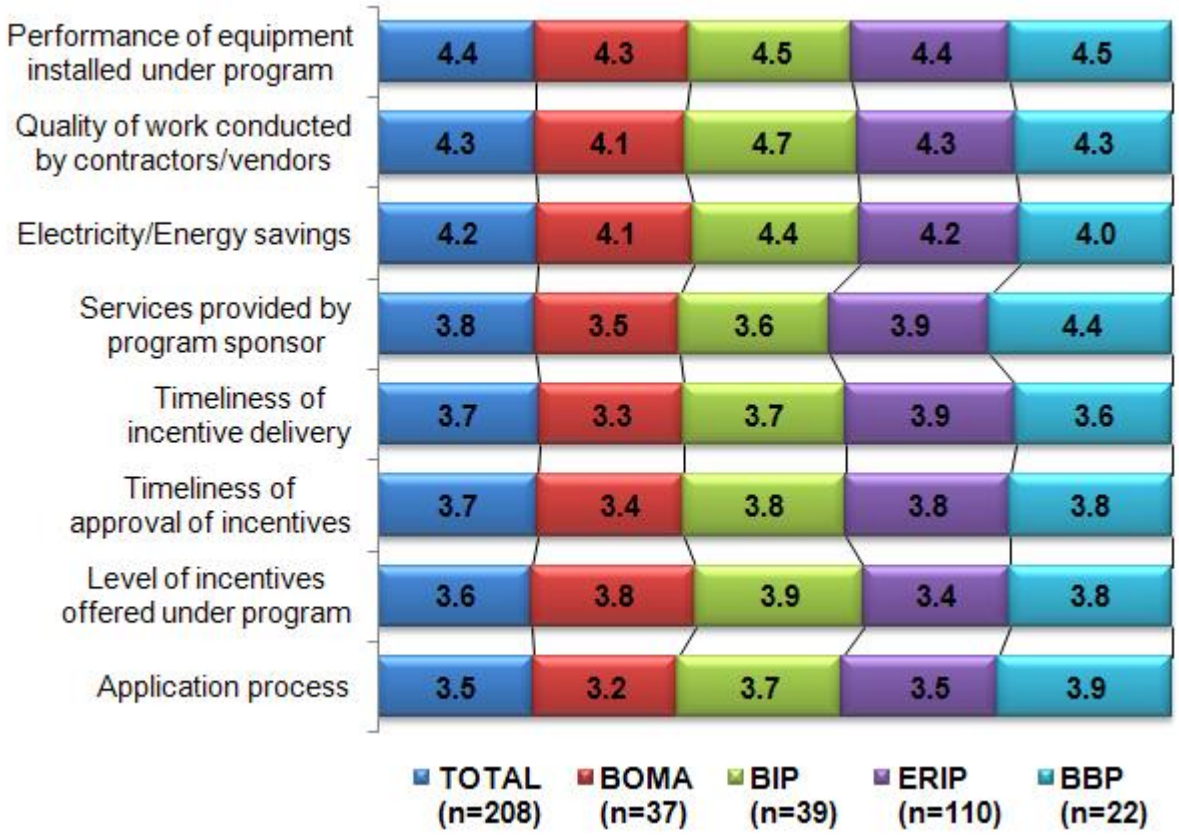


Source: Q13

Mean scores calculated on a 5-point scale where 1=Very Dissatisfied and 5=Very Satisfied with the mid-point of the scale being 3.0.

- In looking at the reported satisfaction ratings of various program elements, the highest satisfaction ratings were recorded for performance of equipment, quality of work completed by the contractors and vendors and electricity/energy savings. In contrast, the relatively lower satisfaction ratings were related to program process issues such as the application process, the level of incentives offered under the programs, the timeliness of approval of program incentives and timeliness of incentive delivery.

SATISFACTION WITH ELEMENTS OF THE PROGRAM



Source: Q14

Mean scores calculated on a 5-point scale where 1=Very Dissatisfied and 5=Very Satisfied with the mid-point of the scale being 3.0.

- Participants in the BBP program gave a high satisfaction score to services provided by the program sponsor (4.4 out of 5) and this was the second highest ranked program element for satisfaction. In contrast, for the other programs this was the 4th to 8th rated element for satisfaction and received average scores between 3.5 and 3.9 out of 5.

- ***In sum, participants are generally quite satisfied with the current programs. At the same time, there is opportunity for continuous improvement. Specific area of focus should be an assessment on how to make the application process flow smoothly and speed up the program.***

Program Legacy and Market Conditioning

Program participation contributes to an energy saving culture and is likely to lead to implementation of additional energy saving measures

- The majority of participants in all four programs indicate that they are **a lot more likely** to participate in future energy management programs.

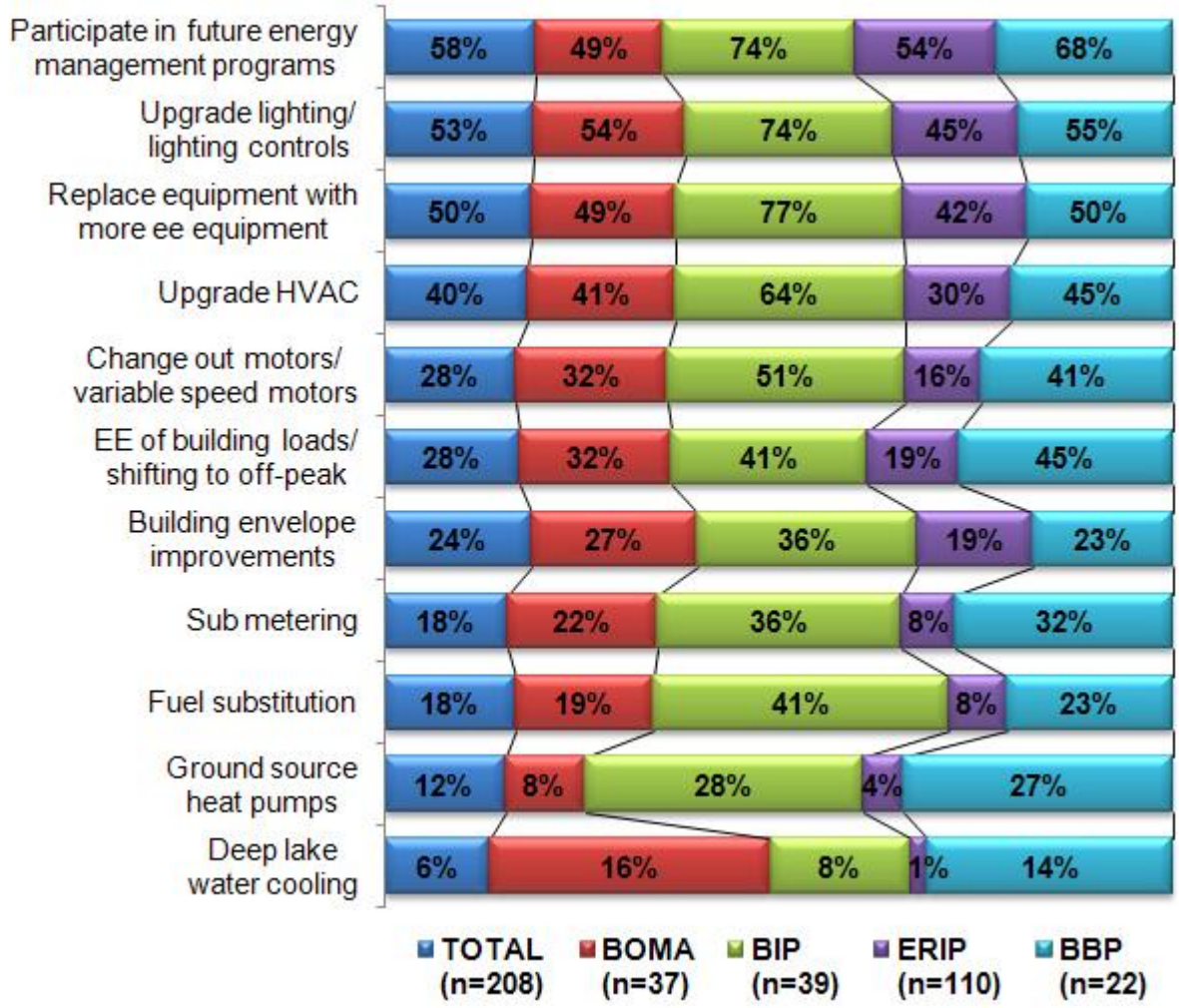
- The three types of measures that are most likely to be most influenced by enduring program participation contributions are upgrading lighting, replacing equipment with more energy efficient equipment and upgrading HVAC.
  Ground source heat pumps and deep lake water cooling in contrast are the measures that are least likely to be most influenced by enduring program participation contributions.

- Participants in the BIP program express the highest likelihood of making additional changes/upgrades for most of the different measures as a result of participation in the program whereas participants in the ERIP program record the lowest likelihood of making additional changes/upgrades.

- ***This cross-cutting evaluation confirms that participation in one or more energy-efficiency programs predisposes implementation of energy-saving measures and participation in similar programs in the future. While stated intent is strong, there needs to be some discounting as to when the new energy-saving activities would be undertaken.***

LIKELIHOOD OF ADOPTING FUTURE MEASURES AS A RESULT OF PROGRAM

"A Lot More Likely"



Source: Q15

As a result of participation in the [PROGRAM], would you say that your organization/company is A Lot More Likely, A Little More Likely or there is No Difference to the likelihood of making the following changes/upgrades?

Program Suggestions and Barriers to Participation

This section provides diagnostics for future program design based on responses to three different open-ended questions included at the end of the survey.

Given that program participants are generally satisfied with the respective programs, the suggestions offered for program improvement are largely based on making participation easier, broadening the scope and improving education and communication about the programs. The other energy programs mentioned to help the future management of energy and equipment are based on financial rewards plus reinforcement of the need for measure knowledge (audits).

Application process improvements offer most value to companies/organizations:

- The most frequent spontaneous suggestions for improving energy programs by participants in each of the four programs were to simplify/streamline the application process.

- For BBP, ERIP and BOMA approximately a fifth to a quarter of participants suggested broadening the program scope and including more measures. Only one participant in the BIP program, however, made a suggestion about broadening the scope.

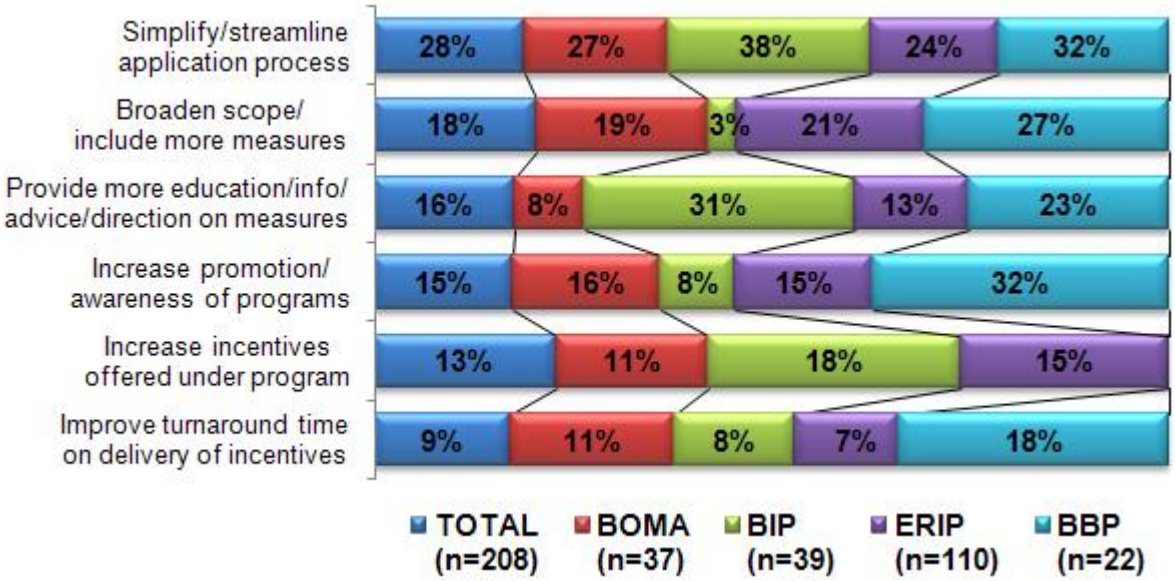
- For the BIP program the second most frequent suggestion for improvement was to provide more education/information /advice/direction on measures.

- Generally improving the promotion/awareness of the program was the most frequent suggestion (along with simplifying the application process) for the BBP program and the 3rd or 4th most frequent spontaneous comment for participants in the other three programs.

- Some participants in the BIP, ERIP and BOMA programs suggested increasing the incentives levels, however, not one participant in the BBP program made a comment of this nature.

- Improving turnaround times on incentive payments was another suggestion that was made by participants in all four programs.

SUGGESTIONS OR ADVICE FOR PEOPLE DESIGNING ENERGY PROGRAMS TO MAKE THEM MORE VALUABLE



SourceQ16

Rebate programs are the most appealing for managing energy and equipment investments in the future.

- **Rebate** programs are mentioned most frequently by participants in all four programs as the type of energy programs that would help them better manage their energy and equipment investments in the future.

- **Audit** programs were the second most frequently mentioned type of program for better managing energy and equipment investments in the future by participants in the BIP, ERIP and BOMA programs. For BBP participants, however, providing online information was the second most frequently mentioned type of program with audits in third position.

- Other spontaneous comments on energy programs that would help a company/organization better manage its energy and equipment investments in the future include having new rate structures and better promotion /awareness of the programs that are available.

OTHER ENERGY PROGRAMS THAT WOULD HELP COMPANY BETTER MANAGE ITS ENERGY AND EQUIPMENT INVESTMENTS IN THE FUTURE	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
Rebates	60%	46%	69%	59%	73%
Audits	29%	16%	44%	30%	23%
Online information	16%	14%	18%	13%	32%
New rate structures	14%	16%	18%	14%	9%
Better promotion/awareness of programs	9%	5%	18%	8%	5%
DK/RF/NA	17%	30%	10%	16%	14%

Source: QF7

Location needs and upfront costs are the main barriers to implementation of more measures.

- For participants in the **BBP, BIP and ERIP** programs **the primary barrier to shifting energy use is that at their site energy shifting /reducing peak energy use is not an option.**
- **Upfront costs** are mentioned as the **primary barrier by participants in the BOMA** program and as the **secondary barrier** by participants in the **BIP and ERIP** programs.
- For the **BBP the second, third and fourth most frequently mentioned barriers** were that **all the energy saving measures that could be made had been already implemented, more information would be required** on how to effect further improvements in energy efficiency and/or **limitations in the building code**. Only one participant in the BBP program mentioned upfront costs as a barrier.
- After the specific barriers listed above there is only one other instance where the level of mentions of a barrier exceeds 10% for any one program. **For the BIP program lack of technical resources was the third most frequently mentioned barrier.**
- ***Some but not all of the barriers to additional energy saving/shifting measures are insurmountable. More program supporting information on how/why to implement the measures and long term cost/savings implications for the various measures should erode many of the current barriers and lead to expanded program participation.***

FACTORS PREVENTING MORE SAVING OR SHIFTING OF ENERGY USE AT THE COMPANY/ORGANIZATION	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
Not an option at site/use during peak necessary	**30%**	11%	**36%**	**32%**	**41%**
Too expensive, costs too much upfront	**21%**	**30%**	**31%**	**18%**	5%
Already done	7%	8%	3%	4%	**27%**
Need more information on how to do it	6%	5%	3%	6%	14%
Pay back too long	5%	8%	---	7%	---
Lack technical expertise/knowledge	5%	3%	---	8%	---
Will do it at a later time	4%	3%	---	7%	---
Lack resources	4%	3%	10%	3%	---
Limitations to the building code	3%	5%	3%	1%	14%
Do not think will save enough to make worthwhile	3%	3%	3%	4%	---
Do not have enough time	3%	5%	5%	2%	---
Lack of available staff to handle	---	3%	---	---	---
DK/RF/NA	8%	14%	8%	8%	---

Source: Q18

Profile of Program Participants

This section details on the profile and firmographics of the participants in this cross-cutting evaluation by program for reference purposes.

QUALIFIED/PARTICIPATED IN OTHER PROGRAMS PAST TWO YEARS (Q17)	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
YES – Qualified/Participated	**25%**	**32%**	**21%**	**29%**	**5%**
Local Utility/LDC Program	14%	16%	5%	18%	5%
Natural Resources Canada	9%	11%	8%	11%	---
OPA - ERIP	2%	5%	8%	---	---
City of Toronto - BBP	1%	3%	5%	---	---
NO – Did not Qualify/Participate	**65%**	**62%**	**64%**	**62%**	**86%**
TYPE OF LOCATION (QF2)					
Primary location	**64%**	**57%**	**85%**	**65%**	**41%**
Satellite or secondary location	11%	11%	5%	10%	23%
One of several sites but neither primary or secondary	25%	32%	10%	25%	36%
%TOTAL OPERATING COST SPENT ON ELECTRICITY (QF3)					
Under 10%	**43%**	**35%**	26%	**44%**	**86%**
10 – 24%	27%	32%	**41%**	23%	14%
25% or more	14%	16%	21%	15%	---
DK/FR/NA	15%	16%	13%	19%	---

INDUSTRY CLASSIFICATION	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
Property Management/Real Estate	23%	**41%**	**38%**	15%	---
Manufacturing	14%	14%	8%	**19%**	---
Retail	11%	8%	13%	14%	---
Education/Academic/School	9%	---	3%	5%	**59%**
Government/Municipal Owned	9%	---	---	12%	23%
Hospitality/Entertainment	7%	5%	10%	6%	5%
Other Business Services	7%	14%	13%	3%	5%
Financial Services	5%	14%	3%	4%	---
Not for Profit/Charity	5%	---	3%	8%	---
Health Care	3%	---	---	4%	9%
Construction	2%	---	5%	2%	---
Distributor	2%	3%	---	3%	---
Transport/Travel	1%	---	5%	1%	---
Telecommunications	1%	3%	---	1%	---
Energy/Utilities	1%	---	---	2%	---
Private Institution (Church, etc.)	1%	---	---	2%	---
Agriculture & Mining	*%	---	---	1%	---

Source: QF1

NUMBER OF FULL TIME EMPLOYEES AT SITE (QF4)	TOTAL SITES	PROGRAMS			
		BOMA	BIP	ERIP	BBP
	(n=208)	(n=37)	(n=39)	(n=110)	(n=22)
Less than 100 employees	**61%**	**54%**	**82%**	**65%**	14%
100 – 499 employees	21%	11%	10%	23%	**50%**
500 – 1,000 employees	6%	---	8%	2%	32%
Over 1,000 employees	7%	30%	---	2%	5%
DK/FR/NA	5%	5%	---	8%	---

SINGLE EMPLOYEE WITH ALL ENERGY MANAGEMENT RESPONSIBILITIES FOR THIS LOCATION (QF5)					
Yes	**55%**	38%	**54%**	**56%**	**77%**
No	45%	**62%**	46%	44%	23%

ORGANIZATION'S APPROXIMATE REVENUES LAST YEAR (ALL SITES) (QF6)					
Under $5,000,0000	24%	11%	**36%**	28%	---
$5,000,000 - $10,000,000	14%	16%	23%	13%	5%
More than $10,000,000	38%	**43%**	26%	**32%**	**77%**
DK/FR/NA	25%	30%	15%	27%	18%

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